Universität Bremen

Her Place in History: The Fragmented Representation of Women in Science and Their Narrative Reassessment in Contemporary Historical Science Plays

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“I would venture to guess that Anon, who wrote so many poems without signing them, was often a woman.

Virginia Woolf, *A Room of One's Own*

1 INTRODUCTION

1.1 THE CURIOUS CASE OF DOUDNA AND CHARPENTIER

The year is 2020 and the world is occupied with several great historical events: a pandemic sweeps the world and the COVID-19 virus claims millions of lives with no immediate end in sight. After the brutal death of George Floyd at the hands of a police officer, people are once again protesting on the streets for racial equality in the face of police brutality towards People of Colour. Important political events seem to happen every single month of the year.

By the beginning of autumn, a novelty occurs in the scientific community. In October of 2020, the Nobel Prize committee announces that the Nobel Prize for Chemistry is awarded to not one, but two women alone. This is a first since the inception of the price. The two laureates are Jennifer Doudna and Emmanuelle Charpentier, two biochemists and geneticists who, at that time, worked for the Max Planck Unit for Science in Berlin and for the University of Berkley in California respectively. These two had discovered and engineered a tool for genome editing, now known as the CRISPR-CAS9 technique (Hargittai *Meeting* 169) and have been awarded this prestigious prize for science as the first two women to share it in the category of chemistry. This new tool allows for a more precise treatment of genetic diseases or cancer and can also be used to edit the genomes of plants to create more efficient food sources (Hargittai *Meeting* 170). However, it is also criticised for the potential it holds for the human race as it would be too easy to use the CRISPR-CAS9 technology to tailor the genetic material of unborn children, resulting in the rise of eugenics and all its ethical implication (Hargittai *Meeting* 171).

This dissertation is not interested in the ethical consequences of the discovery of Doudna and Charpentier; there are others who are much more suited to answer these philosophical questions. Instead, my focus lies on the singularity of them being awarded the Nobel Prize – it is the first and, as of November 2023, the only time two women have received this prize. They are accompanied by a narrow pool of female laureates: aside from them, only five other women have ever received the Nobel Prize for Chemistry, meaning that out of 115 Nobel Prizes for Chemistry, only seven pools of laureates involved women. One of those laureates is the famous Marie Curie, who won her second Nobel Prize in 1911 after winning the one for Physics in 1903, and her daughter Irène-Joliot-Curie together with her husband Fréderic Joliot in 1935. The pool of Nobel Prizes

in Chemistry that went to women alone is even more select: apart from Doudna and Charpentier, only Dorothy Hodgkin-Crawford and Marie Curie have been able to secure the prestigious prize for themselves, in 1964 and 1911 respectively. Irène Joliot-Curie, Ada Yonath and Frances H. Arnold had to share the prize with male colleagues ("Nobel Prize awarded women", *nobelprize.org*).

What appears to be a collection of trivia on the Nobel Prize is actually only a symptom of a larger issue in the field of science in general: Women are underrepresented in science, despite the growing numbers of female students of STEM subjects – science, technology, engineering and mathematics – in the past decades. I specifically call it an underrepresentation instead of a lack because it is not for a lack of women working in science. More and more women around the globe pursue scientific careers, both in research and in academia (cf. for example the census taken by the UNESCO Institute for Statistics in 2019), yet the public perception of science remains male-dominated. This goes much farther than the pool of laureates for scientific prizes. The image of a scientist remains male, among other denominators such as White, able-bodied, Western, etc. Children in school, when asked to draw a scientist, will still produce pictures of men in at least half of the cases, with the numbers having vastly increased since the first round of this test in 1966 (Miller et al. 1947).

Education is occupied with the male image of science in a similar way. Students learn of the Rutherford model, Bergmann's rule or the Laplace distribution, all concepts that are named after male scientists, but can rarely name one historical female scientist. I test this regularly in my classes on women in science, in which I let my students raise their hands if they can name one historical scientist. I then ask them to drop their hands in there are thinking of men. In the best case, some of them are still raising their hands. The only woman they can then usually name is the aforementioned Marie Curie, whose daunting and unreachable success has even inspired an entire effect named after her, the "Curie effect", which denotes the unreachable standards that are expected of women to succeed in STEM (Opitz 390). When I then ask my students to lower their hands if they are thinking of the famous Marie Curie, usually all hands have dropped. My own experiences as a teacher are hardly demographically relevant or represent any larger group of people; yet they support my aforementioned theory of women being nigh invisible in science.

And even if women achieve success in a scientific field, then chances are high that they will feel as if they have been undeservedly acknowledged. A recent study proves

that many successful female scientists suffer from the "imposter syndrome", meaning that they assume that their success was only reached because they made everybody in their vicinity think that they were smart and thereby, like an imposter, fooled their peers (cf. the study by Muradoglu et al.). The "imposter phenomenon" was first coined by Pauline Rose Clance and Suzanna Ament Imes, who researched feelings of "intellectual phoniness" and shortcoming in high achieving women in their article from 1978. It has been 45 years since this article was published and we still see women's skewered sense of self in the face of their success (Clance and Imes 242). It is a vicious circle of women feeling unseen and unwanted in a specific field of research and therefore then not wanting to pursue any careers in it. If science is considered a male-dominated field, then woman appear to have no place in it.

Looking into the history of science, the historiography appears to confirm this one-sided image of science. The annals of the history of science speak of the impact male scientists have had on science: Albert Einstein's theory of relativity dominated 20th century physics, Johannes Kepler upended the Catholic church's beliefs with his heliocentric concept of the sky in the 16th century, and Charles Darwin's discovery of natural selection completed the principles of heredity laid by Jean-Baptiste Lamarck, just to name a few. Male scientists make the discovery, create the theory and cement their legacy. It would appear that until maybe half a century ago, women played no part in the making of science, except for a few trailblazers who are usually categorised as eccentric exemptions from the general rule rather than as representatives of their peers.

This explicit misconception presents the starting point from which this thesis will move forward. As recent feminist historiography namely has proven successfully, this could not be further from the truth. There have always been women involved in (proto-) science[1], despite the gender boundaries and institutional obstacles that were thrown in their way. The issue at hand here is not the lack of women doing science but rather the lack of *recorded sources* of women doing science. What women have contributed to the development of our modern day concept and works of science has long been neglected by the historiography of science. As this thesis will show, the omission of women had

[1] When I speak of women in science, I also include proto-sciences in my definition. The proper coining of science did not happen until the 19th century, when William Whewell established the profession of scientist as a successor to natural philosopher (Clark 480). For reader convenience, I will use the term science even when speaking of women's work before the 19th century.

nothing to do with their lack of participation – their contributions were simply either not recorded or the records were considered too insignificant in a male-led and male-centred system that furthered its own advance. History, despite its claim on factuality and neutrality, has long been identified as a study that relies on crafting narratives just as much as fiction does. Naturally, these narratives can be based on the available source materials, but if these source materials have been pre-selected and filtered to begin with, then the image presented by history will remain twisted. And in the course of this narrative of the history of science, certain contributions, namely those of women, have been lost for a long time. It was not until the 1970s that the male-dominated field of historiography of science was finally diversified by women historiographers who made it their goal to retrace the forgotten or unmentioned women.

Literature, in its function as a mirror to society, has followed this trend and in the past 25 years, we have seen an explosion of historical fiction about female scientists where before only historical male scientists had been covered. In his article on the contemporary science novel, Norbert Schaffeld cautions against "consider[ing] fictionalised versions of scientific discourse to be near documentary evidence of historical developments" but sees them rather "as narratives of the past or present providing the reader with an epistemic offer" ("Aspects" 121). The genre of historical fiction "utilises famous scientists of the past to address a set of science-related or biographical questions which remain topical", providing "a thematic transfer into the present, whilst simultaneously attempting to narratively reconstruct the life and work of a scientist and his or her socio-historical environment" (Schaffeld "Historical" 169-170).

Historical female scientists have carved quite a space for themselves on the contemporary stage and playwrights have sought to readjust the historical narrative in favour of those women. While novels and films have also covered the lives of female scientists both fictional and historical, it is specifically the explosion of science on stage in recent years that has seen an increase in female stories being told. As Ute Berns highlights, "[t]oday's plays continue to challenge hegemonic historiography from gendered, postcolonial and ecological perspectives that endeavour to pluralize the past" (1). The "plays' narratives of the past and their historicizing narratives of the present fill gaps and offer new perspectives as they reconfigure dominant discourses of class and gender", delivering a counter-canon to the historical standard that has been prevalent for so many decades (Berns 4). This challenging of canonical historiography can work in tandem with postclassical narratology. Where women have been written out of the

narrative of history, dramatic texts have specifically used narratological techniques to write them back in, following the trend of postclassical narratology to expand into formerly unmediated kinds of literature.

The common misconception about women's participation in science, their ensuing re-discovery and the literary re-appreciation of their work is what has inspired this dissertation and its key questions. I seek to cover the following aspects with this monograph: to catalogue what we conceivably know of women's participation in science as of today, to explain how the records of this female participation could have been lost for so long and, first and foremost, to analyse how contemporary science drama has employed the narratological means at its disposal to re-introduce female scientists back into the narrative of the history of science and to close the gaps that have been left behind by this fragmented representation. My analysis will fruitfully combine the existing history and historiography of women in science and the transmedial approach of narrative studies that examines the narrative reassessment of women in science. The narratological analysis thereby not only includes the metaleptic view of history but also the significant rise of narrativity in contemporary drama that specifically foregrounds the experience of women in science. The analyses will show how many narrative means that have existed in dramatic texts for centuries have now been modernised to represent a contemporary approach to postclassical drama and have in turn worked to re-include women in a comprehensive narrative of history. For this task, I have collected eight science plays with certain criteria, which I will present in the following.

1.2 CORPUS

Narrowing down a corpus for this dissertation was probably the most time-consuming issue as the criteria for the dramatic texts were relatively narrow and the demands in return therefore high. The texts needed for this corpus had to fulfil the following criteria to be even deemed appropriate: they had to be conceived of since 2000 in order to maintain a contemporary focus of the corpus and to be published or produced in the English-speaking world first; translations of works from other languages were not considered as this would have meant a muddying of the corpus. All texts had to feature one or more historical female scientist as their protagonists, which is where most of the science plays already failed to be counted as their protagonists are mostly fictional and,

even if they were historical, male. Famous historical science plays such as *Copenhagen* by Michael Frayn (1998), *Partition* by Ira Hauptman (2003) or Vern Thiessen's *Einstein's Gift* (2003) were therefore out of the question and additionally have been discussed in scholarly publications at length. It is the designated task of this dissertation to provide a successful counter-canon to the male-dominated pool of analyses.

Generally speaking, these texts can be subsumed in the genres of the science play and historical fiction. Finding a comprehensive definition for the genre of the science play has occupied many scholars in the past decades since the emergence of the genre as a definable whole, such as Sidney Perkowitz, Carl Djerassi or Silvana Barbacci. Eva-Sabine Zehelein offers a broad overview of the different approaches in her monograph *Science: Dramatic – Science Plays in America and Great Britain, 1990-2007*. For a definition of historical fiction, Alan Munslow's *Narrative and History* (2007) and Jerome de Groot's *Remaking History: The Past in Contemporary Historical Fictions* (2016) offer extensive studies of the genre and its origins. Since I do not conduct an analysis that is based on genre studies, these genre conventions will play no part in my analysis.

Finally, once I had assembled a first preliminary corpus of dramatic texts published in English since 2000, I began reading these plays with a focus on narratological and narrative devices employed in the texts. This once again weeded out some potential plays, even though most of them, as I had expected, showed postclassical narratological tendencies of employing narration on stage. As I was soon learning, there were many more suitable plays that may not have been published in English but have seen several productions on English-speaking stages. In order to be able to account for more a larger variety of plays, I contacted many playwrights and stage companies to ask for their unpublished manuscript of their play on a historical female scientist and most of them were gracious enough to give me access to their work[2]. After this careful selection process, I have chosen the following plays as the corpus for this dissertation: *Comet Hunter* (2003) by Chiori Miyagawa, *Photograph 51* (2011) by Anna Ziegler, *Silent Sky* (2014), *Emilie: La Marquise du Châtelet Defends Her Life Tonight* (2010) and *Ada and the Engine* (2019), all three by Lauren Gunderson, as well as the three unpublished manuscripts of *Remembering Miss Meitner* (2002) by Robert Marc Friedman, *Uniform*

[2] I am very indebted to the kindness of these authors and would like to use this space to thank them for their generosity and for sharing my enthusiasm for the stories of these extraordinary women.

Convergence (2019) by Corrine Yap and *The Half-Life of Marie Curie* (2019) by Lauren Gunderson.

I would like to address and draw attention to the lack of diversity in the women whose stories are told. Apart from *Uniform Convergence*, which features the contemporary story of an Asian-American professor, I was unfortunately unable to find plays, either published or staged, that featured Black or Indigenous women, nor Women of Colour or women with disabilities[3], from religious minorities or from different social classes. Lesbian women, non-binary persons[4] or trans women are sadly also not accounted for. This mirrors the figurative blinders of historiography that usually only incorporates White, able-bodied, middle- or upper-class heterosexual cis women when focusing on retrieving the story of women in science. It is certainly already a great step in the reappraisal of history to divert from the male canon of scientists, yet the future hopefully has room for an even more diverse experience. I hope that I have simply overlooked some plays featuring other experiences or that these plays have been published or staged without my knowledge while I was already writing my dissertation. The reality is, however, that as long as these women remain undetected in the historical archives, playwrights will be unable to feature them in their work. Many repressive regimes all across the world will still halt and censor the historiography of minorities in their countries, meaning that many of the stories of women in science outside of the perceived White norm may still be buried in the archives or, in the worst case, lost forever. As the chapter on the history of women in science will show, we already know too little of women in science as a whole. In this already small canon of women we are aware of, the diversity of experiences is nigh inexistent. I am aware of the shortcomings of my corpus in terms of different experience but for now, it cannot be helped. I am hopeful that the future will bring more diverse plays on the experience of all women in science.

As much as theatre and stage plays rely on their actual performance, this dissertation will not be able to include the individual stagings of these plays. The reasons for this focus are manifold: first, it would simply exceed the scope of this thesis to include both an analysis of the text as well as the performance. Secondly, some of these texts have

[3] *Silent Sky* features the astronomers Henrietta Swan Leavitt and Annie Jump Cannon, who were both hard of hearing or at least partially deaf. Nevertheless, I am hesitant to count this as a play on women in science with a disability since their disability is not a topic of immediate concern in the dramatic text.

[4] It is because of this limitation in historical perspectives that I am using a binary approach to gender in this dissertation, even though I am fully aware of the plurality of gender identities.

yet to be staged for a wider audience and therefore exist only in their textual form. Thirdly, if these plays have been successfully staged, then it is often doubtful that reliable recordings of these stagings exist. A recording also presents an additional layer of narrative to a play, begging the question of how it has been recorded, under which circumstances, whether these recordings are fragmented or altered by the person editing the video, etc. The analysis in this thesis is purely text-based and relies on the material provided by the publishing companies or, in the case of the unpublished manuscript, on the version the authors provided me with.

1.3 OUTLINE

This dissertation is divided into three larger sections, one of them focusing on the historical and historiographical background, the other on the methodological foundation, narrative studies, of my analysis. The final topical chapter then combines both of these chapters before by applying the historical and historiographic context by means of narratological devices in the dramatic texts. Each major chapter includes a short final summary.

I will start with a historical overview of women in science, namely chapter two. In a first part of this chapter, I trace the existing history of women in science from prehistoric times to developments of the 21st century. My focus in this chapter not only lies on a comprehensive outline of women's participation in science, but also on tracing this development chronologically. Women's participation in science did not evolve in a linear fashion from non-existent to full capacity. On the contrary, their access to education and therefore to the places of knowledge and research was closely tied to their role in society in that given time frame. As this role was subject to change throughout the centuries, the involvement of women in science is bound to change accordingly. Common historical arguments and counter-arguments for the inclusion of women in scientific fields are consequently also a part of my overview as well as additional information on women's education throughout history. What will not be addressed in this second chapter is the general topic of women as objects of science. My thesis only considers women as practitioners of science, not as research objects.

The second part of chapter two moves away from history and focuses on the historiography of science and the specific inclusion and exclusion of women from it.

Although the first part of chapter two has dealt with what we conceivably know of female scientists in history, this second part of the chapter discusses how this knowledge has been accumulated, detailing why we know what we know. This second part also lays the groundwork for the following third chapter on narratology by introducing the narrative turn, which signified the expansion of narratology into fields outside of literary analysis. Using Hayden White's approach to history as a narrative, I will connect the field of historiography to the narrative turn and thereby to the re-evaluation of its claim on neutrality and factuality. What then follows is a description of the efforts of feminist historiography to retrace the lost history of women in science.

Chapter three then continues with the narrative framework, proceeding from the general introduction to the origins of narratology to the intersections of it with drama and gender. A genesis of the study of narratology is essential to show how drama, which we perceive as an unmediated type of literature, has always been included in the original canon of narratological studies. It was only after the classical phase of narratology that epic literature was foregrounded in narratological analyses which has thankfully been remedied by postclassical and transmedial approaches to narrative studies. Since the objects of my analysis are all female scientists, it is also necessary to consider the intersection of gender and drama, more specifically feminist narratology, which was first conceived of by Susan Lanser in her article "Towards a Feminist Narratology" in 1986.

Chapter four comprises all the analyses of the eight dramatic texts presented before. This chapter amalgamates the historical and historiographic focus of the second and the narratological focus of the third chapter and applies both to the fictional narratives of the historical scientists. The analyses are ordered chronologically, ranging from the least to most recently published text and all follow the same structure by providing a quick introduction as well as a biographical background on the scientist featured in the text before proceeding with the actual analysis. A final subchapter then summarises and contextualises the different narratological and topical similarities between the individual analyses in order to give a more concise outline of the results. The final chapter five then ultimately summarises and combines my results and provides an outlook on what is currently being done to improve the visibility of women in science.

2 THE MARGINALISATION OF WOMEN IN SCIENCE

2.1. A BRIEF HISTORY OF WOMEN IN SCIENCE

To lay the foundation of the later chapters, I begin with a look at the history of how women have participated in science. Certain patterns and situations for women are repeated over the course of history and while it would be interesting to cluster these patterns, I want to look at them in a diachronic fashion. The reason is simple: as David Wootton highlights in his monograph on the Scientific Revolution, historical advancements never come in a linear fashion. What is considered a regular amenity in one period can be obliterated and forgotten in a later period, only to be rebuilt once again later. There was better indoor plumbing in the Roman Empire than in the Elizabethan Era, even though the latter came several hundred years later and ought to have progressed from there on (Wootton 4-5). The same logic applies to the history of women in science. Depending on their status in society at a given time, women's advancement in science is marked by significant changeability over the course of history: "Women – as representatives of private life – were repositories for all that was not scientific: in a scientific age, women were to be religious; in a secular age they were to be the keepers of morals; in a contractual society they were to provide bonds of love" (Schiebinger *Feminism* 71). A secure place for women as scientists in one period of time could be revoked in the course of a few hundred years and would not come again for several centuries. The situation of women in science in the 21st century is based on what has transpired in the thousands of years of human history and their participation in science has been shaped by historical events such as war, political crises and economic instability just as much as history itself has, with both progress and regress (Schiebinger *Feminism* 31-32).

What is referred to as science throughout this thesis also denotes its predecessors. In 1834, William Whewell, Fellow of the Royal Society and scientist himself, coined this now ubiquitous term of the "scientist" that supplanted the profession of natural philosopher (Clark 480). Natural philosophy originates in Antiquity and according to historian Edward Grant, it reached its peak in the 15th century with the end of the Middle Ages. Aristotle and his teachings served as a major influence for the study of natural philosophy (Grant *History* xi-xii). Even after the Scientific Revolution, natural philosophy was still practiced but had moved away from Aristotelian metaphysics in order to use the inductive methods of the new sciences. The 19th century then brought the

final decline with the introduction of new terms for the subdisciplines of science that would replace that of natural philosophy (Grant *History* 4). For consistency's sake, I use the terms "science" and "scientist" throughout this entire chapter and they represent the predecessors of these terms as well.

To evaluate the history of women in science, the access that women have had to education also needs to be considered. Women's education throughout the centuries, just as their acceptance in the sciences, has always been tied to their social standing. Without the presence of women in secondary or even elementary education, it is no wonder that only a few privileged women have managed to rise above their assumed social station as housewives and carers. It would be easy to name these privileged women who deviated from their assigned role and rose to fame in the sciences as trail-blazers. Yet, as the second part of this chapter shows, that is exactly what early feminist history has wrongly done in its attempt to refocus the historical discourse on women's achievements. Focusing on the stories of single great women instead of on the great majority of women and their experiences ignores a key part of women's collective history. I have therefore decided to limit myself to telling the stories of the female scientists who are the protagonists of the dramatic texts in my literary analyses. These individual stories come at a later point in my thesis. This current chapter depicts the experiences of the group of women as a whole, not those of a few, trying to do this heterogeneous group justice.

In addition, I also include common historical arguments and counter-arguments for women's participation in science. This could have been an entire section in itself but since all these arguments are always tied to the social and cultural conventions of the time they were formulated in, this combined approach seems more plausible. Contrasting these arguments against the actual situation of women at that time will also prove how any reasonable idea of equality for men and women may be distorted by a supposedly equally reasonable pseudo-scientific fact. The interpretation of scientific knowledge always depended on what was required at that point in time to justify the exclusion of women from science and the male dominance in the field: "[T]he moral principle of equality was tied to whatever factual equality or inequality was prevalent at the time. The idea was that if women and men are equal or unequal, then society ought to mirror that" (Frize et al. 50). And this does not only concern the work of women as active scientists: science as a male subject also signifies that the research objects and inventions are catered to male needs. A gendered approach to science can structure knowledge in a lasting way to women's disadvantage (Schiebinger "Getting" 10). One famous example is that of the

first experiments with crash test dummies. Because the physiology of those dummies was moulded after an average-weight able-bodied human man, crash tests and the ensuing modifications made on airbags in cars only benefitted men, while women were completely left out of the research for years (Hill et al. 3).

2.1.1. PREHISTORIC WOMEN

It is a common misconception that women have not participated in science until the late 19th or early 20th centuries and could therefore only have been actively excluded from that point onwards (Schiebinger "Origins" 8). Arguments against women in science have existed since Antiquity and are therefore not a new phenomenon. This view locates misogyny only in the past and eradicates the way that women have fought over millennia up until today to be recognised as equals (Frize et al. 36). In some form or other, women have always been involved in the making of science, though the term science was only coined in the 19th century. But even before the recorded history, women were involved in developing skills, technologies, crafts, and tools that now form our concept of modern science (Frize et al. 56; Alic 12). In order to understand how we come to know about women's lives in prehistoric times, we have to differentiate between two phases of humanity: on the one hand, there is historical humankind, a phase of humanity from which written records have been left behind. On the other hand, there is archaeological humankind, from whom we only have artefacts to decipher (Wootton 3-4). While there is no written evidence as to women in prehistoric age, artefacts and murals can serve as sources.

Based on these artefacts and the findings from prehistoric times, it is assumed that there was no distinction by sex in early societies. Women were as much involved as men in the daily chores surrounding the early branches of proto-scientific knowledge. While there was a distinction in the different chores that needed doing, men focusing on hunting and women on gathering, both equally contributed to the daily life. Participation was needed from everyone to ensure survival, regardless of sex or gender. Prehistoric women were right beside prehistoric men at the forefront of activities that paved the way for later disciplines such as botany, astronomy, zoology, and medical sciences. They needed to know which plants where edible and which not and also when they would grow, which required basic knowledge of the lunar cycle as an early measurement of time. In addition

to that, first healing remedies were fashioned from plants which meant women engaged in early ways of medicinal treatment. All these would also require constructing some kind of tools to process food and materials (Alic 12-19). The Neolithic Revolution, which happened between 12,000 and 7,000 years ago, signalled a new era of life for prehistoric people. Animals were domesticated and the knowledge about horticulture gathered by women allowed men to focus less on hunting and more on agricultural work. This meant a much more self-sustainable and stable lifestyle. The use and forging of metal began and the rudimentary stone tools were replaced by tools made from metal. Animal husbandry required a basic knowledge of genetics and zoology, again a precursor of our modern-day sciences that fell into the responsibility of prehistoric women (Wootton 3; Alic 14).

The legacy of early participation of women in science has been transported via oral history into the annals of written history in the form of goddesses, religious figures, and myths. While these mythical and religious figures are often portrayed as superhumans, historians such as Margaret Alic believe that they have origins in extraordinary women in their respective fields. Over time, tales of these regular women with exceptional abilities have transformed via oral transmission into the fables of goddesses and deities. In early Egypt, Isis, the Mother Goddess of the Egyptians, secured women's place in society in Egyptian civilisation much longer than in Neolithic societies. Greek mythology represents a vast number of supernatural entities, who in this case are often less of magical beings but rather humans with extraordinary skill, such as Demeter, Minerva, the Fates or the Muses (Alic 15-19).

These early days of equality show that in the beginning, women's place in science and its precursors was beside men. But with the beginning of what we consider recorded history, women are losing their place alongside men in the advancement of the early sciences and are pushed to the margins.

2.1.2. ANTIQUITY

The first accounts of written history can be traced back to early Egypt to roughly 2500 BCE. These show an Egyptian society that placed women as equals to male citizens and their involvement in early science. This holds true just as much for many countries of the early Arabic world (Alic 20). Women in Mesopotamia and Sumer worked in medicine and chemistry, conducting alchemical experiments to produce perfumes and cosmetics,

which secured women a leading role in alchemical studies when words of these experiments reached Alexandria via oral transmission. Cosmetics and especially decorative make-up were part of the routine of the social elite of ancient Egypt and a marker of wealth and power for both men and women, signifying the importance of these experiments conducted by women (Alic 20-21, 36; Wyer et al. 5).

In Ancient Greece, society functioned rather differently. While the conglomerate of Grecian societies is lauded by modern historians for its establishment of democracy and its functioning political organisation, the principles of this democracy did not apply to all citizens. Only men benefited from democracy while women as well as slaves were still not treated equally. In this early society the separation of the domestic and the public sphere already excluded women from positions of influence (Frize et al. 4-5). The Greek society was highly patriarchal and forbade women to study, leaving them illiterate and dependent on male relatives and later on their husbands (Alic 24-25). If a woman wished to shape the world around her, her power lay in the domestic sphere and on influencing her husband accordingly so that he would represent her interests in public debates. Men were associated with action and immaterial concepts while women were tied to the material and passive realm of life (Frize et al. 12). The same is mirrored in the approaches to education: women's education consisted mainly of housekeeping with only the basic principles of rhetoric, while men received a full education including languages, rhetoric, philosophy and early forms of mathematics. Women's access to early science was through domestic work, such as crafts, textile work and the preparation of food. Additionally, despite their limited hierarchical status, women engaged in the practice of midwifery which would remain in the hands of female professionals for many centuries to come (Alic 28). The only women who were exempt from these confining rules were female prostitutes, who were allowed to move more freely in Ancient Greek society. They used their additional skills to attract learned customers from a higher social sphere (Frize et al. 12).

Women's participation in science in Antiquity relied on their access to proper education. The approach to women's education in Ancient Greece rested on the teaching of the great philosophers of their time, such as Aristotle and Plato. Aristotle refused the idea of women being equal to men in society and therefore did not see the necessity to educate them (Alic 26-27). Aristotle regarded women as defective version of men, in the sense that men's intellectual capabilities are superior to those of women. The perfection lies in men, while women can only be seen as a soulless mutilation (Frize et al. 10-11).

These views are mirrored in his approach to procreation and the respective roles of the sexes in it: women, according to Aristotle, only provided the base matter for the creation of a new human life and men provided the essence and soul:

> For the first principle of the movement, or efficient cause, whereby that which comes into being is male, is better and more divine than the material whereby it is female. The male, however, comes together and mingles with the female for the work of generation, because this is common to both. […] For the female is, as it were, a mutilated male, […] for there is only one thing they have not in them, the principle of soul.
>
> (Aristotle 23, 31)

This radical view would in later centuries serve as an excuse for women to be excluded from universities. Aristotelian teachings were embedded in the curriculum and also taken as scientific proof for women's inability to comprehend complex matters (Kumar xvi).

Plato, as opposed to Aristotle, represented more egalitarian ideas despite living in an earlier time than Aristotle did. For his day and age and especially in comparison with his contemporaries, Plato's approach to women's intellect was almost radically different. He conceded that Athenian women were not equal part of the society they lived in. But, nevertheless, he attributed to them the same capabilities that men supposedly had, wanting them to share in all duties of private and public life and calling for proper education for women according to the role they would assume. His distinction of people lay less in the distinction by sex but rather by two kinds of human beings in general, namely guardians and their assistants, who were meant to rule and lead their society, and workers, who contributed to society with menial labour. He distinguished and compared women and men who were of a similar nature, for example female and male guardians (Frize et al. 6-8). Just because women were naturally meant to bear children did not mean that they were also obliged to care for them, which could just as well be the task of a male worker: "In Plato's view, then, biology is not destiny, for either sex" (Frize et al. 7). The nature of women has often been used against them: if women are observed as less intelligent, it automatically points to their nature, their female brain, for example, and not to the society that has kept their intellectual development at bay. Plato did not side with this argument. Based on his observations of women, for example their advances in

medicine, he argued that this showed that men and women must naturally have the same capabilities and therefore are equally entitled to higher offices (Frize et al. 40-42).

There is, however, a problem with Plato's theory. His supposed equality of men and women rests on comparing them on the matter of their capabilities. The entire idea of allowing education for women hinges on the presumption that only those who show an intellect above average are entitled to an education. Those who are destined to be workers, who are more suited to menial work than to intellectual tasks, are still unworthy of an education. This proves, according to Monique Frize et al., that Plato's ideas may at first glance seem less misogynist but really are not: "[E]quality for elite women is not the same as equality for all women" (10). An equality that is tied to capabilities or abilities is not true equality, neither for women nor for men (Frize et al. 51).

Women fared only marginally better in the Roman Empire than in Ancient Greece. While they were more or less on the same level as slaves in Roman society, they at least had access to a better education than Greek women did. They were taught how to read and write and depending on their social class even had tutors (Alic 30). Women were, as in Egypt and Mesopotamia, also involved in medicinal practice even though Antiquity would mark one of the last centuries where women would be free to pursue this practice (Alic 33). In contrast to Ancient Greece the Romans themselves did not develop their own branches of science. What we consider Western science today is what was established mainly in European and Greek societies (Wyer et al. 5). Romans rather adopted the knowledge that was orally transmitted to them from Greek slaves brought to Rome, including knowledge on medicine and health (Alic 30). Similar to how prehistoric oral histories often fashioned exceptional women into goddesses and deities, a comparable mystification occurred regarding Greek female physicians whose stories were told to Roman citizens. They were often portrayed as priestesses and superhuman beings (Alic 21). Those who were interested in science in the Roman Empire usually belonged to an elite of educated citizens who wanted to learn but were not willing to read the abstract and complex treatises written in Greek. Latin was the predominant language in the Western part of the Roman empire while Greek was more popular in the Eastern part, mirroring the split of the Empire that was ushered in by Diocletian (Grant *Foundations* 9). Greek scientific texts were commonly brought into Latin culture by means of Latin translations. But these translations often oversimplified and distorted the original content in the process of being copied. Plagiarism was not really a theory in Antiquity and therefore the liberties authors took with the original text would go

unnoticed. Indeed, plagiarism was ubiquitous and a standard procedure (Grant *Foundations* 11-13).

2.1.3. THE MIDDLE AGES

With the end of what is referred to as classical Antiquity, the Middle Ages began. Over the course of almost a thousand years, humankind developed and grew (Grant *Foundations* 33-34). The stabilization of the political situation across Europe in the 11th century led to an improved standard of living. Advancing agricultural techniques meant safer sources of food which in turn led to a rise in population and longer, healthier lives. This rise in the population called for an increased need for space in towns and cities or the founding of new towns. The feudal system was established as a new political structure and the first concepts of taxes came with it, serving as the first stabilisers of organised societies (Grant *Foundations* 33-34). These newly stabilised societies also benefitted the development of sciences. The Middle Ages contributed to the foundation of the modern sciences in several ways: universities were established as institutionalised places of learning, natural philosophies as precursors of natural sciences were studied more intensely and a new kind of scientific language and vocabulary was emerging (Grant *Foundations* 191-203).

Women's power and agency in the Middle Ages started to revolve around the private sphere, a pattern that will be repeated in the centuries to come, as was already the case in Antiquity. Because science was not as institutionalised as it would be in the Early Modern period, women were still allowed to privately practice their own kinds of science, especially those that were needed around the house, such as basic biology, chemistry, and physics (Sheffield 6-8; Erler and Kowaleski 1-2). Outside of the domestic sphere, women could be found in midwifery and early medical science. With the increased travel across continents during the Crusades and international trade, new diseases were brought to Europe, which called for more medical practitioners and in turn allowed for more women to venture into medicine. Male practitioners often relegated their cases to their female assistants which meant additional practice, an increased clientele, and a good reputation for women healers and midwives. Female midwives formulated early treatises on female sexuality and the female body, many of them very explicit and graphic (Alic 55-57). Medieval readers were used to such frank conversations but mainly British historians of

the early 20th century, still influenced by the more modest Victorian Era, had trouble accepting that a woman could write so freely about sexual matters. This meant that these treatises would later not be attributed to women and their important contributions were lost for many centuries. By the end of the Middle Ages, due to a growing resentment towards learned women, many of the female practitioners were defamed as witches and charlatans to keep them from 'stealing' the patients of their male colleagues (Alic 55-57).

With the Middle Ages came the first real institutionalization of sciences in the form of universities. By the 12th and 13th centuries respectively, universities grew out of early unions and guilds of similarly trained craftspeople who wished to secure independent management for their trade. This signified a transformation of societies and intellectual discourse in Western Europe. Universities were able to act on equal terms with sovereigns and enjoyed a higher status and protection by the law, similar to that of clerical institutions (Grant *Foundations* 33-36). Sadly, the curriculum at those early universities was heavily influenced by Aristotelian philosophy, which highlighted women's intellectual inferiority and meant that from the 12th until the late 19th and early 20th centuries, women would be barred from attending university and receiving a degree (Kumar xvi; Schiebinger "European" 473). The only exception to this rule was Italy, where women were allowed to study for a few more centuries before those institutions were closed to them, too (Alic 57).

One place where women were free to learn and able to rise into higher social hierarchies were the female-led convents, which were usually tied to male-led monasteries. Most medieval scientists practiced within the walls of religious places and women in convents were privy to these practices. Independent and upper-class women would choose the life in a convent to either avoid losing their dowry upon marriage, as the money would then be invested in the convent, or to engage in a kind of education that otherwise would be out of their reach. Their positions as abbesses held similar privileges to that of a lord: their office brought a certain amount of power, financial stability, and a better education than they would have received as housewives (Wyer et al. 5; Alic 62-63). But this safe space for women would be eradicated with the rise of clerical asceticism, which saw the exclusion of women from education even in the clerical context. Convents were now separated from the monasteries to preserve the modesty of nuns, which meant their separation from these places of education. By the time the Reformation revolutionised the church in the 16th century, these safe spaces would be entirely closed to women (Frize et al. 56; Alic 75-76).

Additionally, the reconciliation of Aristotle's view on women with that of Christianity reaffirmed the supposed inferiority of women: "With Judeo-Christian traditions, religious men and women believed that women were subordinate to men and that the natural world ought to submit to the will and demands of human beings" (Sheffield 10). The subordination of women was once again explained in an allegedly reasonable fashion that tied into the Christian belief. The clerical philosopher Thomas Aquinas (1225-1274) referred back to Aristotle's concept of the woman as a defective man and posed the question how a perfect God, if the Bible is to be believed, could have created an imperfect woman. He reconciled this supposed flaw in the godly plan by assuming that God had created the woman, as imperfect as she was, because she was needed for once as a helper to men, but also for procreation and therefore to support the advancement of the perfect man:

> It would seem that the woman should not have been made in the first production of things. For [Aristotle] says (*De Gener. Animal.* ii, 3), that the *female is a misbegotten male*. But nothing misbegotten or defective should have been in the first production of things. Therefore, woman should not have been made at that first production. […] *I answer that*, It [sic] was necessary for woman to be made, as the Scripture says, as a *helper* to man […] Wherefore we observe that in these the active power of generation invariably accompanies the passive power. Among perfect animals the active power of generation belongs to the male sex, and the passive power to the female.
>
> (Aquinas 274-275, emphasis in original)

As other did before him and would do after him, Aquinas found women to be naturally inferior to men, just like Aristotle. The misogynist views of Aristotle and Thomas Aquinas prevailed because they supported the patriarchal structures that had evolved over the past centuries and would only further implement the rule of men over women (Frize et al. 15, 18). In opposition to this, the Muslim philosopher Averroes (1126-1198), a contemporary of Aquinas, captured the other side of the debate of nature and nurture, claiming that it ought to be no surprise that women show less capabilities for higher duties if they had been kept ignorant and out of education for centuries (Frize et al. 16).

2.1.4. EARLY MODERN PERIOD

By the end of the 15th century, several important historical events demarcated the Middle Ages from a new era that was to come, among them Christopher Columbus travelling to the until then unknown American continent in 1492. In the early 16th century, Christianity separated into new religious denominations following Martin Luther's critique of the corruption and greed of the Catholic church. Both of these events, among others, had a lasting impression on the life in the Western world. This new era, the Early Modern Period, would bring about an entirely new approach to what now is referred to as modern science. It encompassed not only the Renaissance and the Enlightenment, two extremely influential periods and movements that would shape the intellectual and academic world for centuries to come. It also entailed the Scientific Revolution[5], which in turn signified the beginning of modern science and the switch from natural philosophy to a more empirical and value-neutral approach to sciences.

In order to cover the Early Modern Period in an organised way, I focus on the three major periods that have shaped our understanding of science and to show how women have or have not participated in them: The Renaissance, the Scientific Revolution and the Enlightenment. These three periods overlap in terms of dates which makes a clear distinction between them difficult. Jerry Brotton, for example, includes Francis Bacon and his new approaches to scientific methods in his monograph *The Renaissance – A Very Short Introduction* (2006), while I assign Bacon's ideas to the Scientific Revolution. Nevertheless, Bacon can be taken as part of both the Renaissance as well as the Scientific Revolution. I treat the three periods separately because the situation for women in science shifted significantly throughout them and is, as defined before, tied to the respective social and cultural circumstances associated with these periods.

The Early Modern era signalled a new time for an organised system of education in Europe. Defining a standard education, however, is impossible both when comparing girls' and boys' education. For centuries, while there were first attempts at a standardised curriculum, not all children had access to this system and the system was certainly not the same for boys and girls. It is not possible to compare an Early Modern educated woman with an Early Modern educated man, for they received a very different education which

[5] This monolithic concept of the Scientific Revolution has faced some critique in recent years. The next chapter discusses the construction of historical narratives such as the Scientific Revolution in more detail, (see 2.2.). For now, the concept of the Scientific Revolution as one coherent movement is used.

was always tied to their social status and what society expected of them (Whitehead "Introduction" x-xii). To further complicate tracing the history of women's education in the Early Modern period, most documentation focusses on schools for boys only (Charlton 12). Women were not only taught in schools such as elementary or primary schools, but also in their own families, in church and in other social circles. Yet no matter their social class, education for women was inevitably rooted in "social and cultural norms prescribed by those in authority" (Charlton 19-20). What was primarily taught to girls at a young age was to focus on their position as a wife in later life, namely on chastity, silence, and obedience (Charlton 7). What we would consider a regular education for young girls now was not what was prescribed almost six hundred years ago, and certainly not for the lower classes. It is assumed that nearly 90 percent of Early Modern women were illiterate. These numbers would only improve in later centuries and mostly among the wealthier families (Frize et al. 73). Historian Jean R. Brink advises to take these numbers with a grain of salt. Scholars only have access to relatively few sources on literacy in general and most of these sources focus on male literacy and not on female literacy, which only allows for assumptions on literacy at that time (97). Nevertheless, it is clear that women, as in the centuries before, did not have the same access to education and therefore to science as men did in the Early Modern Period. In contrast to their male counterparts, female students had to resort to other ways of learning about science:

> As historians have increasingly stressed, early modern science was not studied and practiced only in universities, laboratories, anatomy theaters, or other public spaces. Rather, natural inquiry unfolded in a variety of other contexts as well, many of which were more hospitable to the participation of women [...] [W]omen engaged with science in the home, [...] in courts, [...] in the pages of vernacular literature, [...] and in academies, salons, and epistolary correspondence. […] Women acquired scientific knowledge in different ways, depending on their circumstance: some had access to a degree of formal, humanist education, while others cultivated it through experience - in the workplace, the apothecary shop, or other arenas.
>
> (Ray 3)

2.1.4.1. THE RENAISSANCE (14TH TO 16TH CENTURY)

The Renaissance as a term came into being retrospectively in the 19th century. It describes the "profound and enduring upheaval and transformation in culture, politics, art, and society in Europe between the years 1400 and 1600" (Brotton 9). Classical texts, the concepts of humanism, and the turn towards an upcoming scientific revolution mark this era as a turning point in the history of science (Raber "Introduction" 3). Significant inventions as well as publications served to distinguish a new approach to sciences with the beginning of this time period. Johannes Gutenberg invented the printing press in 1439/1440 and paved the way for a quicker and easier distribution of scientific treatises. Nicolas Copernicus upended the alleged divine order of the universe by proclaiming that the earth was not the centre of the universe but one planet among many that circle the sun. And Vesalius and Paracelsus overturned the humoral theory of Hippocrates and introduced a more alchemical analysis of the human body, signalling the approach of modern medicine (Brotton 98-105). The venture into new places across the oceans brought new plants, animals, and people to Europe and this demanded an improved look at sciences such as botany, zoology, or medicine. While natural philosophy of the Middle Ages was still associated with magical and philosophical approaches, the Renaissance would introduce a new approach to scientific methods (Brotton 104, 110). Yet all these milestones were achieved by men and with the coming of the Renaissance the knowledge and contributions of medieval female scientists were forgotten or eradicated (Alic 76).

Feminist historian Joan Kelly even goes one step further and asks the provocative question "Did Women Have a Renaissance?" in her influential essay of the same name from 1984. The Renaissance is usually associated with the slow but steady abolishment of courtly power structures. The shift from the feudal system to early modern state governance is hailed as a move towards a more egalitarian political system that allowed for more independence. The same cannot be said for women: Kelly contrasted the more liberal life of women in the Middle Ages with the newly restricted life of women in the renaissance. The constraints that were lifted from men during the Renaissance in terms of social or ideological order were still in place, if not strengthened for women (Kelly 19-21). Additionally, female nobles lost their influence over younger generations when the court system was slowly dissolving and their positions as tutors to younger nobles were given to men (Kelly 35). Chastity was introduced as the new female norm and women were forced into a system of "female dependency and male domination" (Kelly 21). Nowhere in Europe did women have a legal status nearly comparable to that of men and

their identity was always associated with their male relatives or their future husbands (Raber "Introduction" 8).

This development is closely linked to the societal changes brought about by the Reformation which was set into motion in 1517 and lasted until the middle of the 17th century. In the previous centuries, the Catholic church had allowed for women to be educated in places such as convents, as shown above. This had meant a safe space for women to express themselves and participate in some way in the public life (Raber "Introduction" 13). With the arrival of Protestantism in England and Germany, however, these convents were closed or now put under the rule of male-led monasteries. The new social order, influenced by biblical teachings, saw women devoted with "greater discipline in the service of a new definition of the pious family, which locked women into daily acts of submission to male authority" (Raber "Introduction" 6). Women were to be wives and mothers under their husbands or male relatives as heads of houses, which once again restricted female influence to the domestic sphere. This exclusion of women from public life was seen as a natural hierarchy that was God-given (Raber "Introduction" 8; Frize et al. 76-77).

The Reformation also had an immense impact on women's education, especially in England. The English separation from the Catholic Church was set in motion by Henry VIII and his desire to remarry after a divorce. The king founded his own church, the Church of England, and installed himself as the head. It was the same Henry VIII who decreed that women and those belonging to the lower classes should not be allowed to read the Bible, which meant that literacy was certain to separate different classes and gender: if women were to be dependent on their husbands, then so would the lower classes be inferior to the gentry (Brink 96). Kenneth Charlton estimates that "[b]y the turn of the sixteenth century most women in the upper and middle classes were able to read and write in a functional way. The vast majority of women, however, were quite illiterate in both senses" (4). This close relationship of the newly founded Church of England to the royal family and their descendants had an influence on the education of women, which was from then on styled similarly to that of royal women. Education of women was moulded after conduct books that were used throughout all classes to teach women how to fit into society in their designated role. Because these books were translated from Latin to English, they were used in the education of middle and lower classes as well (Frize et al. 75-77). Learning how to read and write as well as basic moral principles were important for both young girls and boys. But, in contrast to their male counterparts, young women

were not meant to advance into any professional careers beyond that (Raber "Introduction" 1-2). In addition to that, the new household chores of Renaissance women saw a move from the self-taught active skills that required scientific knowledge to more passive duties. Because many scientific innovations of the Renaissance were designed to ease everyday duties, women were made obsolete as amateur scientists in their own home (Raber "Introduction" 16; Brotton 103).

2.1.4.2. THE SCIENTIFIC REVOLUTION

Much of our present-day understanding of science has been shaped by the Scientific Revolution, which took place in the early 16th and 17th centuries. It comprises both the Renaissance and the Enlightenment but will be treated in a chapter of its own, simply because its significance for the development of science is too great to be discussed as an afterthought. With the rejection of what was until then considered the foundation of natural philosophy, namely the studies of Aristotle, the Scientific Revolution signalled the beginning of modern sciences (Grant *Foundations* 168-169). David Wootton uses a very succinct comparison to highlight how the Scientific Revolution has shaped the lives of people. He distinguishes between a citizen of early 16th-century England, before the Scientific Revolution, and a citizen of 1733 who was then educated in a different manner. The former would still believe in witchcraft, superstition and fables and would have seen science, philosophy and magic as one and the same thing. The latter, however, would by then have had access to the newly conceived telescope and know how to use it, depending on his educational background. The role of God in his perception of creation would become smaller and he would be aware of and believe in the Copernican system of the earth orbiting the sun. The Scientific Revolution led people, as Wootton puts it, from believing to knowing and to a whole new approach to scientific endeavours (6-12).

Among the many forefathers of this revolution, the philosopher Francis Bacon was a key figure in shaping this new concept of conducting science. He proposed that experimental science was to serve as a new concept in studying nature and that scientists were to "deriv[e] general theoretical principles from particular facts" (Brotton 114). Bacon rejected the abstract research of his contemporaries who studied what other men had done before instead of experimenting and learning for themselves. He highlighted the importance of experiments and specificity in conducting science which would, according to him, lead to value-neutral results. Over time, the results of experiments would accumulate and confirm the hypotheses that were posed at the beginning of scientific

research. It was Bacon who introduced the inductive approach to science that we still use today. Nature was waiting and would not reveal herself, if Bacon was to be believed, which is why men needed to force nature to reveal her secrets to them (Sheffield 11-13).

This deliberate gendering of nature as female recalls an image that has been present long before the Scientific Revolution, namely that of Mother Nature. Women's link to nature and the gendering of nature as female awarded women with a certain amount of power and respect. If nature was female and to be worshipped, then women were seen in a similar vein. This connection gave them a certain amount of authority in society, an association with the natural sciences and philosophy. This meant especially in the Middle Ages an acceptance of learned women (Sheffield 4-6). While this power and respect may not have been equal to that of men, it still served to the advantage of women. With Bacon's and his contemporaries' new attitude towards nature, now not as something to worship but as something to forcefully control, this last stronghold of women was taken away. This control of men over nature was inherently used to justify men's domination and control over women in society as well (Frize et al. 68). The new "role of the scientist was to establish order and control over the natural world and, by extension, over the lives of women" (Sheffield 14).

The loss of respect for women in science came with the professionalization and thereby the definitive "masculinization of science" (Frize at al. 68) that has prevailed until today. In tie with Cartesian dualism and the concomitant separation of the body and the mind, science was now associated with masculinity which was in turn linked to reason and objectivity. In contrast, femininity was linked to feelings and subjectivity, which clearly divided women by their supposed nature from the newly founded neutral science (Frize et al. 69). Science was moved out of the private domains and was from now on to be conducted as a professional business in spaces such as universities, academies or in designated societies, such as the Royal Society of London. The Scientific Revolution introduced the first positions for hired scientists who were paid to conduct experiments and reveal new concepts. What is considered a regular job in our modern day and age was a novelty in the beginning of the 16th and 17th centuries.

The professionalization and move of science to the public sphere inevitably meant the exclusion of women from pursuing a scientific career in earnest (Schiebinger, "Origins" 9). Women had been confined to domestic spaces for centuries and when science was moved out of their reach, their only influence on the professional world of science was through their male relatives and husbands, always mediated and rarely self-

taught (Schiebinger *Feminism* 27). While the new instalment of academies and societies would have meant more space for members to attend and therefore more space for women to participate, women were still barred from participating as they have been since the inception of universities and other academic institutions (Schiebinger "Philosopher's Beard" 184). It is even more ironic in this context that women may not have been allowed to be members of elite societies and academies, but were nevertheless welcome to work as menial labourers for the male members of these societies. They could not have been banned from consuming science in forms of scientific journals but were still not able to actively conduct science (Schiebinger "Origins" 12-13; Schiebinger "Philosopher's Beard" 196). The exclusion left women with two choices:

> They could attempt to follow the course of public instruction and certification through the universities, as did their male counterparts. Or they could continue to participate within the (now private) family sphere as increasingly invisible assistants to scientific husbands or brothers; this became the normal pattern for women in science […]
>
> (Schiebinger "Philosopher's Beard" 192)

As Londa Schiebinger rightly phrases, women could attempt to follow the same path as men did by trying to enrol in university programmes. But as the social norms dictated that women belonged to the domestic realm and that science as a male profession was now almost exclusively conducted in the public sphere, their chances were limited. Even though universities and academies are our centres of science today, there were other institutions and venues for women to conduct science, namely those outside of the professionalised institutes as amateur scientists. The term "amateur" has to be used in context, though. What could be seen as a derogative term in our modern-day context used to refer to a much more respected profession back then (Schiebinger "Origins" 16). In France, scientific salons were wide-spread and they were almost exclusively run by women. As a form of social gathering place French salons offered women the opportunity to come in contact with intellectuals outside of the professional context and to discuss their findings with them. They functioned as a refuge for those women who were interested in science and wished to be educated but did not have the opportunity to access a university degree (Frize et al. 99; Fara 15; Schiebinger "Philosopher's Beard" 188). Nevertheless, this was clearly a place that was only accessible to higher classes such as

noble and wealthy women (Schiebinger "Origins" 15). This venture into a more informal field of the study of sciences turned many women into popularisers of science, who made it easier for fellow lay women outside of the profession to understand what was discussed behind closed doors. And since these amateur scientific ladies proved to be loyal and wealthy customers, manufacturers turned to them for special advertising and special products, in addition to specific magazines that were published for learned women (Alic 79-80).

Some feared that this new occupation of women with science could result in the disruption of the social order. If women were more concerned with scientific studies in their private life than with their roles as mothers and carers, then this could pose a serious threat to the status quo (Schiebinger "Philosopher's Beard" 189). Other reactions to those learned women were also often satirical, such as Molière's play *The Learned Ladies*. Many were framed as fraudulent and while some of these women may have been less than earnest, many of them did not deserve this spite (Alic 92-94). Some found other arguments to demean this female occupation with science. If women were accepted in their amateur studies of science, then their interest in natural sciences such as botany was deemed fitting as it would suit their simple and docile nature (Alic 108). Or, if women were to proclaim interest in studying astrology in their pastime, it was argued that the occupation with the heavens and the cosmos would keep them humble and remind them of their own insignificance in the grand scheme (Alic 79). The most important thing, it seemed, was that women would not pose a threat to male students of science: "As long as scientific ladies confined themselves to the new playthings, avoiding the rigorous study of higher mathematics, physics and medicine (where they would be competing with men), society could accept their new preoccupation with amusement" (Alic 79).

2.1.4.3. THE ENLIGHTENMENT (16TH TO 18TH CENTURY)

The final decisive movement of the Early modern period is the Enlightenment. It spans roughly from the middle of the 16th century to the end of the 18th century, finding its end with the American and French Revolution (Pollack "Introduction" 2). The Enlightenment is perceived, from today's point of view, as the foundation of modernity, inspired by the writings of French scholars who eventually demolished the *Ancien Régime* and the absolutist rule of the monarchy before introducing new governments that would involve the people as well (Edelstein 1-2). Yet the Enlightenment encompassed more than just the French and American struggles for independence. Across all of Europe and the

Western world, the Enlightenment stood and still stands for "philosophical principles grounded in a belief in the salutary powers of human reason and, in particular, in the ability of rational beings to govern themselves" (Pollack "Introduction" 3). After the principles of democracy and reason from Antiquity had already been revived during the Renaissance, proponents of the Enlightenment claimed that this new age of reason and rationality would rival those ideas for centuries to come (Edelstein 2-3).

The Enlightenment and especially the 17th century featured many philosophical and scientific advancements. The Royal Society of London was founded in 1660, making it one of the oldest and most prestigious societies for science (Porter "Enlightenment" 144). One of the most iconic scientists of both the Enlightenment and the Scientific Revolution was Isaac Newton, famous mathematician and physicist who defined the laws of gravity and who was also one of the first presidents of the Royal Society (Porter "Enlightenment" 132). Science in the vein of Isaac Newton was to "set plain facts above mystifying metaphysics" (Porter "Enlightenment" 136). Order was the paramount goal of scientific research. Similar to Francis Bacon, Newton argued that nature was now conquered by men and was therefore free to be experimented upon. If nature, as his contemporary René Descartes proclaimed, was indeed soulless and without conscience, then there was no harm in using it for scientific purposes (Porter "Enlightenment" 131, 142). Newton justified the usage of nature, which was for centuries stylised as female, for the greater good of man's advancement in science, continuing to erode the place of women in science.

In keeping with earlier centuries, however, women found ways to circumvent their exclusion and to participate in the sciences. As much as they were excluded from the public and academic places of learning, they still held influence in the domestic sphere. Just because women are often not mentioned in written reports on science, this does not mean that they were not involved. This exclusion from written records, which are usually the ones to survive in the course of history, also means that many contributions of women to science were historically ignored. In a way, this foreshadowed the long way women in science would still have to go. During the 17th and 18th centuries, they often worked as assistants and menial workers for male relatives or husbands who were professional researchers. They provided cheap labour force at times when a scientific career was not yet enough to earn a living for men (Fara 7-19). Women of a higher social standing had more opportunities than those of lower social classes. They found ways of influencing the scientific discourse as correspondents of male scientists, as benefactresses or patrons of

scientist or, as centuries before, as leaders of informal scientific salons (Wyer et al. 6). The 18th century showed the first signs of change for women's status in shaping science, if only in a minor way: women started to enter the literary market. Their work as popularisers of science secured them a more permanent space of influence at least on an informal base. Additionally, literature as a safe outlet allowed them to condemn the double standards of a male-dominated society that excluded women on the basis of shallow arguments (Clark 483; Porter "Enlightenment" 324).

By the beginning of the 17th century, René Descartes, himself a famous philosopher and scientist, declared that the mind and the body were not connected as was thought before. The body was just the vessel, the mind was independent from the shape of the body and "thus he advocated a reliance on the right reasoning of the individual mind to explore knowledge for itself without any prejudgments, prejudices, or outside interferences" (Sheffield 12). But Descartes' call for an unprejudiced approach to education did not apply to everyone as he did not include women in this argument. If women had hoped that they would now be treated as equals based on the Cartesian idea that the mind had no sex, then they were mistaken. This hope was also undermined by the emergence of new theories about physicality and its relation to intelligence and capabilities. Pseudo-sciences such as craniology attempted to justify women's lesser intellect based on their smaller brain size (Schiebinger "Philosopher's Beard" 197-198). In the same way as the democratic principles of Athens in Antiquity did not benefit women, the egalitarian calls based on Cartesian dualism did not benefit them either. Francois Poullain de la Barre, a student of Descartes, called out this hypocrisy and harshly judged his own sex for being "self-centered in their judgements" (Poullain de la Barre et al. 53). If the mind is sexless and if men have a mind that is detached from their body, then so do women. He argued that it is not women who are inferior, it is society that only wants men to advance because it is men who govern the laws:

> Even the wisest legislators found no interesting role for women when they founded their republics. All laws seem to have been made to keep men in their present position of power. Men we regard as fonts of wisdom have never said anything good about women.
>
> (Poullain de la Barre et al. 55)

He also claims that arguments for the inferiority of women do not take into consideration the way women have been brought up and educated in contrast to men, which would explain their underrepresentation in science (Frize et al. 22-24).

René Descartes was not the only enlightened philosopher who argued that women were intellectually inferior. The German icon of the Enlightenment and proponent of reason, Immanuel Kant, doubted that women were capable of deep thoughts since their understanding of the world supposedly only lent itself to the beautiful instead of the profound. He feared that education might blur the distinction of genders, turning women into men and therefore nullifying their attractiveness to the opposite sex (Frize et al. 23, 33). Once again, it seems that women's service to men is more important than their basic rights. Kant's fear of a disruption of the social order is mirrored in the highly stylised literature and art of the Enlightenment, which clearly shows the ideal of women as mothers and carers (Pollak 10). Both Nicolas Malebranche and David Hume take the same line of argument as Kant does: Malebranche, another student of Descartes, saw women as inferior to men, as superficial and flimsy (Frize et al. 25). Scottish philosopher David Hume considered women's emotionality as their defining weakness, which made them unsuitable for higher offices (Frize et al. 33). John Locke, English philosopher, showed a similar prejudice against women in his own theories. He argued for freedom and equality of all men, proposed that governments need to be elected by the free citizens and, most famously, divined the concept of the mind as a blank slate that is to be filled with what is learned and taught throughout one's life. All these ideas, however, did not apply to women. Women were not equal in Locke's view, but inferior to their husbands and male relatives who held power over them. Locke did concede that the hierarchy of the sexes imposed by the tale of Adam and Eve was to be disputed. He was "principally interested in refuting the idea of a divine grant of authority of Adam" as a representative of the male sex, yet "lived in a world in which the subjection of women was an empirical fact and was willing to yield to the contemporary view that this fact had some foundation in nature" (Butler 105). In line with Kant's argument, the wishes of men were to be treated with priority to those of women. And as far as the blank mind of a women goes, Locke did not favour education for women and saw no sense in training them for higher professions (Porter "Enlightenment" 332-333; Pollak 5; Frize et al. 27-28). French philosopher Jean-Jacques Rousseau characterised women as entirely passive and weak. They were made to please the men in their lives, whether as wives or as sisters or daughters, and their education needed to be adapted accordingly (Pollak 9). Rousseau's

ideas fit into a pattern of education for women that had been going on for centuries, in which education was not based on a principle of equality but rather on the preparation for the individual's role in society. If the designated roles of women and men were not equal in the society they would grow up to inhabit, then their education ought to mirror that. To believe Rousseau means that one is born a woman and therefore born unequal:

> For Rousseau, then, biology is destiny, and women's lives have to be entirely focused on, and subject to, men's needs and pleasures. Women are not to be independent and should receive only a limited education, directly linked to their roles as nurturing wives and mothers.
>
> (Frize et al. 32)

For women, this meant that their physiology determined their destiny, no matter the Enlightenment's claims for equality for all. In order to avoid being called out for their hypocrisy, many philosophers pre-empted the call for women's rights by referring to biological reasons for women's inferiority (Pollak 9). Arguments of nurture in opposition to nature, as they had been made before, were no longer considered. Women were born to be child-bearers and mothers, and their nurturing nature was decreed by their innate biology. These arguments found their peak in the Complement Theory that gained influence in the 17th and 18th centuries, when science was made more exclusive and was removed from the private domain and therefore often from the influence of women. Women's very nature supposedly made them ideal for the domestic sphere in opposition to men's nature that suited the public sphere. Women were therefore the necessary complement to men and these complementing natures of the sexes balanced society (Frize et al. 37-40). Biology was also used to instil the fear of infertility of learned women. Going after an education instead of caring for their family was seen as very egoistical behaviour of women, as it would endanger the survival of the entire human race if women were to focus on education. Leaving childcare to nurses instead of mothers and bearing fewer children because of a woman's preoccupation with science would threaten the social order. It was feared that the organs needed for reproduction, such as the ovaries or the womb, would wither when women decided to educate themselves (Schiebinger "Philosopher's Beard" 189, 200). These arguments were also used to ban women from yet another sphere of scientific practice, namely that of midwifery and nursing, where women had been present and dominant for many centuries. It was argued that women

were not allowed to work as professional carers and nurses, only in their own private lives, which effectively kept midwives from pursuing their careers (Bakos 225). Images of motherhood were conflicting, especially for lower classes: women were stylised as mothers and devoted to their families, yet if they were unable to care for their children, say in case of needing to do housework or work the land in order to survive, they were condemned as horrible, selfish mothers. This ambivalent and accusing image of working mothers is still prevalent in the 21st century. The pressure on women to care for their children themselves was high. Calls for breastfeeding one's own children meant that wet nurses were suddenly out of work and men started to appropriate the professional field of midwifery for themselves (Pollak 10-13).

While the Enlightenment was the supposed triumph of reason and rationality, it also coincided with the terrible peak of the Atlantic slave trade. The globalised trade during the Enlightenment increased and so did the demand for cheap labour forces in the form of slaves from the African continent. Philosophers such as John Locke criticised the assumption that people are treated unequally but he himself invested in transatlantic slavery, directly benefitting from a system that devalues human beings based on their skin tone (Pollak 3-4, 14-15). Even though many historians try to pose the Enlightenment as a neutral and reasonable movement, it was not neutral in terms of class, race, and gender (Schiebinger "Getting" 10). There is a certain irony in Western society seeing itself as superior to Eastern "Oriental" cultures when women in England had a legal status that was much worse than that of contemporary women in the East (Porter "Enlightenment" 323). This puts women in a difficult place as well: women of the Enlightenment, and earlier centuries, too, were both victims of oppression in their own lives, yet also supported the oppression of others, especially in terms of colonial history. Wealthy women from upper classes profited from slavery and while many White women were no doubt victims of abuse by men and held little legal status, they were still in a much better place in society than those men and women who were not White and therefore not even considered human beings before the law (Pollak 7, 17). It is therefore difficult to be unbiased when reading treatises from proto-feminist writers such as Mary Astell, Olympe de Gouges or Mary Wollstonecraft who employ the term "slave" when referring to women's place in Western society while they ignore the real enslavement of millions of women (Pollack "Introduction" 4). Their intentions were honourable; they stood for the equal treatment of their fellow women. Still, their terminology disregarded the fate of many other women who suffered much more.

2.1.5. THE 19TH CENTURY

With the beginning of the 19th century came the definition of science as we use it today. This meant that science was to be accepted as a proper career path, a profession that men might use to earn their living. It also increased the authority that was attributed to scientists and their work (Clark 480-81). Women where still pushed to the side-lines in science, with men dominating the professional scientific discourse. Societies and academies of science often still refused to accept women as members (Alic 148, 179). Only botany, a study that was perceived to be fitting for more stereotypically female characteristics such as softness and empathy, was dominated by women (Schiebinger "Philosopher's Beard" 196).

With the ensuing further distinction of science in the professional and in the private sphere came a renewed interest in a more popular approach to science. Publications and lectures that brought science to those outside of the professional careers increased considerably in the 19th century, with scientists appropriating this new potential market to broadcast their findings to the public (Clark 480). The aim of popularisers of science was simple: to show people outside of the professional sites of science that they too could participate, regardless of their education or means. Scientists such as Michael Faraday served as exemplary scientists for their cause. Faraday was a self-educated man from a working-class background who advanced into a high standing in the scientific community. If he had been able to rise above his background, then so could others (Bernard Lightman 346-8). Many of the population were discouraged by the professionalization of science and its inaccessibility. Richard Proctor, an influential science populariser of the 19th century, uttered harsh critique on the professional scientific communities of the academies and societies. He argued that instead of promoting science for everyone to participate, members of such elitist clubs were more interested in serving their own reputation (Bernard Lightman 349). Science had to be understandable and accessible to the broader public, if it was to advance. It was in popular science that women could finally find a niche to occupy, as they had been doing since the Scientific Revolution had started to exclude them from many professional places of conducting science. They played a vital role in connecting those classes that were usually left out of the complex forms of science with a simpler understanding of how science makes meaning (Clark 483).

Popular science was especially important for the Industrial Revolution that took place in the late 18th and early 19th centuries, signalling the dawn of a new era of production. Manual labour was exchanged for machines, while the harnessing of steam and water power meant more efficient manufacturing processes. Wealth increased with certain classes and others were provided with a more regular structure and steady source of income, which in turn led to another increase in population. The Industrial Revolution also connected the middle and lower classes with the importance of science as they were now dealing with certain aspects of practical sciences in their jobs at factories (Alic 175). This is where women as authors of popular science books made an important contribution: their work in facilitating the understanding of science was essential to the workers of classes that were not used to having access to higher education. Science was to be made accessible, regardless of education, gender, and social standing (Bernard Lightman 349). Authors such as Jane Marcet, Rosina M. Zornlin or Margaret Bryan published textbooks on several different topics ranging from physics, chemistry to geology in an effort to provide science education for a general audience. This target readership was presumably female and specifically catered to them by "employ[ing] the style of letters, dialogues, or conversations, familiar formats for teaching science to young readers and to women of all ages" (Frize et al. 123). Additionally, the recognition of a more practical knowledge of sciences was also supported by popularisers of science (Bernard Lightman 346). Women's practical knowledge in botany, biology, and other sciences needed in the domestic sphere was now starting to be recognised by professionals. But the Industrial Revolution also meant disadvantages for many women: the production of certain goods was entirely removed from the home to the factories, which put many women out of work, even if it was unpaid. What ensued was the increased dependence of women on their husbands as providers of income while they were also confined to their domestic duties as housewives and mothers (Frize et al. 69).

The education system also saw some major reformation during the 19th century. Elementary education was now available for both girls and boys and was even made compulsory in countries. In addition, girls and boys were often co-educated. The reason for this was simple: it was much cheaper and required a lot less funding for the counties to run one school for all instead of two separate institutions (Alic 175; Frize et al. 110). This meant that for the first time in many centuries, girls were receiving an education alongside boys. It is not clear, however, whether both boys and girls had access to the same classes in school or were simply sent to the same institution but still separated by

gender to go to different classes. But it is estimated, based on the available surviving material, that by the end of the 19th century, almost half of the students in secondary education were female, which meant a significant increase compared to earlier centuries (Frize et al. 119). In many countries, though, the system had its flaws. The English school system of the 19th century was heavily criticised for the uneven distribution of public funds in secondary education. This might allude to the doubts whether girls and boys really received the same education or simply went to the same building and were then separated. In places where there were still girls' schools, the teachers had to be female. But since they were women themselves, they too had only had access to the limited education that was given to girls at that time and therefore were not able to help their pupils to advance beyond what was taught to themselves (Frize et al. 109-111). This meant a vicious cycle for female education, in which the system supported itself and kept women in a place of lesser education. The Industrial Revolution also played its part in deciding who had access to secondary education and who did not. Even though elementary school had been made compulsory in many countries, the still prevailing class system meant that working-class children would have to drop out of school for manual labour. In the meantime, children from wealthier middle- and upper-class families monopolised the secondary education, which further divided the differences between the classes (Frize et al. 115). But not only the class system meant a more difficult access to secondary education for women. German universities did not allow women to study in the 19th century, even though some of the most important scientific advancement of that time were made at German universities (Alic 178).

The arguments that kept women from performing science were the same as they had been for many centuries. The Complement Theory was still used to justify the division of labour forces into private and public spheres. Women were perfect in their own, lesser way, it was argued, and meant to complement the more perfect male standard (Schiebinger *Feminism* 70). Academies and societies continued to prefer male over female members because they feared that women's alleged sensitive nature would stand in the way of experiments that would involve animals or heavy labour (Kumar xvi). Pseudo-sciences such as craniology were now supported by the measuring of other body parts such as the pelvis as an indicator for womanliness in opposition to the cranium as the measure of intelligence. The larger the pelvis and the smaller the skull, the less intelligent a person would be, which was inevitably tied to the female bone structure as the epitome of lower intelligence (Schiebinger "Philosopher's Beard" 198). Another

scientific current that supported this theory was that of Social Darwinism. In 1859, Charles Darwin published his ground-breaking treatise *On the Origin of Species* and laid the foundation for the now widely accepted concepts of evolution. These theories, namely that only those who are perfectly adapted to their surrounding will survive and the others would be eliminated by natural selection, were transposed onto sociological concepts. The "survival of the fittest", a phrase coined by social Darwinist Herbert Spencer, in this case meant that genius is reserved for men, who have rightly advanced in society because they are meant to lead (Schiebinger *Feminism* 23). Women, on the other hand, are the less developed versions of men. They have occupied a lower place in the societal hierarchy because they are physically and mentally inferior to men (Kumar xv).

As grim as the prospects in the 19th century might seem, there was also a new movement gaining headway that would signal a real change for the fates of women. The first organised feminist movement of the 1880s that lasted until the 1920s pushed for many causes that would guarantee a lasting place for women in society. The Suffragist movement demanded many things, such as that women would receive the right to vote. At the core of this movement lay the wish to abandon the separation of the domestic from the public sphere, allowing women to participate in politics and public life outside of their allotted space as housewives. The supposed weakness of the female sex, its emotionality and temperament, were no longer to be seen as undesirable in voters but as a perspective that needed to be included in the political life (Hannam 32-34). This also included a demand for the recognition of women's scientific talents, regardless of their supposed inferiority (Schiebinger *Feminism* 23). 19th century female scientists such as Ada Lovelace, Emilie La Marquise du Châtelet and Sophie Germain had proven that women were capable of performing just as well if not better than men in science, and the calls for equality became louder and would be impossible to overhear in the coming centuries (Alic 175).

2.1.6. THE 20TH CENTURY

The 20th century posed many challenges to the continued fight for women's place in science. The Sputnik crisis, the space race, and two new waves of feminism signalled a change for women in science (Kohlstedt 13). But the two World Wars, the ensuing return of women to the domestic sphere and the continued stereotypes women had to face also

provided difficulties. Similar to what I have shown before, history has had its advances and recesses when it comes to the participation of women in science, especially in a century as diverse as the 20th.

Among the most cataclysmic events of the 20th century were the two World Wars. Before the First World War (1914-1918), women had made some major breakthroughs in their work for equality. The Suffrage movement had secured women across the world the right to vote, some gaining franchise in the late 19th century, most of them only in the first half of the 20th century. With the beginning of the First World War, an opportunity opened up. Many women occupied the jobs in science of those men sent to war. Here, they were able to prove their worth in the professional sciences such as physics and chemistry. But after 1918, women had to face several obstacles to secure the place they had fought for so hard (Kohlstedt 10). Men returning from war had trouble finding jobs again, also because of the economic downturn after the War. Fewer positions were available and many were still filled by women. They demanded that they should be preferred in job applications because they had fought for their countries and now deserved to be compensated and to be re-integrated into society. The men in powerful positions yielded to these claims, supplanting women with men in prestigious jobs. Additionally, many countries faced a rapid depression after the war and the plummeting economy in tie with a new rise of conservatist politics negated the little successes women had achieved so far (Kohlstedt 10).

Before and during World War II, from 1939 to 1945, science was used in warfare and the discoveries made in science propelled the importance of capable scientists. Women, now again in the position to the take the jobs that had been vacated by men during the war, pursued scientific careers (Haynes 303). They were, nevertheless, still paid less than their male colleagues had been paid and did not have the same access to the laboratories that their predecessors had, also due to the difficult situation during wartime. They worked as secretaries and menial assistants, in positions with lower wages. But the years during WWII still meant a surge of women in science (Kohlstedt 11). Many men returned to their higher positions in academia after WWII and used their influence to nullify all the advancements that had been made for women in higher education (Kohlstedt 12). After the War had ended, science was once again made a male-dominated space after women had participated so much, which inevitably excluded women from the advancement of the post-war sciences (Schiebinger *Feminism* 30-31). Their new roles in

the post-war years were that of housewives and mothers, re-establishing the domestic perfection that was craved after the turbulent years of war (Kohlstedt 12).

There was still no room for women at universities in the 20th century (Brink 102). And even later, when women were allowed to pursue a degree in scientific subjects, their chances of being hired as researchers or teachers outside of all-female colleges were slim (Bertsch-McGrayne 4). These colleges for women were ambivalent: they provided a safe space for women to study and to share their interests with each other, but they also proved a cul-de-sac, as they would continue to be treated as inferior for the remainder of the continuing century. Women with degrees from all-female colleges were still less likely to be hired. As teachers, women could be mostly found in public schools, women's colleges, and as a minority in co-educational facilities or prestigious universities (Kohlstedt 5). To make matters worse, even the secondary education was still stuck in previous centuries. By the beginning of the 20th century, most schools that provided secondary education for girls were still finishing schools, designed to prepare women for their social roles as mothers and homemakers instead of teaching them how to start a career (Bertsch-McGrayne 3). The first wave of feminism might have paved the way into universities for some women but the number of women pursuing a PhD in science significantly dropped in the second third of the 20th century. European fascist politics, the American fear of communism and the Cold War preoccupied the political system and pushed concerns for equality to the side-lines (Schiebinger *Feminism* 30).

In America, a significant resurgence of women in science happened in the 1960s and 1970s, thanks to laws, governmental funding and a new interest in hiring more scientists in general to win the space race against the Soviet Union (Schiebinger *Feminism* 31). But, even with similar qualifications, women's careers tended to be less successful than those of men in science and engineering: men could be found in higher and tenured positions while women occupied lower positions with limited contracts (Eisenhart and Finkel 15-16). The Royal Society accepted their first full female members, three in total, in 1945. Even though there had been no explicit rules that would have banned female participation, women had simply not been admitted or had not even applied until then (Schiebinger "Origins" 12). The first woman ever elected to the French *Académie des Sciences* was Yvonne Choquet-Bruhat, a French physicist and mathematician, in 1979 (Schiebinger "Philosopher's Beard" 187). But not only outside factors contributed to the small number of women in science. The hostile climate in science classes and programmes towards women proved an additional obstacle and discouraged many women

from pursuing their desired career path (Eisenhart and Finkel 19). Intimidating role models such a Marie Curie, famous chemist and physicist and two times Nobel Prize winner, cast their daunting shadow over aspiring female scientists. In what has been coined the "Curie effect", Marie Curie serves as a role model that is too great to reach for women in science. It also provides men in higher positions with an excuse to say that they expect a Marie Curie in a woman who wants to be hired in science (Kohlstedt 4; Opitz 390).

The 20th century also saw the emergence and establishment of mass media. The influence of media representation would also shape the image of scientists who gained new authority as public figures. Representation in the media matters because the images that we are exposed to on a daily basis will shape our cultural notions of norms (Schiebinger "Getting" 3). This holds especially true for the role of the scientist in our society. The image that has been perpetuated by the media is that of a scientist who is male, old, and White. Those who are not privy to the exclusive realm of professional science, such as women, are pushed to the margin and hold no power (Haynes 4). Women, according to some media representations, are not interested in science at all and prefer not to engage in it (Eisenhart and Finkel 19). Interestingly, the only representation of women, especially in science fiction, is that of an assistant to their male superiors, which curiously mirrors the role that many women were expected to assume for centuries. The same goes for the literary depiction of the few women in science: drawing on historical arguments that have been made against women in science, female scientists are either seen as unfeminine and unattractive or were overly sexualised in order to undermine their competence. They are the Bond girl, the secretary or the token female scientist on a team that is exclusively led by men. And even when women are venturing into science in literature, they often serve as a romantic interest for the male protagonist[6]. Their occupation as a scientist is not meant to signify their interest in science: their presence in the lab is only needed so that they can meet the male protagonist (Haynes 302-306). Or, mirroring the desired societal position of women, in media they are steadfastly portrayed in the private sphere even though there were finally women working in professional science in real life (Clark 484). These representations would re-instate old limitations for

[6] Recent films such as *Arrival* (2016) and *Annihilation* (2018) have provided successful counter-examples to these tropes.

women and also pose new boundaries for them to overcome in order to re-enter science (Kohlstedt 10).

The previous centuries have foreshadowed the role that many women would continue to play in their work as scientists in the 20th century, namely as assistants to their male colleagues. Often, this role would be falsely attributed to them even though they deserved more credit. Because of that those independent women scientists working with male scientists had to fight the assumption that they were not equal partners but merely manual labourers (Bertsch-McGrayne 4-5). This goes especially for co-working married couples in science. Margaret Rossiter, historian of science, "has noted how often [notable male scientists of the 20th century] were, in fact, married to women in their fields and thus able to have informal and sometimes unacknowledged assistance in their work" (Kohlstedt 6). Married women especially received less credit for their work with their husbands (Rossiter 330). Rossiter has referred to this as the "Matilda effect", named after and dedicated to the Suffragist Matilda Joslyn Gage who herself had criticised the way men use the hard work of women to boost their own standing (Rossiter 335-337). This newly coined term is an expansion to Robert K. Merton's "Matthew effect", which describes how well-known scientists are often credited for work that they themselves have not accomplished or did not accomplish alone. Merton named his effect after the parable in the gospel of Matthew, which states that those who already have plenty will always be given more (Rossiter 325). In a very ironic twist, Merton himself has long forgotten to give credit to his own wife and colleague, Harriet Zuckerman, who helped to conceive of this term (Rossiter 334). This is one of the reasons why women's contribution to science has often been left out of historical records: women did do science and did contribute to it, but were omitted in favour of their much more recognised male colleagues.

The problems faced by different generations of women often mirror each other: they wish for women's advancement in science, for equal opportunities, and equal pay. They are fighting stereotypes and discrimination and are trying to make sure that women receive higher positions (Kohlstedt 13-14). The 20th century saw a rise and the establishment of an organised feminist movement after the Suffragists had already secured women the right to vote by the beginning of the century. These newly organised second and third waves of feminism have worked to highlight the obstacles that women have had to overcome to participate in science for centuries. From the 1970s onwards, efforts were taken to retrace the work of women in science that had been forgotten and overlooked (Schiebinger *Feminism* 21). The feminist approach to the historiography of

science and the critique on it are the focus of a later chapter. This section highlights the many activist strategies outside of historiography that were taken to advance women in science in the 20th century. Data on the discrimination of women in science was collected and in turn published. It was also highlighted that women face different standards in job applications, standards that are usually set higher than those for men. Additionally, laws and public funding were used to found organisations that would provide women with experience in leadership in order to prepare them for the positions they might one day hold (Kohlstedt 7-9). Actively discussing the discrimination they face has also meant a difficult situation for women. In 1984, Martha Minow pointed to the "difference dilemma" that women encountered in working on equal rights. Calling out the gender pay gap and discrimination can make the situation worse, yet not calling them out will not resolve the problem and leave the unfair power structures in place (Schiebinger *Feminism* 68). The discrimination of women in science has also been discussed and approached on a governmental level in several different countries and continents. In the Treaty of Amsterdam, signed in 1997, the European Union and its member states actively committed to fight any kind of discrimination, including discrimination on the basis of sex and gender. The European Union consecutively established a Women and Science Unit in 1998, encouraging their member states to create equal opportunities for men and women by providing dedicated funds (Schiebinger "European" 474-5). By 1997, the total number of female students of science and engineering had increased by ten percent compared to the 1980s, marking an all-time high of women making up 40% of the students by the end of the 20th century (Kohlstedt 16).

2.1.7 THE NOBEL PRIZE

While there are many other prizes that are awarded to exceptional scientists in their field, the Nobel Prize holds a special place, especially in the public's eye. It is one of the most well-known honours that can be achieved and is taken as a marker of distinction. The esteem and influence that come with being awarded this prize have long been denied to women, from its inception on until recently.

Critique surrounding the prestigious awards has existed ever since its first ceremony in 1901. All of the criticisms naturally also apply to women and disadvantage them even further than their male colleagues. Some criticism applies to science awards in

general: no matter the intention of such prizes, the question remains whether they actively promote scientific advancements or encourage scientists at all (Casadevall and Fang 4688, 4683-4684). Other criticism directly concerns the Nobel Prize. Within the first couple of years, the committees faced difficulties regarding the wording of Alfred Nobel's will. Nobel had decreed that the prize should honour scientific achievements from the previous year. Significant discoveries are usually not recognised or confirmed in the span of twelve months and it needs more time to distinguish whether a scientific discovery fits the description given by the founder of the prize. This condition was soon abandoned in favour of allowing for a longer span of time for scientists to be considered (Casadevall and Fang 4683). What has since not been abandoned, however, is a grey area that has been left by Alfred Nobel's will: deceased scientists cannot be nominated posthumously for the prize, meaning they have to be alive by the time they are announced as the winners. In combination with the extended period of time it takes to recognise the importance of a scientific discovery, this means that many scientists who contributed significantly to their field but have died soon after are overlooked by the committees (Casadevall and Fang 4683).

What remains one of the major criticisms on the Nobel Prize and what is also my concern is the missing inclusion of women in the pool of laureates. I have to strongly disagree with Thoru Pedersen's applause for the Nobel committee. He emphasises that "the selection committee did not wait long to recognise women. Only two years after the Nobel Prizes were instituted, Marie Curie shared the prize for 1903 Physics" (Pedersen 2186). It is true that there was an early female laureate in Marie Curie but in the grand picture of the Nobel Prize, women have been scandalously neglected. The Nobel Prize in Physics can serve as an excellent example: after Marie Curie's recognition, it would take another 60 years for a woman to receive the Nobel Prize for Physics, namely Maria Goeppert-Mayer in 1963 and then another 58 and 60 years, respectively, for two female laureates, Donna Strickland in 2018 and Andrea Ghez in 2020. Recently, another woman was elected for the Nobel Prize in Physics, namely Anne L'Huillier in 2023, alongside two other male scientists ("Nobel Prize awarded women", *nobelprize.org*).

From its inception in 1901, the Nobel Prizes for science, meaning physics, chemistry and medicine or physiology, have been awarded 346 times[7]. As of November

[7]All numbers and statistics have been taken from the official website of the Nobel Prize, https://www.nobelprize.org/. The percentages have been calculated by myself.

2023, a total of 646 laureates have received these honours, some of them shared, some of them awarded to single scientists. Of these over six hundred laureates, only twenty-five were women: thirteen women received the Nobel Prize in Medicine or Physiology, eight for chemistry and only five for physics. Because Marie Curie has received both a Nobel Prize in Physics and in Chemistry, her contribution is only counted once. Prizes awarded to only women are even rarer. A Nobel Prize in Physics has never been awarded to a woman or group of women alone. Three Nobel Prizes in Chemistry have been awarded to women alone, namely in 1911, 1964 and 2020, marking over 50 years in between these recognitions. And only one Nobel Prize in Physiology or Medicine, in 1983, has been awarded to a woman alone. This means that out of 343 prizes, only four have gone to a group of women or one woman alone.

When displayed in percentages, these numbers are even more jarring. Only 3,9 percent of the scientific Nobel laureates in the past 122 years have been women and only seven percent of the awarded prizes had a woman among the laureates. Out of all the prizes ever awarded, only 1,2 percent have gone to women alone. These low percentages cannot be accounted for by a lack of women entering science in the past century. Between 1966 and 1996 alone, the number of women earning a doctoral science and engineering degree has more than quadrupled (Kohlstedt 16). Sharon Bertsch-McGrayne lamented in 1998, over twenty years ago, that only two percent of the scientific Nobel Prize laureates are women, yet the numbers have not drastically improved since then (3). Given all the work of women's movements to advance women in science, these percentages show the deep-seated prejudice that is still held against female scientists. It is a vicious cycle of those in power retaining their power. If men still dominate the scientific field, then men will most likely be more respected and make up the committees involved in distributing prizes. And if only men are voters and therefore laureates, then there will be little room for change for women. The increased influence and social and political power that comes with a prize will undoubtedly be used to further the prize winner's own agenda (Rose 58-59).

Only in recent years have the Nobel committees started to consider women, some of them retroactively for discoveries made decades ago that are only now awarded. Yet this late recognition also comes at a price, as Hilary Rose notes:

> The overdue recognition of these distinguished but now older women scientists limits the possibility of their exercising the usual power of a Nobel

> laureate. Their age means that, however brilliant, they are manifestly less likely to be in touch with younger up-and-coming scientists and less likely to campaign for them. The move also diminishes the pressure to recognize those others, in their forties or fifties, who would be in a phase of their […] career cycle where they might best utilize the reward and the status.
>
> (57)

In addition, the prize money is less important to already established scientists, as noted before, because they no longer need it to secure independent research. Few women are as bold as Rita Levi-Montalcini, laureate of the Nobel Prize in Physiology or Medicine in 1986, who vocally complained about the unfair treatment she received. Her male colleagues at her institute received their honours and Nobel prizes over ten years before her, even though their discoveries were made at a similar point in time (Rose 57). What has also been noted is that many laureates may have been role models in their respective fields of study, yet their private and political opinions are more than controversial. Among the male laureates there have been scientists who have been overtly racist, denied climate change, and held anti-Semitic or misogynist views. Receiving the Nobel Prize has given their voice an additional boost of authority and only supports the idea that the Nobel committee tolerates such views (Casadevall and Fang 4684-4687). If the committee is willing to award such laureates with their prestigious prize, then this shows that the archaic attitude towards women in science has not changed.

2.1.8 THE 21ST CENTURY

Based on what has been covered so far, the 21st century and the continued negative treatment of women in science have shown that there is still a lot of work to do. Some arguments that have been used in the past centuries have finally been abandoned: researchers have eventually concluded that neither sex is smarter than the other. The brains of biological men and women are "indeed physically distinct, but how these differences translate into specific cognitive strengths and weaknesses remains unclear" (Hill et al. 19-20). Hormones are no explanation for the lack of women in science subjects and careers. This lack can rather be accounted for by "gender differences in preferences and sociocultural influences on girls' performance" (Hill et al. 20). The supposed lack of

interest by girls in science stands in contrast to the sociological factors that lead young women to believe that they will not succeed in science and therefore need not be interested. If young girls are pressured to adhere to certain gender roles that society still assigns to them, it is no wonder that so few women are willing to pursue a career that society has not planned for them (Hill et al. 22). But differentiating between nature and nurture seems no longer sufficient. What young women are brought up to believe can very well find its way into their nature, too. Referring to Anne Fausto-Sterling's critique of the binary distinction between what nurture and nature can change, Neelam Kumar righty states that "[o]ur bodies physically imbibe culture" (Kumar xx).

The 21st century is still too young to make definite assumptions about what changes it may bring for women in science. But certain statistics can be a useful tool to catalogue the situation of women in these first two decades of the new century. Even if "[m]easuring discrimination does not remove it […] numbers [do] enjoy the cachet of truth in our society and statistics are thought to provide an objective measure" (Schiebinger *Feminism* 3). The statistics of the recent decades show little improvement. Even though the STEM subjects – science, technology, engineering and mathematics – are a major contributor to the working sector, women are still underrepresented in the respective fields (Hill et al. 2). What makes cataloguing women in science even more difficult is the fact that, by the beginning of the 21st century, only few sources on how many women were employed in science compared to men were available (Eisenhart and Finkel 14). It is estimated, however, that by 2002, nearly a third of the scientists were women, with an increasing tendency (Angier 75). Good news can also be found when examining the performance of children in STEM subjects in early education, where girls are gaining ground on boys (Hill et al. 3). And even if boys are statistically better in the cognitive areas required for a career in science, girls have shown that they can improve with training and be just as good, if not better. In the years between 1980 and 2010, the number of mathematically gifted children has intensely shifted in favour of girls. This example would support the importance of nurture over nature as thirty years are too short of a time span to account for any genetic change (Hill et al. 20). Improving the offers for young girls interested in STEM subjects can drastically improve the numbers. Upon entering college, male and female students apply at a similar level of qualification and in a similar ratio, but still twice as many men as women major in a STEM subject (Hill et al. 7). It is not that talent in women is not there. They simply do not reach higher positions because they drop out earlier or are not offered tenured positions that will ensure them a

lasting career. In European universities, the gender gap between men and women increases at higher levels. While women still make up almost two thirds of the doctoral recipients, the percentage of women in senior faculty positions drops to only 11% (Shen 22-23).

Science remains a male field of study, not only in terms of its practitioners but also when it comes to the subjects and philosophy of science. Discrimination does not merely happen against women but against stereotypical female characteristics in general. What is attributed to women has not changed much in the past centuries and their inability to conduct science is still held as a prejudice against them (Kumar xix). Many male scientists are still governed by their old stereotypes against women and the old stereotype of science as male and white is still prevalent (Angier 76). The comments of Nobel Prize laureate and Fellow of the Royal Society Sir Richard Timothy Hunt provide a recent example. He claimed in 2015 at a conference for scientific journalism that there were only three things women in the lab did: they either fall in love with a male colleague, make their male colleagues fall in love with them, or cry when being criticised. Many female scientists responded to Hunt's overtly sexist comment by posting pictures of themselves on social media in their lab coats using the hashtag #distractinglysexy. They humorously claimed that they knew how their outfit could distract their male colleagues or how they had just been crying behind their protective goggles. Hunt's comments were seen as evidence for the prevailing stereotypes against female scientists. He apologised but had to resign from his post at the University College of London due to the backlash he received from male and female colleagues alike (Wendling).

Universities have shown to favour an attitude and normative life that is modelled after a stereotypically male career path and they disfavour women for supposedly deviating from the desired norm of a worker (Bird et al. 199-200). What also works in women's disadvantage is that housework and domestic care are still seen as female chores which continues to keep women from pursuing careers. Childcare, domestic housework, and care of elderly or sick relatives take up time that could instead be dedicated to work (Whaley 193). Similar to what has already been discussed for the Nobel Prize, the vicious cycle of men in power wishing to remain in power hinders women from gaining ground. The "old-boy network" of well-connected men keeps women from accessing higher institutional positions (Whaley 193). If more women were represented in senior positions, then younger aspiring scientists had female mentors to confide in and to guide them: "A key strategy for achieving gender balance is the exchange of advice and practical

information between researchers at different career stages" (Watt 413). But this also comes at a price, as Sharon Bird, Jacquelyn Litt, and Yong Wang lament: women and minorities in general are expected to conduct the "institutional housekeeping", meaning that they have to "[monitor] gender equity" which "adds to their official responsibilities of teaching, publishing, and grant seeking" but is not recompensed in any way (195). Lasting changes can only be made if the much-needed work on equity is either distributed fairly amongst faculty members or compensated formally.

Despite all, many remain hopeful that this century will finally bring the desired change. Fiona M. Watt, renowned biologist in the research of stem cells, has shared her optimism in a recent article with *Nature*:

> I think it is therefore safe to say that, at least in the UK, larger numbers of women are rising to the top in academia. It appears that the era of the token woman faculty member is finally over, and I would hazard a guess that in the next 10 years the upward trend in senior women faculty will continue.
>
> (413)

A change seems to be coming for women in science and in academia. With each new generation of aspiring scientists, the workplace can be shaped in favour of those who have yet to be heard. If Fiona M. Watt is right, then the next decades will hopefully bring a lasting change.

2.2 THE HISTORIOGRAPHY OF WOMEN IN SCIENCE

I have so far shown *what* we know of the role of women in science. But there is reason to doubt that this can feasibly be all we know. History as an empirical and value-neutral science is only a construct of the past centuries and as such needs critical deconstruction. The same goes for our supposed knowledge of women's participation in science. This section is dedicated to explaining *why* we know what we supposedly know about the contribution of women in science and how our common conception of history as reliable needs to be re-evaluated.

In this context, I use the terms of women historians and feminist historians interchangeably. Different scholars refer to themselves as either feminist historians or women historians, yet they all work on establishing women in the historical narrative, which allows for this synonymous use. In a similar vein, I have chosen to use historian and historiographer synonymously because their professions are very closely related and sometimes difficult to separate. History and historiography are interlinked disciplines and relate to connected processes: history is the product of historiography, and as such compromises the writing and studying of history and the methods that are used. Historians and historiographers therefore work in different aspects of the same field.

2.2.1 HISTORY AS A NARRATIVE

2.2.1.1 HISTORY AS A RHETORICAL ART

One tends to take history as a collection of certain facts. History has established itself as a value-neutral science that favours empirical methods and is not connected to the fabrication and fiction that is common in literature. But this clear distinction between history as fact and literature as fiction is a phenomenon of the past three hundred years and has in recent decades been called into question.

In Antiquity, there was no such distinction between history and literature. Both counted as rhetorical arts and history was a part of literature as a whole (Carignan 397). Telling a good story needed rhetorical skills to fashion a cohesive narrative, in literature as in history: both served "some (political) purpose and [were] composed according to the rhetorical techniques of *divisio*, *narratio*, etc." (Korhonen "General" 9; emphasis in original). Narrative style and presentation were key to successful rhetorical performance

in historical and literary storytelling (Carignan 398). In contrast to our modern understanding, history did not even need to refer to the past but was rather focussed on mythic tales of contemporary figures. Without proper means to set dates on events, history was less concerned with specificity and empirical methods (Korhonen "General" 9; Gallop 422). Subsuming them as rhetorical arts, Aristotle made one distinction between history and literature. History, he argued, dealt with the particular, the real-life incidents that actually happen and can serve as case studies. In contrast, literature, or poetry as Aristotle calls it, deals with the universal, the possible and overarching themes of life. Where history tells the story of the achievements of a particular human being, poetry is able to detail the universality of this person's experience on a larger scale. History and poetry are two sides of the same coin and only differ in their separate approaches to one and the same thing (White "Historical" 25).

This classification of history as a rhetorical art continued for centuries up until the early Victorian period. Romantic historiographers of the early 19th century still wrote history in the style of narrative literature. The Victorian concept of historical accountability had less to do with factuality and more with conforming with pre-existing interpretations of history. 19th century authors such as George Eliot saw historical fiction as a means to experiment with history, as she did in her famous novel *Middlemarch* (Carignan 397-400). But the success of the scientific methods of empiricism and objectivity in the natural sciences meant that all academic disciplines now felt the need to adhere to those scientific standards. In the mid to late 19th century, historiography distanced itself from its literary roots and started to adopt more empirical methods (Korhonen "General" 10). Critics felt that literature could no longer be trusted to deal with historical events and claim that its versions held authority. Historians now argued that their version of the past was the only version that counted and could be conceived as true because of their newly improved techniques of neutrality and objectivity (Munslow 4; Korhonen "General" 10). By separating themselves from their fellow humanities, historians liberated themselves from the label of literary speech that would from now on be viewed as the opposite of fact and accountability (White "Historical" 25). The ideological split was soon followed by an actual split in the institutions and their teaching. By the late 19th century, history had been separated from the faculties of the social sciences at Cambridge, Oxford, and other universities (Carignan 396). A key figure in this quest for neutral and fact-based methods to present the actual past was the German historian Leopold von Ranke. His famous diction "wie

es eigentlich gewesen ist", meaning how it actually was, became the leitmotif of this new empirical approach to historiography. The movement initiated and guided by von Ranke has turned its focus on a historiography that is committed to finding the truth in the past by use of scientific methods. Von Ranke highlighted the importance of primary sources as a key to understanding the past and portraying it as faithfully and truthfully as possible (Korhonen "General" 10; Kuukkanen 342).

This categorisation of history as an empirical, factual science has continued in the 20th century during which history was initially treated as part of the value-neutral, objective sciences. But by the second half of the 20th century, the narrative turn would move history away from Rankean philosophy and back towards its origins in the rhetorical arts.

2.2.1.2 THE NARRATIVE TURN

The narrative turn occurred during the second half of the 20th century and conceived of narration as a transdisciplinary concept that could be applied outside of literary theory as well. Narration was no longer confined just to the arts but became a principle human action to understand the world we live in by placing events into a temporal and causal structure. Narrative techniques were now detected and analysed in other social sciences such as sociology and philosophy or even in neighbouring disciplines such as medicine, law, and in the natural sciences (Heinen 1; Fahrenwald 82). The literary theory of narration had been successfully "dislodged from its original academic home in the humanities" and "[i]n the last decade[s], narrative has become a significant focus of inquiry in virtually all disciplinary formations" (Kreiswirth 378). In the case of history, this means that one might need to regard history as more than epistemic and additionally focus on its aesthetic and moral implications (Kuukkanen 359).

Several scholars have contributed to the re-evaluation of historiography and history in the wake of the narrative turn. Not all can be named and discussed, but Hayden White deserves special attention. In 1973, White published his ground-breaking monograph *Metahistory* that would shake the foundations of historiographical practice. White's approach was simple: he revisited the historiography of the 19th century, when the field had been in its golden age and had started to identify itself as an empirical science. White doubts that von Ranke has been interpreted correctly and argues that the ensuing re-organisation of historiography had not been what von Ranke had intended. White claims that von Ranke was more concerned with a realistic depiction of the past,

not just one single and empirically proven truthful past (White, *Metahistory* 164). On the basis of other critics such as Northrop Frye, White then continues to retrace the epic and narrative tropes that both literature and historiography have used. While White accepts and uphold the distinction of fiction and fact, he nevertheless argues that both come into play in historiography:

> In this theory I treat the historical work as what it most manifestly is: a verbal structure in the form of a narrative prose discourse. Histories (and philosophies of history as well) combine a certain amount of 'data', theoretical concepts for 'explaining' these data, and a narrative structure for their presentation as an icon of sets of events presumed to have occurred in the past.
>
> (White *Metahistory* ix)

He questions the strict separation of literary style, such as narration, and history and identifies certain tropes and narrative techniques that historiography has employed ever since its inception (Korhonen "General" 12-14).

The exact tropes that White identified are not necessary for this dissertation as I prefer to focus on the implication that White's argument holds for the entire practice of historiography. He destructed the founding myth of neutrality and factuality that historiography had been built upon as a field of study in the 19th century. White argues that "historical consciousness in general was predetermined by certain linguistic structures" and that the modes employed by literature and historiography were more closely related than thought before (Korhonen "General" 11-12). White did not wish to simplify the work of historians by sorting them into basic categories. He rather wanted to liberate them from the confines of their self-imposed neutrality and allow them to return to their rhetorical origins: "Life in itself is merely a sequence of events without any narrative structure of its own. Narratives are made afterwards" (Korhonen "General" 13). If historians use certain tropes to catalogue historical facts and shape them into historical narratives, then the usage of these tropes and styles will show that they had a narrative preconceived that they are imposing on these facts (Korhonen "General" 12-13).

Others, such as the philosopher Jean Paul Gustave Ricœur and the historian Frank Ankersmit, sided with White's line of argument. Ankersmit argued that it was the

historians who fashioned narratives and unity in historical events when previously there were none, and that our conception of past eras as cohesive entities, such as the Cold War, are entirely made by historians. It is not the Cold War because the people living between the end of World War II and the fall of the Soviet Union referred to their own time as such; it is the Cold War because historians have retrospectively categorised the events in these 40 years as a cumulative narrative, even if the term has been used beforehand (Kuukkanen 342). The past exists meaningfully in the way it is written about (Munslow 9). The narrative structure that historians give to the separate events of the past creates a new whole, a solid unit that links these single events meaningfully. The coherent narrative structures can then be used to reveal how we, in the present, see and evaluate the past from our current point of view (Ankersmit 38). Ricœur agreed with White but was more concerned with the present's relationship to time and the past. Narratives help us to understand the past and make sense of it, he claimed. Ricœur „sees both history and fiction as crucial for our relation to the question of time, and thus he sees narrative poetics as a necessary supplement for phenomenological analysis of temporality" (Korhonen "General" 17).

However, the narrative turn was not left uncriticised. Many historians outright rejected the conflation of history and fiction. They still considered themselves positivist and empirical scientists who rejected using narration in their work. They argued that by undermining their claim to professionalism, as White did, the scientific nature of their entire field might be compromised (Musschoot 144). New Empiricism has developed as a sort of counter-movement that focuses on the reliability and neutrality of facts that lend historiography its credibility and authority over literature (Munslow 8). If historiography were to lose its basis in the reliability of facts, then its position as a serious science would be endangered. But, as stated above, White's main concern is not the destabilisation of history as a field of study. By reminding the professionals of their field's background in literary theory, he argues for a liberation and more open-mindedness of the profession (Korhonen "General" 13).

2.2.1.3 The Uncertainty of Historical Knowledge

In White's new approach to historiography as a narrative, historians themselves function as the narrators of history. What historians do is glean elements from historical source material in the form of events and then chronologically order them and transform them into a story (Martínez and Scheffel 176). Historians may think of themselves as simple

witnesses and chronologists of the past but they are, in fact, purposeful interpreters (Jordanova 11). Similar to authors of fiction, historians have to make choices usually attributed to narrative literature: who speaks and gets to speak, who hears and gets to be heard, the chronological order of events, and the emplotment of single events into a coherent narrative, to name only a few. And even though historians certainly use factual sources to frame their narrative, they nevertheless only select certain facts and then mould them to fit their preconceived narrative. The final result, that is the final version of the past, is always influenced by the choices the historian has made along the way (Munslow 4-5, 62-63). Our image of the past has been narrated to us and the resulting product of this narration is a result of deliberate choices the historian had to make along the way (Kuukkanen 343).

In their work as collectors and interpreters of history, historians also have to deal with the sources that have been left by previous generations. The ambiguity of historical sources presents another problem in the attribution of reliability to historiography. Historian Ludmilla Jordanova has successfully shed light on the difficulties historians face when dealing with sources in her recent monograph *History in Practice*, published in 2019. Historians usually distinguish between two kinds of sources: primary sources, which are taken to be unmediated and raw, and secondary sources, which are records of primary sources that may have been altered since their genesis or even been tampered with. But Jordanova warns that this distinction is not as clear as it seems. Some terms that are used to describe artefacts already indicate that sources are rarely treated as value-free and reveal preconceived notions: "To call something 'evidence' implies that the case for its relevance has been made – evidence bears witness to an issue" (128). The term "document" even signifies a certain kind of factuality. Relaying this kind of trust to a source, to declare it a certain evidence, also tells something about the ambitions and intentions of the historian who coins the term. But historians can be wrong in their assessment of the sources they use. To judge whether a source has remained untouched and unaltered is a very difficult feat, even for skilled historians, as Jordanova emphasises:

> All scrupulous historians realise that evidence may be deceptive and endeavour to incorporate appropriate forms of awareness into their practices. The strength of historical arguments will depend on the available

> evidence – its nature, quality and quantity – as well as on the skills of the historian.
>
> (127)

This applies to all kinds of sources available to historians. Personal accounts, taken as primary sources, are always influenced by the affected person who shares their impressions and are not a neutral analysis of a historical event. Photographs are not candid snapshots in time but are often staged and can be changed or cropped in the aftermath of development. And even official records, which are taken as the peak of reliability, pass through many different hands and in that process can be changed irrevocably. Additionally, historians cannot be expected to have read every single source on a specific historical event, both because their research would never end and also because some sources may have been lost in time. Some records might not even have been saved at all, which can also be an indicator of the value that was placed on certain knowledge in the past. The same goes for oral history and the knowledge it has carried through generations. This knowledge may have never been written down and therefore could potentially also be lost (Jordanova 127-134).

It is not only the difficult access to sources that can complicate a historian's work. Available sources have maybe not been altered, but even in their unaltered state they have been conceived of under certain political and ideological circumstances. Objectivity is usually unattainable, neither in the source's pure state nor in its interpretation after the fact. Especially secondary sources need to be critically evaluated in the context of the time, country, and political climate they were generated in. Each source has been made for the specific readership of its time and has been employed in the identity formation of countries, societies, or governments (Jordanova 10, 124, 134). Historian Judith Zinsser warns that historical archives and historical knowledge are key identifiers for countries and may therefore very well be deliberately exclusive of some stories: "For history represents a people's, a society's, a culture's way of remembering itself. […] The recorded is saved, and conversely, the unrecorded is lost" (quoted in Hendricks 361). The glorious moments are preserved for later generations to enjoy and be proud of. Practices and events that either would shed a bad light on the past or that were simply not perceived as important were purposefully forgotten, not always with bad intention but sometimes simply out of habit.

This leaves us with a new appreciation of history: what we have so far regarded as certain historical knowledge is, in fact, quite uncertain. This does not mean that historiography and history have no claim to reveal some truth in what they present. It only means that we need to critically evaluate and put into context what is presented to us as empirical historiography. It is simply one possible version, one particular version, to refer back to Aristotle, of what the past may have been like. The French bon mot "L'histoire n'est qu'une fable convenue" captures this quite perfectly: history is but a story that has been agreed upon and can change with every new generation of interpreters. Different historians will interpret the same sources in different manners, meaning that there cannot possibly be one final true version of past events (Hentschel 212). It always depends on the historians who fashions the narrative out of the single events. The knowledge that we have gleaned from history has always been constructed by the narrative and discursive actions of historians (Munslow 4). History obviously has its justification as a science and as a means of recording and depicting the past; one just has to be careful in taking its version as the single definitive truth.

2.2.2 FEMINIST HISTORY AND HISTORIOGRAPHY

When browsing historical archives or educational resources such as textbooks for history classes, one cannot fail to notice that history, apparently, has only ever been shaped by men. The important people we learn about at school are men who have preceded us and have altered the course of history in lasting ways. Male conquerors, statesmen, male scientists, male philosophers – history is full of great men and curiously devoid of great women, save for a few that deviated from the societal norm of their sex. But, as I have established beforehand: if historiography is not as certain as thought before, then it is only natural to ask who has been left out of it and, more importantly, why. Feminist history has sought to re-establish the forgotten women in history and as such has had many decades of practice to question the master narrative of androcentric history.

2.2.2.1 EARLY FEMINIST HISTORIANS

History and historiography have been established as a subject at universities in the late 19th and early 20th century with a focus on social and economic history in particular.

The late 19th century until the late 20th century marked the peak of the historiographical practice. But, similar to the establishment of the natural sciences at universities, the professionalisation of historiography also meant its further masculinisation. Women had practiced historiography beforehand, as they had also practiced science, but they were still excluded from the prestigious locations where history was now situated. The new historiography, led by men, focussed on male concerns and male policies (Downs 9-11). For a long time, women were invisible in the practice of historiography. The male standard of the historian made it difficult for women to join their ranks. And even if they ascended in the historiographical hierarchies, greater value was still given to male authors, who had the privilege of the authoritative voice. If men were the standard, then men would define the practice and be the norm against which women historians would have to be measured (Alberti 1, 5; Kessel 225-230).

Women only entered professional historiography at a much later point in time using different paths in their careers. One way to secure a place in the higher positions of historiography for women was to cater to the political motivation of historiography. This usually meant submission to a male-centred standard once again. Another was to focus on subdisciplines that were more at the margin, in order to not present too much competition to male colleagues by occupying fields that are often overlooked and not nearly as authoritative. Or women could use the power of amateur historiography outside of academia to share unheard histories with a broader public, which could be the most successful tactic. Guidelines in the amateur field of historiography were much more liberal and allowed for women historians to tell stories that would go unnoticed in a more professional setting. Additionally, the general public provided a much larger audience than the academic field and therefore the stories revealed would garner more attention (Epple and Schaser "Multiple" 12; Kessel 229). A first challenge for feminist historians was to retrace the women that had been forgotten by traditional historiography in order to undermine the androcentric assumption that only men mattered in the historical debates. This proved a difficult situation for early feminist historiographers, to prove the male standard of historiography wrong and to simultaneously be taken seriously by male colleagues. But women's position in history was not fixed and needed to be treated accordingly (Alberti 3-6; Hendricks 362; Lerner "Placing" 5-6).

In these early days of their practice, women historians had to find a balance between portraying their subjects outside of the limited categories of the daunting trail-

blazers and the helpless victims. In the first decades of writing on women in history, many historians resorted to two stereotypical portrayals: in the first, they only measured women's contribution by a male standard. In what Gerda Lerner, one of the founding scholars of women's history, called contribution history, women's contributions were limited to the male standard and were defined accordingly, thereby supporting the male standard of importance once again. Contribution history may be a starting point to retrace forgotten women but it has its limitations and needs to be treated as such (Lerner "Placing" 6-9). The second stereotypical portrayal meant focusing too much on the exceptional women and left out non-elite women's experiences. This narrative of single great women tends to ignore the way that their contributions have changed the lives of other women outside of the privileged elite. Lerner uses several examples to highlight this one-sided focus, one of them especially poignant: she argues that only focusing on the exceptionality of the founder of the birth control movement, Margaret Sanger, ignores how her work has changed the lives and self-perception of many ordinary women who were also key in advancing this movement of sexual self-determination. It is not just single great women who change the society they live in but also the majority of women living in that society who carry the changes into everyday life (Lerner "Placing" 6-9). This focus on exceptionality also can lead to a Whig portrayal of history, meaning that history is portrayed as a continuing battle of progressive liberals against conservatism in the fight for human rights (Mayr 301; Alberti 9). But, as was discussed at the beginning of this chapter, history is never a straight line of individual advancements and historiography needs to mirror that.

2.2.2.2 After the Second Wave of Feminism

The second wave of feminism changed the situation of many women, among them the situation of women historiographers. After the first wave in the late 19th and early 20th century had secured women the right to vote and the access to higher education, the second wave now moved alongside the growing Civil Rights Movement, Gay Rights Movement and anti-war protests that shaped the society of Western countries. Feminism profited from the heightened political awareness. During the late 1960s and 1970s historiography received fresh attention to retrace the forgotten stories of women and their contributions to virtually all fields of life (Downs 20-21). The question was also raised why male authors wrote histories about men without considering their gender and the resulting advantages they had received. A demand for an overturn of the all-

encompassing narrative of history came in tie with the linguistic and narrative turns that took place at about the same point in time as the focus on women's history expanded in the 1970s (Epple and Schaser "Multiple" 8-10; Kessel 226). It soon became clear that the concept of focusing on women's history would not be enough and in the 1980s, the term gender history[8] was established in its stead. The goal was to expand the discussion in order to include the concepts of sex and gender as social constructs, which concerned more than just women's history. Gender dynamics were now in the focus of the discipline, instead of just women's situations (Epple and Schaser "Multiple" 8; Fox Keller 245).

The aims of feminist history were quickly stated and fairly simple: "[W]hat would history be like if it were seen through the eyes of women and ordered by values they define?" (Lerner "Majority" 162). Women historians wished to point out the limitations that traditional historiography had been subject to so far, which had led to women not being remembered and now needing recovery from the archives of history. Several assumptions that had so far guided the practice of historiography were questioned, such as why certain figures, namely women, had been left out. Questions were raised as to what they had done to deserve such exclusion or what may warrant their renewed inclusion in history (Lerner "Majority" 169-180). The status of forgotten women's reputation and their lost knowledge needed to be remembered in order for them to be included in a new narrative of history. Traditional sources and especially the evaluation of these sources was now examined as they had so far only concerned male agents in history. Many sources that had covered the work of women were destroyed, sometimes purposefully, sometimes accidently, and the lack of sources made the work of feminist historians much harder (Guglielmo 4-5). Women historians needed their own set of tools and methods to write history that was more inclusive than the narrative that had already been written. Even the historical periodisation was catering to the situation of men, as Joan Kelly famously uncovered in her previously discussed essay on women during the Renaissance (Kelly 19).

Feminist history in its early years was not without flaws. The most prevailing criticism of early feminist history, and the one that has concerned feminists up until today, was the call for a more inclusive approach. The treatment of women as a minority

[8] As the focus of my thesis lies primarily in women in history and not on gender dynamics in general, I will continue to use the term women's or feminist history for this thesis.

in historiography may be true from a point of view that classifies women as one homogenous group who all share the same experience. But the actual situations of women differed greatly and allowed for no such generalisations. Second-wave feminism was led by White women who experienced a completely different discrimination from that of Women of Colour or of women in lower social classes. Experiences of the women on the margins of society were probably not even saved in historical records and are potentially lost forever (Lerner "Majority" 170; Downs 23; Fara 16). Women are both victims and perpetrators, as chapter 2.1 has shown: women were suffering from discrimination at home during the Enlightenment but also contributed to the exploitation of People of Colour. This places women in both categories at the same time with vastly different experiences across the whole section of women. With the third wave of feminism and the inclusion of theories of intersectionality by scholars such as Kimberlé Crenshaw, newer generations of feminists sought to rectify the faults of the generations that had come before them. Women outside of the White, heteronormative spectrum were now beginning to feel spoken to and spoken about. Women's historian wished to build a network of inclusivity and cooperation instead of the competitiveness and restriction that historiography had signified to them before (Downs 21).

But not just the community of historiography was changed by the arrival of feminist history. Women's history has also questioned the standard narratives and categorisations that have so far been used by historians. As such, feminism has lastingly shaped the practice of history and historiography by "creat[ing] knowledge that challenges what we take for granted to be true and factual" (Wyer et al. 2). Women's history has changed the basic founding principles of historiography to be more inclusive and open to broader analysis.

2.2.2.3 An Explanation for Women's Absence

As a result of their work, women historians identified several factors that contributed to the exclusion of women's lives from the canonical historical archives. Historical agency and the ensuing mentioning in the annals of history were seen as a privilege of an elite minority. With the beginning of the Enlightenment, history constructed a Eurocentric image that distinctly differs from that of the pre-modern times. Having a history, and especially a history that was worth telling, was a privilege of "civilized" White and Western society, meaning that those societies on the periphery were bound to be left

out. And even in this White and Western society, there were still those whose stories were seen as more important than others. Men were the epitome of history, women were not. Femininity was always tied to the present, without a past or a future, while masculinity was allowed both in a sense of progress and development: "Femininity thus appeared as the negation of history, and masculinity seemed to be exclusively tied to history" (Epple and Schaser "General" 13).

Similar to the natural sciences, historiography became professionalised as well as nationalised for political agendas. This also meant the exclusion of women as professionals at least in higher positions and as the subjects of history. This entailed that historiography became professionalised as well as gendered (Epple and Schaser "General" 11-14). Generally speaking, history and historiography were a male privilege. Women's history was ignored because male values had shaped the practice of historiography and other parts of society and culture for too long. And even the little knowledge that survived and was transmitted into our present needs to be evaluated critically. The sources that are needed to investigate women's history are there but often they have been collected and organised by men for men, making a neutral interpretation nearly impossible (Lerner "Majority" 160, 172-173). This relates back to Ludmilla Jordanova's caution against using sources uncritically. Those who established and ordered the archives that historians are now having access to possibly altered the sources during their work in cataloguing them. Women are measured against a male standard in history, which comes at a major disadvantage: the standards were set by men and are therefore not applicable to women, who are now treated as the other. Women were taught in a male-led value system and were therefore also taught that certain standards would forever be out of their reach simply because of their sex (Lerner "Placing" 5-6). The founding myth of value- and gender-neutrality of historiography becomes especially clear when we try to rephrase the history we have been taught, as Judith Zinsser succinctly shows:

> Women are the separately named category, identified by their sex in ways unnecessary for men. [...] To understand the phenomenon, imagine the following phrases in global narratives: 'the male religious leader Mohammed' in a cross-cultural history of early Islam; 'the male artist Michelangelo' as mentioned in a comparative text on the Italian Renaissance and Ottoman calligraphy; 'Thomas Edison, a male inventor,'

> and 'Mao Zedong, the male leader of the Chinese Communists' in a history of the contemporary world.
>
> (310)

History and historiography have never been value- or gender-free, they have simply always been gendered by a male norm. It is a self-sufficient system; men have been in power and in leading positions for centuries in any practice, in governments, local politics, and sciences. Only recent decades have brought a tentative change and have introduced women to the historiographical practices. But if men are perceived as a standard and the norm, then their voices will remain the authoritative ones that are given more weight. The practices may be questioned now but it will take further decades to abandon the deeply rooted patriarchal structures that have governed the sciences (Kessel 231; Lerner "Placing" 10). The value systems of the past defined who was entered into the annals of history and who was not. Women have not been omitted because of the inherent evilness of men but simply because men have continued to reproduce a system that places value on men's stories since it is them who led that system (Lerner "Majority" 178; Guglielmo 5). And if the past principles have deemed women's stories invaluable, then it will take another couple of decades to fully retrace the lost history of women and to introduce methods that will finally place value on those forgotten stories.

2.2.3 Female Scientists in the History of Science

2.2.3.1 Tracing the History of Science

The re-evaluation of historical knowledge on the basis of the narrative turn as well as the re-appreciation of the forgotten stories of women in history also apply to the sub-genre of the history of science. It is difficult, however, to find a place to start when tracing the history of science as an established field. History of science is a very recent discipline that has not had a long tradition (Christie 5-6). The proper history of science as its own branch of historiography is merely two or three generations old and has not yet fully formed and distinguished itself (Kuukkanen 340).

In Antiquity and in the Middle Ages, the approach to history, and therefore to the history of science, was quite different from what we consider today. The Greek concept of time was different as that there was no real desire to give specific dates to

past events. The introduction of chronological and precise time tracking only came with the solidification of Christianity in Europe. Historians of Antiquity cared more about present history than about what could be gained from studying past development. History of science was only created as a by-product in the conversation of scientists and philosophers who remarked on the work of scientists and produced a sort of meta-commentary that could serve as a historical observation (Kragh 1). What came before was not of consequence to the present or future historians of science in Antiquity. Early history of science was to serve the science and scientists themselves.

Most historians have singled out the Scientific Revolution as the foundation of a retraceable and organised effort of recording the historical advancement of science in an orderly fashion. The Scientific Revolution demarcated an important change in the public perception of science, moving it from the beforehand practised natural philosophy to the inductive and professional methods of science that are still used today. The professionalisation of science also signified the global importance of science for the public and for the entire human history as such. If science was to be taken seriously as a professional field of study, then this would also entail a major influence on the public life and humankind to come (Christie 6). The thinkers of the Scientific Revolution, such as Francis Bacon, were less interested in engaging with what had transpired in the sciences before. Rather, they were concerned with separating their newly founded image of science from previous methods and move it into a new era. Some of the great minds of Antiquity were rejected during the 16th and 17th centuries to make way for the greatness of modern approaches to science. Those new methods were established as the true standard of scientific work and in turn, many historiographical records of Antiquity have been lost (Kragh 3). It is interesting to note that from its inception, the history of science has been influenced by certain philosophical and, in the case of Bacon and others, selfishly motivated agendas (Christie 6, 9). Therefore, it is no surprise that for many centuries, historians of science ignored the scientific work of the Middle Ages and earlier times. This even accounts for the lack of many sources from these times, as they were probably destroyed or not saved. The superimposed narrative of the Scientific Revolution as the founding moment of science had connoted previous centuries' advancement as inferior and not worth remembering (Christie 19-20). History of science was fashioned as a narrative that suited the present historians' needs. Even before actual historical accounts of science were conceived of or even published, there had been deliberate attempts to exclude certain participants from being mentioned.

Women had practised in those fields that were now erased from the history of science, such as sciences outside of official institutions. The Scientific Revolution masculinised science and marginalised women in the actual practice as well as in its neighbouring disciplines. While the historiography of science may not have literally started in the Scientific Revolution, the efforts to erase and reshape the previous centuries of science-making have nonetheless paved a way for future historians of science to follow suit.

Additional groundwork for the history of science can be traced back to the 18th century. The Enlightenment focussed on the abilities of the human mind. The intellect of a human being, so it was claimed, could find its peak in practising science, which in turn would benefit all of humankind through progress (Christie 7-8). The "naïve scientific and social optimism" of the Enlightenment regarded the new science as a marker of European thinking and excellency, freed from clerical constraints of the previous centuries (Kragh 4). In contrast to this optimistic and idealistic approach, the history of science was nevertheless instrumentalised in political agendas. Politicians and nationalist divisions in governments used the history of science to highlight the achievements of a society or an entire nation in order to secure their hegemonic position. Influential historians such as Joseph Priestley painted a picture of science as a progressive field of study that left no room for a critical examination of the past (Kragh 3-5).

In the 19th century, the trend of the history of science being used as a political and ideological tool by those in power continued. In this respect, historiography of science mirrored the development of the sciences themselves. The trend of the history of science being used as a political and ideological tool by those in power continued. Where sciences started to distinguish one another in terms of sub-disciplines and specialised areas, historiography of science also started to incorporate the different disciplines as their own (Christie 11). Scientists would also include a historical overview over their own respective field and embed their own research into this context. This was usually a tool for self-advertising and to compare oneself with the great minds that came before, less in a historiographical and more in a self-promoting way: "Scientific history as it used to be written by scientists served the tribe of scientists much as the hero-myths serve any other human tribe" (John R.G. Turner 24). William Whewell, the scientific practitioner who also was the first to use the term scientist as opposed to natural philosopher, published one of the first monographs on the history of science. His work *History of the Inductive Sciences* from 1837 was a narratively

complex and thorough overview of the past centuries' important advancements of the individual sciences. But Whewell also relied on the depiction of scientific growth as being smooth and in a steady progress (Christie, 13-14). By the end of the 19th century, history had started to reject the methods of the humanities in favour of methods of the natural sciences in order to distinguish itself as a respectable and value-neutral profession. The history of science followed suit (Kragh 14).

Further construction of a super-imposed narrative came with the 20th century. What I have so far referred to as the Scientific Revolution has been defined by the historians of science of the 1940s. The historian Alexandre Koyré introduced the term in 1939 and others then employed it as well (Shapin 2). Yet scholars have recently started to deconstruct this monolithic concept of the Scientific Revolution as one coherent, unified movement. The scientists of the Scientific Revolution have been retrospectively framed as the majority when they were, in fact, a minority in their profession. The move from pre-modern to modern science was not just a moment in time but a continuous change that took longer than had previously been claimed by historians (Shapin 6-7). Scholars such as Steven Shapin or Betty Jo Teeter Dobbs have criticised this uniform approach to the history of science. It bears a contemporary view on a past that distorts what was the actual experience of most of the people living during the Scientific Revolution (Osler "Canonical" 4). Shapin reminds his readers in his monograph *The Scientific Revolution* in 2004 that

> the overwhelming majority of seventeenth-century people did not live in Europe, did not know that they lived in the 'seventeenth century', and were not aware that a Scientific Revolution was happening. The half of the European population that was female was in a position to participate in scientific culture scarcely at all, as was that overwhelming majority – of men and women – who were illiterate or otherwise disqualified from entering the venues of formal learning.
>
> (8)

The 20th century also brought a further professionalization of the historiography of science with people now specialising in this line of work. Nevertheless, a clear career path was still not available for potential historians of science. Many of them came from other disciplines, such as general historiography, or were former scientists, who then

ventured into the more specialised field of history of science (Christie 16). Additionally, as the professional side of historiography grew, the mistakes that had been made since its preconception in the Scientific Revolution were identified. The contribution of the Middle Ages to the foundation of modern science was now recognised after it had been ignored since the Scientific Revolution. Rediscovered sources documenting the scientific conducts of the centuries prior to the Scientific Revolution allowed for a broadened scope. The history of science was now appreciated for its educational value as well (Kragh 17; Christie 19-20). First attempts at correcting the narrative of the history of science were made.

2.2.3.2 WOMEN IN THE HISTORY OF SCIENCE

The history of science depicted so far has focussed on progressiveness and the celebration of singular great men with little to no space for singular great women, let alone the majority of women's experiences (Hooker 508). This focus on individual contributors also meant that "[t]he more we have come to know about such much-researched figures as Newton and Darwin, the smaller has become the number of alternative interpretations that the historian can plausibly offer" (Olby "Introduction" xxii). A history that is once accepted as the canonical truth is difficult to rewrite and early history of science of the 20th century showed no intention to include the work that women had done in science. In later decades, historical work on women in science could be found but usually outside of the mainstream historiographical practice. With the inclusion of women into the historiographical profession after the second wave of feminism, the history of women in science was now investigated. Early American and European feminist historians started to trace the obstacles that women had had to overcome to participate in science and how these obstacles might also have contributed to their absence from historical accounts. Efforts were made to retrace the work of women in science that had been forgotten or overlooked by previous historians (Schiebinger *Feminism* 21-24). The ratio of men to women in history of science markedly increased after the 1970s, due to second-wave feminism but also thanks to the renewed interest in science in the 1970s and the implementation and expansion of the history of science at universities. As of 2010, the ratio of men to women in history of science is not yet evened out but the influence of women in this field of study continues to grow, in congruence with the increasing number of women who are venturing into sciences but who have not yet caught up with men (Hooker 509). The new critical

science studies, brought about by influential publications such as Thomas Kuhn's *The Structure of the Scientific Revolutions* from 1962, helped the history of science to develop into a field of its own. In the late 1980s and 1990s, women's contributions to science were tentatively unearthed. Previously unknown information about women's work in science, such as their influence on scientific culture in the private salons of the 19th century, were rediscovered. Since the 1970s, women entered the practice of history of science and chose to rewrite history from the marginalised point of view in order to expose the hidden power structures that have so far kept women out of the historical records of science (Hooker 508-514).

Women historians of science and feminists shared their common criticism of science. Male dominance of scientific practice had long meant the exclusion of women from science, causing an invisibility of female matters both as conductors of research as well as of female research subjects. In turn, the findings of science had long only benefited men, not women (Kourany "Introduction" 1). The male-coded founding of modern science had demonised the female practices of pre-modern sciences and had thereby deliberately excluded women from the history of science. Additionally, fields that have traditionally been in the hands of female practitioners, such as midwifery, biology, and physiology, have always enjoyed less attention from historians of science because of their female dominance. Women historians of science reclaimed women in the history of science via biographies, records about women who had been overlooked by prestigious prizes such as the Nobel Prize, and by exposing the institutional barriers that women had had to overcome. They also examined the way that science has supported patriarchal structures, White capitalism and colonialism across the globe, spreading its detrimental practices of exclusion farther than just in Western science (Hooker 511-513; Wyer et al. 6-7). Historians of science had so far purposefully ignored women's work in pre-modern science and their vital contributions to its foundation, simply because they had deemed their practice less important than that of their male contemporaries: "[T]he serious steps taken at the time to formalise scientific activity excluded women from these new circles of power and had a serious and deleterious impact on women's future involvement in science" (Frize et al. 59-60).

2.3 SUMMARY

Women have always participated in the scientific practice. From their equal position next to men in prehistoric times and their influential work in early Egypt, they were soon marginalised because of the influence of philosophers like Aristotle who considered women less capable than men. During the Middle Ages, women found their safe spaces to conduct science in convents and their private homes or as practitioners of early medicine and midwifery. But the foundation of universities, the establishment of Christian traditions, and the ensuing closure of convents under the rule of male-led monasteries once again diminished the access that women had to education and therefore to practising science. The Renaissance and the Scientific Revolution demarcated a step from pre-modern to modern inductive sciences as well as the establishment of the first organised political systems. Both did not benefit women, as they lost their hold on practising science in their private spheres and still had no access to political power. The professionalization of science excluded women from the public spheres where science was now being practised. They found their niche in the amateur sciences, as popularisers and benefactresses or as assistants to their male relatives and husbands who were now working as professional scientists. Philosophers of the Enlightenment continued to demean the qualities of women and kept them inferior to men in the societal hierarchy. In the 19th century, an educational reform signified the first real change for women's access to education, allowing them to now receive a primary and secondary education similar to that of boys of their age. This was, however, only applicable to middle- or upper-class women; lower- and working-class children were still tied to their standing and often needed to drop out of school early to work instead of continuing their secondary education. By the end of the 19th and the beginning of the 20th century, the first wave of the feminist movement secured women the right to vote and signalled an upcoming change. During the two World Wars in the 20th century, women had the chance to prove their capabilities as scientists: they filled the vacated jobs left by men required at the front and supported the much-needed scientific discoveries for modern warfare. But a rise of conservatism after the Second World War sent women back to the private sphere. The subsequent waves of feminism have worked to abolish the structures that have so far held women back on their way into scientific careers. Only in recent decades have women started to catch up to men in

the fields of science, technology, engineering, and mathematics. The increasing percentages of women in these careers are a hopeful signal for change.

While women started to reappear as practising scientists in the history of science that I have presented in the first half of this chapter, there are still too few women represented. I have outlined several factors that account for the lack of women compared to men in the history of science. First, history has only in recent centuries staked its claim on being a value-neutral and empirical science while its origins lie in the rhetorical art. However, history needs to be appreciated as a narrative act in order to realise that history cannot possibly give a true portrayal of the past but only one possible interpretation constructed in hindsight. This interpretation of history might even be compromised by political agendas and dominant discourses which is why the omission of women as a less important political agent may come as no surprise. What is known so far is not all that can be known. Second, historiography has for the longest time been a male profession, meaning that women were not only excluded from practising but also from being covered by it. Records of women were either destroyed or ignored because they were deemed unimportant in the grand scheme of historiography. This system sustains itself. Men are the ones who write history and are therefore also the ones who are deemed worthy of being written about. Only in the past couple of decades have women historians unearthed the forgotten records of women. But they are still years behind the historical research that has been conducted on men and therefore women cannot be represented fully in such a short span of time. Third, from the inception of history of science as a discipline, it was used as a political and ideological tool. There was no space for portraying those that did not fit the constructed narrative of the progressive modern science after the Scientific Revolution. Feminist historians of science have worked on the retrieval of the forgotten women of science and have defended their work against patriarchal practises of their colleagues. Just because women have not been noticed as major players in the advancement of the modern sciences so far does not mean that they have not been part of it. As Meredith Ray prefaces her monograph on women's work in the scientific world of the early modern era:

> Not all women who practiced science left a written record, not all women who wrote about science practiced it in a hands-on way. […] It is not

> women who are missing from the picture: it is our lens that must be adjusted to perceive them.
>
> (3-4)

The metaphorical lens that has been used so far to shine a light on women in science was simply never meant to capture all of women's contributions. The work of feminist historians of science has already uncovered a lot of lost material but still has a long way to go. There is hope that with a couple of additional decades of research, the real role of women in the scientific practice across the centuries can finally be appreciated.

3 NARRATOLOGY AND GENDER IN THE DRAMATIC TEXT

3.1 INTRODUCTION TO NARRATOLOGY[9]

The question of course now arises why this dissertation needs a lengthy introduction to narratology. While this section may seem long-winded, it serves an important purpose: anyone who has ever studied literature and has delved into the topic of narratology will immediately associate narratological analysis with epic texts and prose, namely novels, short stories, etc. My own personal experiences when sharing my dissertation topic certainly have confirmed this impression. Many fellow scholars were sceptical about using narratology on dramatic texts. Narratology is seen as a study designated for one kind of literature only, meaning texts that are traditionally narrated by a distinctive narrative instance that mediates the text. For a long time, films, graphic novels, or, as will be the case for this dissertation, dramatic texts were perceived as unmediated and therefore contained no narrative instance and were not considered narrative media. What this first section will show, however, is that the early roots of narratology were not limited to prose texts to begin with. In the course of the development of narratology from its beginnings in Formalism to its prime in Structuralism and Classical Narratology of the 1970s/1980s, the original transmedial canon of narratology has been abandoned in favour of focussing on one kind of medium only. After the narrative turn, recent trends in narrative studies have moved narratology back to its original transmedial roots and the poststructuralist and postclassical narratology has finally once again opened the gates of narrative study to more than one form of literature.

Since the focus of my analysis will be that of gender and its relation to narratological devices, this section will also include the development of narratology from a text-centred to a context-centred school of thought. Focussing on the individual theories

[9] There is an ongoing discussion on how to properly name the method and criticism that I am describing here. The term *narrative studies* is usually taken as the encompassing umbrella-term for any school of thought that includes narrative theory, with *narratology* being specifically reserved for literary analysis only. Other scholars, such as, for example, Monika Fludernik, have chosen to use the terms interchangeably. Since the narrative turn (see 3.1.2.), narrative theory has been employed outside of literary criticism as well, which, in my opinion, requires a distinction between narrative studies and narratology. It is for this reason that I am referring to the method I am using as narratology, e.g. the narrative analysis of literary media. My thanks go out to the participants of the Summer Institute of Narrative Studies in 2021 in Aarhus, Denmark, for inspiring this discussion.

that have formed our contemporary understanding of narratology will also allow for a closer inspection of the development that narrative studies have gone through. Only if we understand the contributing factors that led to the formation of narrative theory, can we comprehend why a postclassical narratology needs to feature the context and the production of the text. Early concepts of narratology suffered from a separation of theory and practice. One must ask what Classical narratological terms can contribute to an analysis of literature when they do not lead to a pivotal new reading of the text.

In order to reappraise drama as a narrative, a concrete definition of narration is needed, which many scholars have tried to come up with. Some of these definitions purposefully exclude drama, such as the one provided by Chris Baldick in his *Oxford Dictionary of Literary Terms*, in which a narrative is defined as a "telling of some true or fictitious event or connected sequence of events […], to be distinguished from descriptions of qualities, states or situations and also from dramatic enactments of events (although a dramatic work may also include narrative speeches)" (Baldick "narrative"). Baldick does give a caveat that drama could possibly include narrative elements but appears to consider narrative and drama as inconclusive. This view disregards the long history of narratology and narrative studies and its transmedial roots and contemporary aims. A definition of narrative must free itself from such restraints of genre in general. Peter Hühn and Roy Sommer have offered a succinct description of narration as a "communicative act in which a chain of happenings is meaningfully structured and transmitted in a particular medium and from a particular point of view […], a representation of a chain of happenings in a medium by a mediating agent" (Hühn and Sommer 228-229). Ansgar Nünning and Roy Sommer have even argued that the narrow concept of a narrative that is based on mediacy as the deciding factor alone might be abolished in favour of a wider concept of narratives in which a temporal plot organisation in a text suffices to count as such (Nünning and Sommer 106). While I appreciate the more open definition of narrative that the latter one gives, I will settle on the one provided by Hühn and Sommer for the remainder of this thesis since it is more suited to a textual analysis such as the one I am conducting.

3.1.1 FROM FORMALISM TO CLASSICAL NARRATOLOGY

What is referred to as narratology today is based on several theories and methods that have overlapped in their time frames. One of the oldest ones is the literary theory of Russian Formalism. While the general concept of Formalism is older, the here discussed Russian Formalism was a school of thought in the early 20th century, with scholars placing the beginning during the First World War between 1914 to 1916, its peak in the 1920s and its definite end in 1929 with the advance of Stalinism (Gorman 37, Schulenberg 181). In its pure form, Formalism "can be viewed as the desire to abstract the formal components, aspects, or patterns of the work from any semantic content" (Margolin 181). This means that, contrary to what the name may suggest, the Russian Formalists were not concerned with the form, as in the aesthetic and style of literature, but with the functions that could be derived from it. This precedes the focus of Classical narratology on form over aesthetic. Formalism came as a response to contemporary subjective analysis of literary texts. Its aim was to objectively reduce literary texts to simple verbal units, regardless of their aesthetic value, and to then look for the overarching, dominating function in the organization of the text that orders these verbal units (Gorman 37-41). In fact, the literariness of their objects of study was not their concern (Erlich 173). In contrast to contemporary postclassical narratology, Russian Formalism aimed to look at literature devoid of its production and context. Contextual factors of literature, such as history, biography or society, were not taken into consideration. The literary text itself was to be looked at, to be described rather than to be interpreted, making Formalism an early forerunner of the text-centred focus that narratology would continue to assume (Gorman 38-39, Schulenberg 182).

Similar to how Structuralism would later use the ideas of Swiss linguist Ferdinand de Saussure, the Formalists took the linguistic concept of morphology and applied it to the study of narratives. This morphological concept claimed that a construct, in this case the narrative, is composed of many individual smaller parts that could be studied more closely (D. Herman "Histories" 23). The meter of a poem, for example, could be used as a smaller unit of the poem at large and could be analysed in the structure of the poem (Gorman 41). These unchangeable smallest units of the form are what needed to be looked at in order to understand how a narrative is constructed (Margolin 180). The focus is placed on theory instead of practice. Leaning on folklorists and linguists, Formalists aimed to describe the general nature of literature and to find overarching categories.

Similar to Saussurean linguistics, early narratologists "privileged the study of narrative in general over the interpretation of individual narratives" (D. Herman *Basic* 28). The wish was to establish literary criticism as its own branch of science, as Gorman puts it, in the sense of the German denotation of *Wissenschaft*, meaning science, as opposed to *Naturwissenschaft*, signifying natural science (40). Literary theory ought to be a subject of its own, with literature being analysed not as a subgenre of other, already existing sciences but in its own scientific study (Gorman 41-42). This trend would later, in the time of structuralist narratology, be continued by Structuralist literary critic Tzvetan Todorov, who translated Russian Formalists works into French, and coined the term "narratology", or *narratologie* in French, as the science of narratives, in the style of other sciences such as biology or sociology (D. Herman "Histories" 19; D. Herman, "Structuralist" 571). Even in these early beginnings of narratology, there was already a nascent idea to extend the study of narratives beyond prose in its entirety. In Formalism, different media such as folklore and poetry as well as prose were already analysed alongside each other, laying the foundation for the contemporary concepts of transmedial narratology (D. Herman *Basic* 24).

The next contributing theory to narratology that will be discussed is that of Structuralism. Similar to Formalism, Structuralism also aims to look at literature devoid of its social and cultural context (Gymnich "Gender" 705) and draws on linguistic methods to classify narratives as a system (Fludernik "Histories", 38). Moving on from Russian Formalism, Structuralism and the ensuing narratological offspring sought to broaden the approach to narrative analysis (D. Herman *Basic* 24). As the name suggests, Structuralist narratology is mainly concerned with the structure of the narrative and, as Formalism was, with its components. Drawing on the work of Ferdinand de Saussure, early narratologists adapted his distinction between the system and the usage: "the system (*la langue*) from which the infinity of narrative messages (*la parole*) derives and on the basis of which they can be understood as stories in the first place" (D. Herman "Histories 29; emphasis in original). Structuralist narratology was founded at a time when Saussure's linguistics were used as the basis for many other cultural sciences and "[i]ronically […] just when its deficiencies were becoming apparent in the domain of linguistic theory itself" (D. Herman "Structuralist" 574; see also D. Herman "Histories" 19). These shortcomings showed themselves in the limited approaches of Structuralist narratology as well. Narratologists, as Roland Barthes stated in his now famous essay on the structural analysis of narratives from 1975, were looking for the overarching

similarities that occur in a variety of narratives, namely the system or *la langue*, which then manifests itself in the different types of narratives, namely *la parole* (Barthes 238). At the heart of Barthes' essay lies the correlation between different levels of a system; in this case a system that compartmentalises narratives into different levels which in their correlation create meaning (Barthes 242). Language and literature are irreversibly intertwined, says Barthes, and "language never ceases to accompany discourse, holding up to it, as it were, the mirror of its own structure" (241). Barthes was also especially interested in deconstructing the myth of a single meaning of any literary text intended by the author, which he famously contested in his essay on *The Death of the Author* in 1967 (Middeke and Müller 202). Despite Structuralism's focus on the text devoid of its context, this abandoning of a single possible interpretation intended by the author leaves room for a more reception- and context-based analysis of literature. If there is more than one possible meaning of a text, then there is more than one possible way of reading it, which allows for a broader approach to literary analysis than Structuralism had at first intended.

Nevertheless, Structuralist narratologists highlighted the importance of descriptive language in order to analyse narratives, thereby paving the way for a text-centred narratology that would ignore the contextual aspects of production and reception (Barthes 242). In contrast to this textual focus, Structuralism had in common with postclassical narratology the belief that narratives exist in all kinds of human interaction. It was the aim of Structuralist narratology to understand the system behind peoples' understanding of stories. In that sense, the early idea of narratology, according to Barthes, was still transmedial:

> Among the vehicles of narrative are articulated language, whether oral or written, pictures, still or moving, gestures, and an ordered mixture of all those substances; narrative is present in myth, legend, fables, tales, short stories, epics, history, tragedy, *drame* [suspense drama], comedy, pantomime, paintings (in Santa Ursula by Carpaccio, for instance), stained-glass windows, movies, local news, conversation.
>
> (237, emphasis in original)

Turning to the period of Classical narratology, it will become clear why this transmedial focus was abandoned for many years. Only later in poststructuralist narratology would media outside of prose and written language again be fully included in narratological

theory. Structuralist literary criticism soon morphed into what is now referred to as Classical narratology, a time when narratology experienced its peak in the 1970s and 1980s. In these decades, Classical narratology moved from the focus of plot and grammar favoured by Formalism to a more discourse-oriented system influenced by Structuralism (Fludernik "Histories", 43). It is the culmination of both Structuralist and Formalist schools of thought (de Jong 115). Many of the categories and terms that were developed during the phase of Classical narratology are still used in our contemporary analyses. Concepts by scholars such as Gérard Genette or Franz K. Stanzel lay the groundwork for important narratological terms, and have been taken and expanded in their later use.

Gérard Genette was one of the first Classical narratologists who devised specific terms and categories for the classification of narratives. In the 1980s, he introduced the concept of the homodiegetic and heterodiegetic or extradiegetic and intradiegetic narrator, thereby distinguishing between different levels of the diegesis, i.e. inside and outside of the story. This distinction served as a major breakthrough in categorising the units of a text, providing specific terms for narrative situations that until then had until then not been classified properly, e.g. a narrator outside of the story who yet spoke in the first person. Genette also put special emphasis on three temporal aspects of a narrative that can be analysed individually: duration, order, and frequency (Fludernik "Histories" 38-40).

In contrast to Genette's rather binary concepts, Franz K. Stanzel proposed in the 1970s and 1980s an analysis of the narrative situation based on three categories: the authorial, the figural and the first-person narrator. An authorial narrator is an omniscient narrator with insight into all characters' minds. A figural narrator assumes the view of a particular character, yet in third person, while the first-person narrator assumes the view of a particular character in first person (Meister "Narratology" 335-336). This approach proved more dynamic than that of Genette because it left room for more than just opposing dichotomous concepts of either/or. Based on his earlier publications, Stanzel reworked his theory in 1979 to now align his narrative situations using the categories of person, perspective, and mode. Similar to many other early narratologists, Stanzel's focus lay on prose and the novel in particular. According to Monika Fludernik, Stanzel is today mainly favoured in the German and Eastern European branches of narratology ("Histories" 38-41).

Both Structuralism and Formalism contributed to the development of narratology in different ways. Formalism provided the distinction of literary theory as its own

scientific field of study and paved the way for narratives outside of prose to be analysed. Structuralism and its scholars in turn produced the theoretical concepts and terms that are now used in narratological analyses (D. Herman "Structuralist" 572). While both fields were important in shaping narratology, they both had the decisive disadvantage that they provided a theory but not a practice or a subsequent interpretation, settling on a descriptive rather than interpretative theory. Both also neglected to consider the context of production of the text (Gymnich "Gender" 705). Classical narratology proved achronical because it deliberately focussed on textual issues and not on the contextual ones, which is where its fatal flaw was found, as Monika Fludernik comments:

> Narratology promised to provide guidelines to interpretation uncontaminated by the subjectivism of traditional literary criticism. This attitude presupposes that texts are stable entities and that readers react to them in foreseeable ways.
>
> ("Histories" 38)

Texts, as Fludernik rightly states, are not always received and consumed in the same manner and fashion. A theory that aims at serving literature over the course of decades and centuries needs to account for the shifting societal and cultural issues that will influence readers in their perception of the text. All the terms coined by earlier literary scholars that we have always used in our analyses – narrator, reflector, focaliser, mode, intradiegetic, extradiegetic, etc. – were solely descriptive in their nature: they served only to assign a function to a certain unit of the text, as intended by early Formalism and Structuralism. Nevertheless, these functions were bound to be subject to the changing audience of the texts, not to mention the changing kinds of texts that technological advancements would produce, say graphic novels, films, etc. What these terms and functions also would soon experience was an application outside of literature in general, which came with the narrative turn.

3.1.2 NARRATOLOGY AFTER THE NARRATIVE TURN

In an earlier chapter, I have already mentioned the impact that Hayden White's ground-breaking monograph *Metahistory* had on the application of narrative theory to the study

of history and historiography (see chapter 2.2.1.1.). White was one of the first scholars to take the concepts of narratology and apply them outside of literary analysis, marking the foundation of a broader concept of narrative study (Fludernik "Histories" 43). This movement of narrative theory to other disciplines was made possible by the attempts of early Structuralism and Formalism to use semiotics to formulate common traits of all narratives, thereby offering a, as criticised before, text-centred but still common set of terms than could be applied outside of literature as well. Even though narratology had been a relatively young study, stories have always fascinated people in any kind of context. Now, the narrative turn had expanded narrative theory beyond the study of fiction and literature into other text-based sciences, highlighting the transmediality and transdisciplinarity of narrative theory (Kreiswirth 378-379). The narrative turn led to a "generalization of the term narrative […] within a wide spectrum of social sciences, resulting in the application of narratological paradigms to legal, medical, psychological, or economic discourses" (Fludernik "Histories" 46). This migration can be potentially detrimental to the narratological concepts: native narratologists know too little of the new disciplines entering the field of narrative theory after the narrative turn and scholars from new disciplines who are only now introduced to narrative theory have only rudimentary knowledge of the key terms used in this discipline, which can lead to a diffusion of the original concepts (L. Herman and Vervaeck *Handbook* 111). Narrative theory needs to go through a whole circle of movement, migrating to other disciplines and then back to the humanities that it originated in, each time due for a reassessment based on the other disciplines' questions and queries. This movement influences the original narrative theory and the new offspring alike, highlighting the "narrative ubiquity", as Martin Kreiswirth calls it, and "its extensive discursive promiscuity and capacity for disciplinary migration" (378). Narratives are analysed and received everywhere, not just in literature, and scholars from other disciplines have long worked on narratives in their own fields without specifically referring to them as such (Kreiswirth 379).

The narrative turn has paved the way for our contemporary approach to narratology that has been used since the late 1990s and early 2000s. With the new millennia and in the wake of the narrative turn also came a turn in narratology in its original home, literary studies. Influential narratologists such as Genette have lamented, looking back on their work, that the roots of narratology featured a canon that was too exclusive (Kreiswirth 380). The text-based, descriptive theories of Structuralist and Classical scholars were now taken and applied to more than just prose. This contemporary

phase of narratology is commonly referred to as postclassical narratology (Meister "Narratology" 339-341). In contrast to the early narratology, this new era shows a more applied approach to narratives, based on the descriptive methods that came beforehand (Meister "Narratology" 329). By using this new term, scholars such as David Herman mean to summarise the trends that came after the phases of Classical and (post-) Structuralist narratology:

> Postclassical narratology (which should not be conflated with poststructuralist theories of narrative) contains classical narratology as one of its 'moments' but is marked by a profusion of new methodologies and research hypotheses; the result is a host of new perspectives on the forms and functions on narrative itself. Further, in its postclassical phase, research on narrative does not just expose the limits but also exploits the possibilities of the older, structuralist models.
>
> ("Narratologies" 2-3)

Formalism and Structuralism began with a text-focussed analysis of literature devoid of its context and Classical narratology continued this trend. Postclassical narratology is both rooted in and expands beyond these early concepts of narratology to include ideas and theories from other disciplines, making it interdisciplinary as well as ideologically influenced (Alber and Fludernik "Introduction" 8-9; Fludernik "Histories" 45). One of these ideologically influenced trends of postclassical narratology is the focus of gender in narratology, which will be discussed in a later chapter. While in the early days of narratology the inclusion of the context of the text was still frowned upon, concepts from other sciences are now used to interpret the text with regards to the context. Postclassical narratology moves from description to interpretation under the consideration of the context of production and reception, something that earlier Classical narratology has been sorely missing. It aims "to transcend 'classical' structuralist narratology, which has been reproached for its scientificity, anthropomorphism, disregard for context, and gender-blindness" (L. Herman and Vervaeck "Postclassical" 450). This new focus by no means excludes a text-focussed approach to narratology; on the contrary, it invites the broadening of narratology on the basis of the text (L. Herman and Vervaeck *Handbook* 112).

Narrative, as Kreiswirth is quoted in an earlier chapter, is ubiquitous and finds itself at the base of all human experience and attempts at meaning-making. It is therefore only fitting that narratives are now "a significant focus of inquiry in virtually all disciplinary forms" (Kreiswirth 379). In postclassical narratology, this also came in tie with a move of narratology outside of prose literature and into a more inter- and transmedial approach. Where Classical and Structuralist narratology had only focussed on certain types of media such as prose, postclassical narratology has sought to include more than just written, textual narratives, moving to oral and also non-literary texts as well as visual media such as computer games, graphic novels or cartoons (Alber and Hansen "Introduction" 2).

Transmedial narratology may seem inconclusive with the focus on prose fiction and written, textual narratives implemented by Structuralism and Classical narratology. While Russian Formalism still appealed to more than one genre, e.g. the epic folktale or poetry, the historically following trends in narratology cemented the stronghold of prose fiction as the narrative media of choice. Luc Herman and Bart Vervaeck claim that narratology's focus on verbal, textual narratives mainly stems from Classical narratology being rooted in Saussurean linguistics and its concept of humans as language-based animals, which would exclude media such as graphic novels or film. With Genette's seminal work on the novels of Marcel Proust, the exclusive focus on the novel and textual narratives was set in stone by the 1970s (*Handbook* 116). Early trailblazers for transmediality such as Mieke Bal, Manfred Pfister, Gerald Prince and Seymour Chatman included other kinds of literature such as film and drama in their corpus but the general trend of narratology focussed on with epic prose (Fludernik "Histories" 48). But, since the late 1990s and early 2000s, narratology has embraced other kinds of media, too, and has developed into a transmedial discipline.

There is a certain overlapping in the approaches of transmedial and transgeneric narratology in scholarly texts. What some scholars, such as Luc Herman, Per Krogh Hansen, Jan Alber or Marie-Laure Ryan, who have been quoted before, denote as transmedial narratology, other scholars such as Peter Hühn, Roy Sommer and Ansgar and Vera Nünning refer to as transgeneric narratology (cf. Nünning and Nünning 18, Hühn and Sommer 228). While the terms may differ, the aims are quite similar. It all depends on whether one wants to subsume the corpus of one's analysis as a collection of genres, typically associated with the three main literary genres of epic, drama and poetry, or as a

collection of media. For consistency's sake, I will keep using the term transmedial narratology, even though I am aware of the different terms.

Transmedial narratology is defined as a narratology that is not tied to a specific kind of media (L. Herman and Vervaeck 118-119). It is ironic that narratology has come to be associated with prose fiction only, given its roots. Early Structuralist and Formalist narratologists, as has been stated before, were looking for "universal structures that were supposed to be at the root of all narratives, irrespective of their concrete medial forms" (L. Herman and Vervaeck *Handbook* 116). But, despite these transmedial foundations of early narratology, Classical narratologists centred on narratives in verbal and textual media, excluding an entire canon of other works. Narratology had always rested on a transmedial foundation but these foundations have been neglected in the course of history by the focus of verbal narratives alone (Ryan 1). Postclassical narratology and narrative studies in general since the turn of the century have seen a rise in transmedial approaches and the opening of the gates of narrative theory to all kinds of new media. What has additionally aided in allowing for a wider variety of narrative analysis is the abolished distinction between highbrow and lowbrow art: where graphic novels, comics and film were earlier considered not worthy of a scholarly analysis, they are now finally accepted as their own kind of literary genre and have entered the canon of narrative analysis. The early focus of narratology has had to open up from a sometimes snobbish focus on written literature and prose fiction to a wider, transmedial canon (L. Herman and Vervaeck *Handbook* 119). This focus on the novel also comes together with a deliberate gendering of genres, which will be discussed in a later chapter on feminist literary criticism.

Opening the canon to a wider variety of literature has also meant "the application, adaptation, and reformulation of traditional narratological concepts […] and thus deal[s] with the influence of the immediate discourse environment on the process of storytelling" (Alber and Hansen "Introduction" 2). If narratological concepts that were formerly only applied to prose fiction are now applied to other media as well, then these concepts will need to be adapted to suit the multimodality of many of these new formats such as film, drama or graphic novels. Transmedial narratologists study narration in these media to point out the different abilities that narration can have in different texts and media, "beyond [the] classical paradigm of narration" (Alber and Hansen "Introduction" 4). Marie-Laure Ryan cautions against taking this approach as an equalizer for all media: not all kinds of media are "equally gifted; some are born storytellers, others suffer from serious handicaps" but "the concept of narrative offers a common denominator that allows

a better apprehension of strengths and limitations" of the respective type (1). Transmediality is inclusive in its approach with a regard for the text and its individuality in narration. Drama, conceived as a typically unmediated and therefore as a non-narrative text type, is the designated format for the upcoming analysis. How drama can be analysed narratologically and how different scholars have approached this topic is the focus of the next section.

3.2 DRAMA AND NARRATOLOGY

The dramatic text and the role that female scientists play in it are at the heart of this dissertation. In order to be able to analyse a dramatic text narratologically, certain terms need to be defined and re-defined. I have already approached the issue of narrative elements in the dramatic texts from the side of narratology, showing in detail how narratology had, in its early days, more than prose texts in mind for its analysis and has only slowly returned to this transmedial approach in the past twenty years. In contrast to what Classical narratology might suggest, drama has a long history of epic elements and tendencies which are key to a narratological analysis. Narration is typically assumed to be found in epic prose, yet drama shows recurring epic tendencies that can be analysed in the same manner as prose texts. This section is dedicated to outlining how a narratological analysis of a dramatic text works.

3.2.1 THE FALL AND RISE OF NARRATION IN DRAMA

We tend to associate epic tendencies in dramatic texts with the recent century only. Brecht and his Theatre of Alienation come to mind as the earliest example for narration on stage, yet this could not be further from the truth. An empirical observation of the history of drama can give plenty of examples of epic tendencies in dramatic texts, long before the Brechtian tradition of epic theatre in the 20th century (Nünning and Sommer 106). Earlier and later theatre has relied heavily on diegetic and therefore narrative elements on stage. Narration in drama has a "rich tradition" that is easy to overlook when only focussing on certain time periods (Richardson "Point" 194). It may come as no surprise that epic aspects of drama can be found as early as Antiquity, namely in classical Greek tragedies. In the long tradition of Greek theatre, figures such as the chorus or a messenger report

show a long history of narration in drama in Antiquity. Scholars such as Françoise Palleau-Papin, Irene de Jong and James Barrett highlight the importance of these narrative instances on the ancient stage (Martens and Elshout 82). In Renaissance and Elizabethan theatre, narrative elements were also present on the stages. These sometimes even had practical reasons: violence or bawdy behaviour was not permitted to be portrayed on stage; therefore, playwrights resorted to narrating rather than showing acts of war, violence or lewdness (Sommer 123). Stage directions may have been used to allow for a certain illusion when techniques on the Elizabethan and Renaissance stage where still too rudimentary to portray certain scenes, e.g. a shipwreck or an earthquake (Suchy 74).

Another practical reason for including narration or narrator figures on stage was the importance of the audiences' reactions. Playwrights needed to capture the audience's interest and keep them entertained, which worked best when done through a narrator figure that breaks the fourth wall and includes the audience in the plot (Sommer 119). William Shakespeare is a prime example of using different epic techniques on stage, from prologues and epilogues, designated narrator figures or archetypical characters such as "The Fool" to add to the discourse level of the play (Richardson "Point" 198). As theatre became more of an entertainment for the upper class and less of a mass medium for lower and middle-classes, the audience was step by step shut out of the diegesis. With the "promulgation of notions of decorum and the reduction of lower classes from the audience […]", narration ceased to be employed on stage after these time periods, "concomitant with the exclusion of folk play material" (Richardson "Point" 201-202). Between the 17th to late 19th century, a more naturalistic focus of staging in theatre abandoned epic tendencies in drama, even though earlier centuries had heavily featured them (Richardson "Point" 194).

With the rise of Classical narratology in the mid-20th century, the decline of narration in drama became visible both in the theatrical as well as in the scholarly world. At the heart of the ongoing discussion of whether drama can be analysed narratologically lies the inherent distinction between the literary genres as mediated and unmediated, which harkens back to the distinction between diegesis and mimesis.

Diegesis in a narratological sense refers to the "narrated events or story […] as a level distinct from that of the narration" (Baldick "diegesis"). Other terms for the diegesis can be the *plot*, the *fabula* or the *histoire*, depending on the narratological school of thought. This is why we can distinguish between different narrative situations, some intradiegetic, which signifies a narrator on the same level as the characters of the actual

plot, or extradiegetic, which includes a narrator that is situated outside of the story and is not a character. There is of course always the potential for narrative figures to transcend these binary boundaries, but these are the common distinctions between narrators according to Classical narratology as defined by Gérard Genette, see preceding chapters. The level of narration, distinctly separated from its diegetic counterpart, has been referred to as the *discourse*, both in French and English, or the *syuzhet*.

Mimesis, in contrast to diegesis, relates back to Aristotle's *Poetics* and can be roughly translated as imitation, referring to a "literary work that is understood to be reproducing an external reality or any aspect of it" (Baldick "mimesis"). In his seminal work, Aristotle insisted that mimesis is an inherent ability of human beings, is always present in artistic work and is part of all genres and classes of literature, in diverse amounts and ways (Schaeffer and Vultur 309). He accounts for different modes of mimesis, one indirect, in the form of narratives, and one direct, in the form of drama, anticipating 20th century narratology's later focus on epic prose. Aristotle's *Poetics* is often celebrated as the basic foundation of drama theory. In his work, Aristotle was exclusively concerned with drama and the stage as it was the favoured kind of media at his time (Richardson "Drama" 142). Many of the concepts of drama theory that are still used today, such as the classical unities or the concept of catharsis, have been coined by Aristotle or were attributed to him at a later point[10]. Plato, Aristotle's teacher, still conceived of epic poetry and epic drama by accounting for a mix of diegesis and mimesis in his third book of *The Republic* (Schaeffer and Vultur 309). Aristotle, on the other hand, confirms Classical narratology's focus on drama as a non-narrative. He differentiated epic from drama by the latter's lack of a mediating instance, even though he also discussed mediating instances in drama, such as the chorus or the messenger, long before Berthold Brecht began his exploration into epic theatre (Pfister 70-71). Yet Aristotle differs from his teacher Plato and lays the foundation for the distinction between drama and epic, coining drama as the height of mimesis in this *Poetics*:

[10] Two of the three unities that are by now ascribed to Aristotle were, in fact, conceived of in European theatre in the 16th century, more precisely in England, Italy and France. Aristotle only demanded the unity of action, whereas the unity of place and time were commodities of later European theatre, see *Renaissance Drama 36/37: Italy in the Drama of Europe* by Albert Russel Ascoli or *Kingdom of Disorder: Theory of Tragedy in Classical France* by John D. Lyons for more detail.

> Aristotle defined the mimesis of drama, as opposed to the poesis of epic poetry: mimesis favors the erasure of the poet, or the storyteller, to show the characters in their present action, as if unmediated. A perfect illusion was thought necessary to reach catharsis: extreme emotions (such as terror and pity) would purge the spectator and free him from such emotion in actual life.
>
> (Palleau-Papin 146-147)

This "erasure of the poet, or storyteller", meaning either the author or the narrator, shows that Aristotle's main concern was the unmediated nature of drama. To him, drama was perfect in its mimesis when there was no mediating instance slotted in between the audience and the diegesis, nullifying the need for a narrator on stage. Aristotle's work was concerned with drama, even if he regarded it as unmediated long before the foundation of the school of thought we would eventually call narratology. Subsequently, a break with the focus of drama in general followed. Scholars such as Dorrit Cohn, Franz Stanzel or Keir Elam have formed a consensus during the peak of Classical narratology that drama is a genre that is purely mimetic and therefore unmediated, while epic fiction or prose can combine both mimesis and diegesis (Richardson "Point" 193). Here, the drama theory and Classical narratology go hand in hand in their distinction of drama and epic. Despite the already discussed transmedial claims of narratology, Classical narratologists sided with the antique distinction of drama as unmediated in contrast to prose as mediated and focussed on epic literature. This clear-cut distinction has contributed to the categorization of drama as an unmediated, non-narrative genre and needs re-evaluation, as the earlier chapter has already shown.

The 20th century saw a resurgence of the epic theatre, with epic tendencies returning to the stage and also capturing the scholarly attention once more (Nünning and Sommer 114; Martens and Elshout 81). Both the playwrights of modernism and postmodernism abandoned the concept of naturalism and once more featured narration as a technique on stage. These techniques even anticipated many later trends in epic prose. The "theatrical stagings of an isolated consciousness antedate by several years the comparable achievements of Joyce and Woolf", making epic theatre one of the first media of the 20th century to feature the depiction of consciousness in fiction (Richardson "Point" 205). Richardson cites Eugene O'Neill as one of these early narrative playwrights. Additionally, new options for theatrical staging aided in the portrayal of narratological

devices on stage. Theatre became more intermedial and multimodal, featuring new additions in sound, visual elements and staging (Hühn and Sommer 235).

When mentioning epic theatre in the 20th century, one cannot go past the achievements and contributions of the German playwright Berthold Brecht, who practically coined the concept of epic theatre of the 20th century in Germany and Europe. Brecht contrasted his concept of theatre against the ideal that had been proposed by Aristotelian theatre, which had reigned the stage for centuries with only a few interruptions. Brecht considered Aristotelian theatre too static, too rigid to be able to have a real impact on the guiding principles of humanity (Kittstein 299). The audience of Aristotle had been engrossed in an illusion, whereas the Brechtian audience was supposed to be consciously alienated from the action on stage in order to realise that what they were seeing was artificial and to engage them in the action (Kittstein 299-300). Brecht was especially interested in removing theatre from its upper-class audience and bring it back before the broad, general public. His designated audience was the proletariat, which would be interested in changing the status quo and which brought enough curiosity and willingness to learn as an audience (Kittstein 299). His theatre laid bare the workings of the social order and human behaviour that contributed to it to his audience. If they were willing to learn, then he could employ Horace' idea of *prodesse et delectare*, to teach and to delight, by combining the teaching with the delight of theatre (Kittstein 299). The distinction of the different classes by wealth and status needed to be addressed. Theatre was not meant for the bourgeoisie; it was supposed to involve social and historical contexts and focus more on the inner aspects of characters, where the stage became the mirror for the soul. If theatre was supposed to move the audience to action outside of the theatre, then it needed to portray the world as it is and highlight to the audience that what they were seeing on stage was artificial and needed correction in real life (Kittstein 296-298). The plot and the commentary on the plot were distinctly separate from one another on the Brechtian stage to allow for reflection (Kittstein 302). Brecht did not only "employ narrators in many of his plays, he also displayed written text before each scene that frequently had a narrative function" (Richardson "Voice" 685).

What Brecht is probably most known for is the *Verfremdungseffekt*, the alienation effect or defamiliarisation of his theatre. Alienation was specifically meant to disrupt the mimetic action and to create distance between what was enacted and the audience. It is supposed to teach and to highlight important structures and messages of the play without illusion, deception or emotional engagement. By consciously breaking the fourth wall,

audiences are alerted to the fact that what they are witnessing is indeed artificial and fictitious. The seeming familiarity of what happens on stage hinders the audience from grasping the true meaning and only a deliberate alienation can help them engage in critical evaluation and action outside of the theatre. Brecht also consciously titled scenes pre-emptively to give the audience an additional information beforehand to prepare them to focus on the how of the scene instead of on the what (Kittstein 301-303). Brecht's usage of narration on stage means to involve the audience into evaluating the action as well as their own world outside of the theatre. This is a key example of how narration can be used on stage and it precedes the transmedial and contextual focus of narration that would only come after the narrative turn in the late 20th and early 21st century.

3.2.2 Narrative Elements in the Dramatic Text

Generally speaking, one can distinguish between two levels of narrative discourse in dramatic texts, similar to epic prose, namely epic tendencies on the intradiegetic level conducted by characters and epic tendencies on the extradiegetic level. The stage as a plurimedial place, including staging, speech, reception and production, offers several starting points for epic tendencies (Muny 13). In his seminal work on *The Theory and Analysis of Drama*, Manfred Pfister has given extensive examples for the different kinds of narration in what he refers to as epic theatre. In more general terms, Pfister concludes that the more the speaker distances themselves from the action they are in, the more epic their function becomes (Pfister 81-82). On an extradiegetic level, meaning the outer level of the diegesis, Pfister counts "authorial secondary text" (Pfister 72), which denotes commentaries in stage directions that are hard to capture in the staging, such as judgement, time frames or temporal and causal words. Russian playwright Anton Chekhov tends to use these kinds of words in his descriptions, for example *still* or *just*. These hint at an action that happened before or outside of the current play that are difficult to portray via staging. They contain information that transcends the knowledge of the characters and actively contribute to the general "literary construction – a narrative and descriptive text which preimposes an interpretative perspective on the dramatic presentation that follows" (Pfister 72). Montage is also important in the construction of the dramatic action, as it "impl[ies] an authority that is able to undertake such rearrangements" (Pfister 73).

On an intradiegetic level of the characters, Pfister differentiates between characters involved in the action and characters on the level of diegesis that are nevertheless not active in the action of the drama. For reasons of space, I am subsuming these two subcategories as epic tendencies in the diegesis in general, regardless of whether the character is involved in the action or not. Pfister lists prologues, epilogues or a chorus, depending on the *dramatis personae*, as well as their respective utterances that serve a narrative function, such as soliloquies, monologues, asides or comments on the action (Pfister 76-83). Non-verbal tendencies of epic action in drama can also be found in stage design, e.g. banners, scene headings, etc., and the acting style (Pfister 72, 84), which is however not a concern of this dissertation as I am focussing on the dramatic text outside of its performance and staging. In the following, I will go into more detail of some of these narrative tendencies in dramatic texts, moving from a more extradiegetic to an intradiegetic level, starting outside the diegesis.

An epic quality can be added to the dramatic text through its stage directions. Stage directions are of course of great importance to the actual staging of a performed play but reading the stage directions as a more intradiegetic aspect can offer similarities and an access point in comparison with epic literature and narration. A dramatic text might be intended to be staged but can also give epistemic insights in its pure textual form (Muny 26, 34-35). An important question to answer is to whom the stage directions really belong to, whether they can be attributed to the author, to a narrator figure or even to a character, e.g. whether the directions are situated on an intra- or extradiegetic level. Many scholars, such as Manfred Jahn, Roy Sommer, Peter Hühn and Patricia Suchy agree that while the stage direction may be functional on an extradiegetic level, their main focus lies on the intradiegetic world of the characters and action (cf. Jahn 672-673; Hühn and Sommer 236; Suchy 71). Stage directions can, of course, work both intra- and extradiegetically, only with different nuances. Patricia Suchy offers that the context of the stage directions also matters in terms of placing them in a diegetic context. She cites Austrian playwright Peter Handke's *Offending the Audience* as an example for impossible staging when the directions are read as literal instructions. When read as a diegetic element, however, they could possibly offer a metatheatrical commentary (Suchy 79). If the directions are left purposefully vague and leave room for interpretation, then they can be fruitfully used by the directors, actors and actresses and the audience as they see fit, transforming their function from written text to staging (Suchy 76-78). Different adaptations of plays show that stage directions are often perceived to be optional rather

than instructional (Suchy 71). When reading a dramatic text as a literary text rather than as an instruction for staging, it becomes clear that what is described in these paratexts is meant to be part of the action. They shape what is happening on stage in the diegesis and therefore add to the narrative level of dramatic texts as they provide commentary and dimension (Muny 69). Or, as Patricia Suchy has succinctly phrased:

> Stage directions seem to be assuming, with increasing frequency in the modern drama, many of the characteristics of the fictive discourse of other genres: most notably, of the novel. If the voice that tells the performer to bring down the curtain 'to see if it works' speaks in fictive discourse, then the voice that utters these words emanates less from an author than from an author's imaginary, and quite fictive, narrator.
>
> (80)

Many contemporary dramas use the stylistic device of a designated prologue and epilogue or other framing devices to add an epic quality to the plot of the text. But classical dramas, as Manfred Pfister highlights, have also successfully employed a prologue by one of the characters to introduce the action (77). Prologues and epilogues relate back to the history of staging drama itself: a playwright had to capture the audience's interest from the very beginning with a prologue introducing the action and later needed to serve a satisfactory end with an epilogue to ensure a favourable audience response. In this sense, prologues and epilogues are more important in drama than they are in epic prose, even though they are more commonly associated with the latter (Richardson "Drama" 146). Who narrates the prologue is an important factor in the act of narration as well. It is usually not the author who offers and introduction to the plot but rather a certain character or even a designated narrator who is ingeniously slotted in between the intra- and extradiegetic level (Richardson "Point" 195). If it is a character who narrates the prologue and who, in the course of their speech, also summarises the plot that is to follow, then this entails a two-fold representation of the dramatic action: one as a narrative act by the character, the other the following enactment of said action (Richardson, "Point" 196). We as the readers are also left to trust the character's judgement, such as the summarising of action that may have preceded the coming plot of the play. Shakespeare's audience, historical and contemporary, needs to trust that the Chorus speaks true when they relate the incidents that led to the conflict between the

Capulets and the Montagues in *Romeo and Juliet*, lending this introductory character a narrator-like authority (Barrett 3). Dramatic action can also be framed by several other methods, as Brian Richardson enumerates: in traditional Greek tragedy, a chorus would introduce the action and frame the following plot accordingly. Summaries in these framing devices are also common, for example in the Plautine comedies. A framing miniature play, most famously used in William Shakespeare's *Hamlet*, can provide meta-commentary on the action and serve as additional layer to the plot. The Elizabethan stage as well as the contemporary Indian stage have used a kind of dramatic introduction to the plot, in which the characters discuss the play that is about to be performed (all Richardson "Drama" 152). The play-within-the-play and framed plays in general "often contain ingenious temporal manipulations because the inner play regularly presents a longer period of story time than its frame play", adding an additional temporal layer to the action (Richardson "Time" 304). A break with the theatrical illusion can occur when the characters find themselves in a situation analogous to what Genette refers to as metalepsis, meaning that the characters of the play suddenly find themselves realising that they are in fact in a play. In this case, the dialogues may shift from covering the intradiegetic action to the extradiegetic atmosphere, describing what the actors are feeling and seeing on stage and reflecting on the play as an actual play in a Brechtian tradition of alienation (Richardson "Drama" 153).

The messenger report, another narrative device, usually functions qua dialogue with other characters, reporting action that has happened off-stage (Pewny 152). A similar iteration of a messenger report is the teichoscopy, denoting a character who is watching an action that is not visible for the audience, usually from a higher point of view, a lookout or while sneaking glances over a wall. This character then describes what they are simultaneously seeing to other characters and the audience (Toohey 26-27). These reports or the narration of off-stage action are an integral part of narration on the dramatic stage that help the dramatic plot move further (Pewny 151). The uses in Greek tragedy were manifold, mostly to report on death, suicide or other catastrophes integral to the plot. Another, more practical and staging-related use of them, was to offer a moment of acknowledgement to a character that had died off-stage without having to cast the character physically with an actor or an actress (Pewny 151-153). Similar to the chorus, the messenger functions both on the intradiegetic level of partaking in the dialogue while simultaneously offering an extradiegetic narrative function in terms of adding information to the plot that characters of stage may not be privy to (Pewny 152). A certain authority

is inherently placed on the report of a messenger. Their tales are not questioned or doubted and almost always have decisive consequences for the subsequent plot of the drama, lending the messenger report an authority equalled by that of a narrator (Pewny 152-153; Barrett 3). The messengers might even be hesitant as a character to speak the truth of what they have been sent to report, as it may see them out of favour with other characters they are reporting to, such as royalty, superiors, etc. (Pewny 153). James Barrett even goes so far as to claim that messengers in tragedies purposefully assume an epic voice to lend themselves authority and to detach themselves from the characters' point of view, especially in dialogue with them (xvi-xvii).

A chorus, by contrast, is less included in dialogue on stage and offers a narration in style of a monologue (Pewny 152). A chorus invites metalepsis, breaks the fourth wall and "suspend[s] the illusion of dramatic action" (Palleau-Papin 146). Choruses can be involved in dialogue with characters but their main purpose is to have a distancing effect on the action on stage (Pfister 79). Included in the chorus' monologue is usually a political commentary on the action that subverts the immediacy of the drama and allows for reflection by the audience while simultaneously influencing the upcoming events on stage. Similar to the archetype of a fool in Shakespeare's plays, the chorus is separated from the action and therefore free to comment on it. It is not meant as a figure of identification for the audience but rather for the critical comment that it invites into (Palleau-Papin 146-147). It "intensifies the action by projecting its emotional consequences so that we as the audience see it doubly by seeing its effect on other people" (Palleau-Papin 146). Depending on the placement of the utterances of the chorus, it can also serve as an additional framing device in the course of an epilogue or prologue, see the example of *Romeo and Juliet* used above. The chorus has two dimensions that allow for epic and narrative communication in the dramatic action: as a "passive observer who is only active in a verbal sense, offering word of advice, warning or prayer" the chorus can substitute for an omniscient narrator figure with distance to the action (Pfister 79). Or the chorus can cross the border from extra- to intradiegetic and engage in dialogue with the characters, directly offering their words of wisdom to the characters instead of the audience, thereby "function[ing] as an epic mediary" (Pfister 79). What the chorus says might even influence the upcoming events, depending on the content of the chorus' speech, e.g. a warning or a political commentary (Palleau-Papin 146-147). A chorus in contemporary drama is rare but can be substituted by other characters situated between the diegetic levels that utter warnings, commentary and offer pro- or analepsis. A

disembodied voice-over on stage, similar to that of a bodiless narrator in film, who comments on the events, can also set the stage in a manner very similar to that of a chorus (Richardson, "Voice" 686). While both the chorus and the messenger report are stylistic devices from Antiquity, their descendants can still be found in contemporary drama, as the upcoming analysis will show.

But these are not the only characters that can be read as narrators in dramatic texts. On the level of characters, many figures in a drama can assume a temporary or constant narrator-role. Brian Richardson specifically cautions against subsuming the category of "narrators on stage [with] […] characters that happen to relate actions that occur off-stage" and rather associates the role of the narrator with "the speaker or consciousness that frames, relates or engenders the actions of the characters of the play" (Richardson "Point" 194). The narrative instances on stage can be just as diverse as they are in prose texts. Whether it is homo- or heterodiegetic, whether it is a first-person or a third-person narrator, all versions are possible (Fludernik "Narrative" 367; Richardson "Point" 209). A shift between a position outside the action and inside of it is also frequently employed:

> The alternation between narration and enacted events is quite comparable in many ways to a homodiegetic narrator's shift between presenting scenes as they unfolded in his or her life and the retrospective commentary that takes place during the time of the writing [...]. The drama further marks such differences in tone and temporality by the narrator moving in and out of character, and addressing the audience rather than the actors.
>
> (Richardson "Voice" 683)

All characters who occupy a narrating function on stage can count as narrators as they can engage both in summarizing action off-stage or aid in the world-building on-stage.

Similar to authorial narrators, Richardson names the generative narrator in dramatic texts who is both situated on the level of characters as well as on a higher level of communication, too (Nünning and Sommer 115-117). This generative narrator enables the actions on stage, similar to a fictional stage manager (Fludernik "Narrative" 368). Generally speaking, Richardson distinguishes between six types of narrator roles in drama, not all of which need to necessarily be embodied by an actor. The first one he calls an internal narrator, similar to Prospero in *The Tempest*, who recounts to other characters what has happened off-stage or prior to the beginning of the drama. One could count

expositional soliloquies in this category as well. Richardson's second type is the monodramatic narrator, the only or one of very few characters in the drama that occupies most of the play with their speech and thereby guides and steers the drama similar to a narrator. The third type, the generative narrator, has been discussed before: a narrator, either reliable or unreliable, that engenders the action and functions similarly to a stage manager. The fourth type according to Richardson is the frame narrator, visible in opening prologues and closing epilogues, another figure that is outside of the level of characters, yet comments on the action, see the Chorus in *Romeo and Juliet* that only appears in the pro- and epilogue. The implied author in drama, a term similar to Wayne Booth's concept of the implied author in prose, is the fifth type. The implied author on stage is "a figure whose consciousness seems to have produced the text and whose personality we deduce entirely from the text". And, finally, the historical author as the sixth type is the historical person who actually wrote the performed play and "whose voice can be superimposed on the framing and fictional voices of the imaginary world of the play he or she has invented" (all Richardson "Point" 209-211). A combination of the types can also occur in an act of a plurimedial multiplying of narrative voices, evident in recent dramatic texts, such as distinctive narrative voices in postdramatic theatre (Martens and Elshout 81, 92). In non-Western drama, e.g. on the stages of the Global South or East, narrator figures are much more common and a frequently used stylistic device (Richardson "Point" 196).

Another inherently epic element of dramatic texts can be found in the direct speech of characters which is presented in the form of monologues or soliloquies. To quickly distinguish these terms from one another, a monologue is a longer speech by a single character that can be heard by the audience or another character on stage and may even be directed to either. A character who monologues knows that they are not alone and offers their monologue as a kind of speech with an addressee (Baldick "monologue"). A soliloquy, on the other hand, is a speech by a character who deems themselves alone on stage. The character that gives the soliloquy offers a deep insight into their thoughts and feelings as well as their potential hidden motifs and agenda (Baldick "soliloquy"). This representation of consciousness of a character on stage is a staple in drama throughout its history and also includes the aside, a "short speech or remark spoken by a character in a drama, directed either to the audience or to another character which by convention is supposed to be inaudible to the other characters on stage" (Baldick "aside"). Authors such as Heinrich von Kleist are well known for their extensive asides and their narratological function (Martens and Elshout 83-86). All these insights into the inner

world of the character are paralleled by classical narration in epic texts. Depending on the narrative situation of an epic prose, e.g. whether the homo- or heterodiegetic narrator has insight into one or several characters' thoughts and feelings, a monologue or soliloquy may work similarly to epic narration. Monologues and soliloquies on stage function in the same way that homodiegetic narration or internal focalization do. The character who monologues or holds the soliloquy is a character on the intradiegetic level and offers insight into their own inner world, limited to their own perception or to that of the narrator. These soliloquies in particular can function similarly to a stream of consciousness in epic narration and may as well be as unreliable as epic narration can be. Monologues and soliloquies can also exceed the boundaries of individual consciousness, for example when a character holds a soliloquy on stage and is overheard by other characters eavesdropping, who then comment on the insights offered in an aside and thereby reveal their own motifs and motivations without monologuing themselves (Nünning and Sommer 117-118). These overheard soliloquies and the ensuing comments on it are a very common technique in drama and may even pose the question of their reliability. If we as the reader doubt the intentions of a dubious character in epic narration, then we might as well be sceptical about the motifs of a dramatic narrator as well when they reveal certain aims in their soliloquies (Richardson "Point" 199-200). Or, to add another layer to the means of narration qua soliloquies and monologues, they may create a humorous effect in staging when thoughts are spoken out loud, especially when the spoken words are in stark contrast to the actions happening on stage (Martens and Elshout 84).

3.3 GENDER AND NARRATOLOGY

I will now come to the final part of this methodological chapter, namely that of feminist narratology. So far, I have shown that dramatic texts and a narratological analysis are not inconclusive at all. The third dimension of my dissertation, namely that of gender, is brought into this section, starting with the intersection of gender and literary criticism before moving on to gender and narratology.

3.3.1 FEMINIST LITERARY CRITICISM

In Chapter 2, I have already touched upon the emerging women's movement that gained momentum by the end of the 19th and beginning of the 20th century. Feminism did not end with winning the right to vote for women across countries and continents, but continued in several consecutive waves, each determined to change the world for women for the better. From the second wave of feminism emerged a new critique of androcentrism, this time in form of feminist literary criticism.

The second wave of feminism accompanied a time of social uprising in Europe and the United States during the Civil Rights Movement, Gay Rights Movement and anti-war campaigns in the 1960s[11]. Women's rights became once again a dominant topic in terms of social justice, and feminist literary criticism was borne out of the desire of many scholars to re-evaluate the literary canon. They asked questions on how literature might be viewed through a feminist lens or how literature might have perpetuated and created gender stereotypes; moreover, forgotten contributions to literature written by women that had been erased from the literary canon were now re-introduced and re-appreciated (Gymnich "Methods" 151). Since then, feminist literary criticism has been firmly located in literary studies with interdisciplinary ties to other sciences as well (Plain and Sellers "Introduction" 3). Notable names in the early years of feminist literary criticism, just to name a few, are Susan Lanser who has also coined the concept of feminist narratology that will be covered in the following chapter, Adrienne Rich who was an early advocate for lesbian literary criticism, bell hooks who has paved the way for the representation of Black and People of Colours' perspectives in literature, Kimberlé Crenshaw, a professor of law whose concept of intersectionality has allowed for literary criticism to take into account more than one lens for the situation of women or Laura Mulvey who has studied the concept of the "male gaze" to describe the eroticisation of women on screen (Gymnich "Methods" 154-156).

One of the main critiques of feminist literary criticism concerns the foundation of the literary canon, which was at that time almost exclusively male, White and from the Global North and West (Rooney "Introduction" 8). Female writers have long mused on the absence of women in what is considered notable literature. Virginia Woolf dedicated

[11]Early feminist literary criticism has suffered from the same flaw of focussing on middle- and upper-class, White, heterosexual women alone and has undergone a similar transition as feminism in general has. For a more detailed perspective on the development of feminism, see chapter 2.2.2.2.

an entire essay, *A Room of One's Own*, to the question of women's writing and observes that "it is a perennial puzzle why no woman wrote a word of that extraordinary literature when every other man, it seemed, was capable of song or sonnet" (31). It is not because women did not produce any literature, as Woolf mockingly states; it is simply because their work was never considered worth mentioning. In addition to leaving out female authors, the canon of literature is usually focussed on genres that have been typically dominated by male authors, such as the novel or the play, whereas genres that have been catered to by female authors, such as (auto-)biographies and epistolary literature, have been neglected (Rooney "Introduction" 9). It goes without saying that this gendering of genres does not stop at the authorship, as "[l]iterary genres may also be gendered, in terms of their primary readership as well as with respect to their typical structural features, in particular their plot" (Gymnich "Methods" 162). Feminist literary criticism has worked to undermine the traditional assumption that readers of literature are only men and to highlight that women as consumers of literature need to be included in a canon that truly wishes to depict the reality of author- and readership (Rooney "Introduction" 4).

But women have also been mis- und underrepresented in the traditional literary canon on the level of content. Literature in this case functions as a mirror of society: hierarchies that are depicted in a literary text are often linked to the prevalent societal hierarchies at the time of production of a text and can in turn then be inscribed in its reception (Allrath and Gymnich "Feministische" 39). A lot more literature has been written about women than by women themselves, or, as Virginia Woolf posed in her aforementioned essay, women "are the most discussed animal in the universe" (20). When literature is written about women, rather than by women, with a male readership in mind, the characterisation of women has often been one-sided and stereotypical. Anyone who has ever read one of the canonical works of literature will immediately be able to think of an example of a female character being portrayed as depraved, dishonest, submissive, weak or emotional, or, on the other end of the spectrum, as a doting woman in relation to a male character, e.g. as a wife, sister, mother, daughter. These characterisations of women are an "articulation of male wishes, desires and fears" and they "equally support patriarchal thought-patterns and serve to legitimise patriarchal power structures in society" (Gymnich "Methods" 159).

Even in the analysis of literature, the supposedly neutral and objective terms that have been used for decades by literary scholars are inherently male-centred and male-coded and have "promoted a privileged attention to those narrative strategies dominantly

employed by male writers" (Allrath *(En)Gendering* 2). Some feminist literary critics have proposed to abandon these terms in favour of new ones, but I have to side with scholars such as Gaby Allrath here (cf. Allrath *(En)Gendering* 3). Complete gender-blindness is nigh impossible and can never be achieved as gender is a vital part of every part of language and literature. I would even go a step further and argue that these terms from the former canon of analysis need to be used: if male-centred terms are used, then gender critique on these terms is thrown into even greater relief because it would highlight the blind-spots that have been left by disciplines such as Classical narratology. As the focus of my analysis lies on narratology, I will now shed light on a branch of feminist literary criticism that is entirely concerned with the intersection of gender and narratology, namely feminist narratology.

3.3.2 FEMINIST NARRATOLOGY

As chapter 3.1 has already proven, narratology had, despite its beginnings as a contextual and transmedial theory, arrived at its peak and Classical phase in the 1970s and 1980s, when only certain genres and especially the text itself were at the centre of the canon. This textual focus disregarded all the contextual factors that may have influenced the production and reception of the text. Narratology experienced an expansion of its focus only in its postclassical phase, namely with the beginning of the 1990s and 2000s. One of these postclassical narratologies that has argued for the inclusion of contextual aspects into textual analysis is feminist narratology.

In 1986, an article titled "Towards a Feminist Narratology" was published in the 20th volume of *Narrative Poetics*. Up until the 1980s, there had been little to no intersection of feminist literary criticism and narratology (Lanser "Towards" 341). The author of the text with this unusual title, Susan Sniader Lanser, proposes that narratology has long suffered from certain blind spots in its analysis and introduces her essay as follows:

> My immediate task, however, will be more circumscribed: to ask whether feminist criticism, and particularly, the study of narratives by women, might benefit from the methods and insights of narratology and whether

> narratology, in turn, might be altered by the understandings of feminist criticism and the experience of women's texts.
>
> ("Towards" 342)

What Lanser suggests is an extension of the aforementioned feminist literary critique of the canon of classical literature. Classical narratology has followed suit and has dedicated its analyses to the narratives mostly written by men and therefore has participated in the exclusion of female writing from its corpus. Lanser even goes further, criticising the narrow focus of classical narratology and claims that "until women's writings, questions of gender, and feminist point of views are considered, it will be impossible to even know the deficiencies of narratology" and that "a narratology that cannot adequately account for women's narratives is an inadequate narratology for men's texts as well" (Lanser "Towards" 343-344, 345-346). In her seminal essay, Lanser lays the groundwork for a new branch of narratology that would move from a text-centred approach to a postclassical narratology in order to include the concepts of gender, sex and sexuality in its analysis. Additionally, this new postclassical narratology could also include more female-led genres instead of the focus on the novel, a male-dominated genre.

As with any approaches to literary analysis, it is difficult to pinpoint one definite manifestation of feminist narratology, as many sub-branches have sprouted from the original discipline as outlined by Lanser. But certain characteristics are common among all of them. Generally speaking, feminist narratology hinges on the assumption that texts are not ahistorical but are moulded by their respective contexts of production and reception, an assumption that feminist narratology shares with other postclassical narratologies (Allrath and Gymnich "Feministische" 37). In feminist narratology's case, the "category of 'gender' has to be integrated into narratological analysis *both* of the story's content *and* of the way this story is rendered in the discourse" (Allrath "Survey" 396, emphasis in original). While gender has been used as a category in the analysis of literature on a content level, feminist narratology now advocates for the consideration of gender in the structural analysis of literature as well, e.g. on its narratological level.

In connecting the societal norms of production and reception in a feminist narratological analysis, the roles of narrator and focaliser become even more important. Very simply speaking, a narrator is always in a privileged position because their voice is given much more credibility than any other character's (Gymnich "Gender" 709). Not only is it the source of information for the reader, but the narrator's perspective shapes

how the reader perceives the fictional world. Narrative authority is inherently connected to social privilege, discursive authority and thereby associated with masculinity or a male voice. Those who speak – and in turn are heard – are usually White, upper-class men with a background of education and who symbolise a hegemonic standard of masculinity (Allrath and Gymnich "Feministische" 42; c.f. the work of Raewyn Connell for the concept of hegemonic masculinity). In the best case, narrative situations can work to undermine patriarchal power structures. Yet for many years, they have only worked to support them, lending authority to male narrators and giving priority to male perspectives (Gymnich "Gender" 708).

The question of reliability of a narrator is similarly tied to their gender: "[F]emale speakers are often regarded as untrustworthy because they are said to display a number of 'typical feminine' characteristics" (Allrath *(En-)Gendering* 1), which only further supports the perpetuated image of the devious and deceitful female stereotype. It is a circle of assessment and attribution: a reader will automatically assign a sex and gender to a narrator, which will in turn influence their assessment of the narrator's value and personality; this is done mostly unconsciously and influenced by their own societal norms and practices (Allrath and Gymnich "Feministische" 50). This is why the categories of gender and sex are so important in a narratological analysis because including these categories highlights the implicit bias and the societal constructions that can be deduced from them. Ina Schabert underlines that certain narrative situations come with an automatic identification, for example an authorial narrator is rarely gender-neutral and usually defined by characteristics inside and outside of the text; sometimes they are even equated with the author themselves (314).

And even if narrators are not explicitly named or identified as a specific person, or even as human or anthropomorphic, then readers will often speak of them with an image of a man in mind in a sense of normative masculinity. Susan Lanser has addressed this bias in her above-mentioned essay, distinguishing between two acts of narration, namely public and private. Public narration is "narration (implicitly or explicitly) addressed to a narratee who is external (that is, heterodiegetic) to the textual world and who can be equated with a public readership" (Lanser "Towards" 352). Private narration, in turn, "is addressed to an explicitly designated narratee who exists only within the textual world" (Lanser "Towards" 352). Private narration is indirect, less subversive and safe, confined to a limited space. Public narration is framed as a direct, male-coded and authoritarian narration that links narration to the separate spheres that existed for men and

women for many centuries, where men were allowed to hold public offices and speak in public forums whereas women's sphere of influence remained the private one. This is why private narration was long reserved for women's writing, e.g. genres that appealed to a female readership and that worked in a more private setting than those that had a male readership in mind, as discussed in the chapter before on feminist literary criticism (Lanser "Towards" 352-353). A contemporary theorist of Lanser's, Robyn Warhol has offered a similar perspective on the different narrative situations from a feminist point of view. Her concept of the distancing and the engaging narrator provides a similar distinction between male- and female-coded narrators, which perpetuate the stereotypical view of the gender roles (Allrath and Gymnich "Feministische" 47-48).

3.4 SUMMARY

In its initial state, narratology had still presented itself as a study that surpasses the boundaries of different genres and media, yet the development of this school of thought manoeuvred it into a rather limited canon. After many years of Classical, and thereby exclusively prose-oriented narratology, the study of narratives has now finally arrived in its postclassical phase, marking the era of a new-context-oriented study that focuses not only on the form of a narrative, but also on its context of production and reception. The focus on epic narratives has been abandoned in favour of a more transmedial approach to narratology, including dramatic texts which for decades had been discounted as unmediated and therefore uninteresting for a narratological analysis. As the previous chapters have undoubtedly shown, a dramatic text can be narratologically analysed to account for narratology's new transmedial focus.

In terms of the new context-focus of narratology, several postclassical narratologies have sprouted from the original study of narratives, one of them feminist narratology. Feminist literary criticism and narratology can benefit from one another and create a more diverse approach to the structural analysis of narratives by accounting for the diversity that can be found in narratives themselves: different narrator figures, different perspectives, different contexts of production and reception. All of the narratological devices that I have named in chapter 3.2. that can be analysed in a dramatic text will, in my upcoming analysis, be expanded by the contextual layer of sex, gender and sexuality in order to account for the blind spots that Classical narratology has had for

a long time. If we have truly arrived in a postclassical phase of narratology, then not only the media- and genre-related borders of Classical narratology need to be abandoned. The same also goes for the textual focus of Classical narratology that needs to make room for contextual analysis in combination with the structural aspects of a narratological analysis. Only a combination of both can bring about a fruitful and thorough analysis of female scientists in the dramatic texts as I have outlined in my introduction.

We can see a parallel here: as discussed before, women have been left out of the canon and history of science as well as out of the canon of literature, both as producers as well as receivers. My upcoming analysis will show how contemporary science drama aims at changing both by including forgotten women from the history of science as the protagonists of drama. The question now remains whether the texts are successful at attributing the needed authority to the narrative voice in the dramatic text for the forgotten women to tell their own story instead of it being told by others once again, shunning the respective scientist to a role of a minor character in their own life and memory.

4 ANALYSIS

The dissertation has now reached its heart and final topical chapter, namely the analysis. It is here where the other two major chapters of this dissertation are finally fused and exemplified by means of a literary analysis: narrative strategies and structures, as discussed in chapter three, that exemplify and illustrate the struggles that women have historically faced in their participation in science, as discussed in chapter two, both analysed by means of contemporary science plays. The intersection that I mentioned in my introduction now finally comes to a peak when I combine history and historiography of women in science as well as postclassical narrative studies in my analyses.

The corpus for this analysis consists of eight dramatic texts, all published or produced in the English-speaking world since 2000 that feature at least one of the aforementioned narrative tendencies discussed in chapter three. The main topic of these dramas must be the life of a historical scientist. There are four texts by the author Lauren Gunderson, who has dedicated a vast amount of her work to bringing science and the scientist, most of them female, to the contemporary stage. Gunderson's texts that will feature in this corpus are *Emilie: La Marquise du Châtelet Defends Her Life Tonight* (2010), *Silent Sky* (2015), *Ada and the Engine* (2018) and the unpublished manuscript of *The Half-Life of Marie Curie* (2019), which was originally produced as an audio play for the audiobook provider Audible[12]. Two other unpublished manuscripts, namely *Remembering Miss Meitner* (2002) by Robert Marc Friedman and *Uniform Convergence* (2019) by Corrine Yap are also part of the corpus[13]. *Comet Hunter* (2003) by Chiori Miyagawa and *Photograph 51* (2011) by Anna Ziegler round out the selection of plays. The texts will be analysed in a chronological order, starting with the oldest and finishing with the ones most recently published or written.

Each analysis follows the same structure. The individual chapter is prefaced with a short mentioning of the scientist as well as an introduction to the chosen dramatic text, including the narrative means that will be part of the analysis. I will then continue with a quick biographical overview of the life of the historical scientist that is featured in the play in order to contextualise her life. Depending on the available source material on the

[12] I am very thankful to Lauren Gunderson and her team at Gersh for trusting me with the unpublished manuscript.

[13] I thank Robert Marc Friedman and Corrine Yap respectively for offering to share their work with me and for the inspiring exchange on the thought processes behind their texts.

scientist, these will vary in length. Both overviews of the biography and the plot of the drama are necessary to give context to the life of the scientist and what aspects from history have been adapted into fiction. This prepares the reader with background knowledge on the main characters before the actual analysis. Throughout the analysis, I will continuously refer back to the third chapter of this thesis and re-introduce the narratological aspects of drama; this is not meant to be redundant but rather for readers' convenience. The body of the analysis then focuses on both the narratological aspects as well as the portrayal of the historical woman in science and her tribulations, sometimes even the intersections of both. Since many of the dramatic texts have either received no or little scholarly attention, either because they are unpublished or because they have only been reviewed, most of the analysis will be my own. A final paragraph summarizing my findings rounds out each individual analysis before I give a general overview of my analyses in a synopsis of this entire chapter.

4.1"WHY SHOULD ONE OLD LADY BE ALLOWED TO GET IN THE WAY OF OTTO HAHN?": ROBERT MARC FRIEDMAN'S *REMEMBERING MISS MEITNER* (2002)

The history of Lise Meitner is a story of estranged colleagues, of the national-socialist German science culture shortly before and during the Second World War and of the ungrateful role of women in science at that time. Similar to many other scientists that will be discussed in later analyses, Lise Meitner's contribution has been overlooked in the history of science for many decades and has only resurfaced thanks to the thorough work of feminist historians and historiographers of science. She worked together with Otto Hahn on fission during the reign of the fascist nationalist party in Germany. When she had to flee Germany to seek refuge because of her Jewishness and was cut off from her research team, Hahn failed to include her in his publications and subsequently received the Nobel Prize for their work on fission, with Lise Meitner left uncredited. In addition to this gross omission, Meitner also was badly treated by the Swedish scientist who took her in, Manne Siegbahn.

The unpublished drama *Remembering Miss Meitner* imagines a reunion of Hahn, Siegbahn and Meitner 40 years after their time of living where all three return to a stage to discuss what happened during these formative years (Friedman "Remembering" 3). The author of the play, Robert Marc Friedman[14], is an experienced scholar in the field of the history of science and has especially focussed on the mechanics of the Nobel Prize for sciences and the political agendas behind the awarding of these prizes. The oversight of Lise Meitner has inspired this one-act drama that he first conceived of as a contribution to the Physics Day at the 6th International Science Festival in Gothenburg in 2002 (Friedman "Forging" 202). Eva-Sabine Zehelein praises Friedman's concise drama for its "reduction to essentials, both as far as setting and dramatic discourse are concerned" ("Science" 223). It is an attempt to "highlight historical figures through revisionist historiography in dramatic from, through a new look at and evaluation of both primary and secondary historical material" (Zehelein *Science* 224).

All three characters of the play are aware of their return to the world of the living after their death and are also curiously aware of the discourse that has surrounded their

[14] My sincere gratitude goes out to Robert Marc Friedman for not only trusting me with the manuscript but also for sending me additional background information on his writing process.

common history. They all carry a script of a play that they are supposed to act out and discuss their lives' trajectories. The fictional Lise Meitner is fed up with the perpetuated false narrative that Otto Hahn has so long held onto and is equally as dismissive of Manne Siegbahn's attitude towards her. The play is one long scene, as intended by the author who had only planned to contribute a short play to the conference he was invited to (Friedman "Forging" 2002).

4.1.1 BIOGRAPHICAL BACKGROUND

Lise Meitner was born in Vienna in 1878 as one of eight children of a wealthy Jewish family. Their Jewishness was more of a cultural than a religious lifestyle and Lise and all of her siblings converted to Protestantism by the time they were grown up (Sime 27). Ruth Sime, one of the leading scholars on Meitner, highlights her thorough education. At her time, such an education was highly unlikely because of the restrictive Austrian education politics where women were concerned, as Austria was one of the least progressive countries in the entirety of Europe at the time Meitner was alive (Sime 28). Nevertheless, Lise Meitner received private tutoring and eventually studied at the University of Vienna, where, under the tutelage of famous theoretical physicist Ludwig Boltzmann, "she became only the second woman in Vienna to receive a doctorate in physics" (Sime 28). Even though the historical Meitner might not be comfortable being referred to as such, she proved a prominent trailblazer for women's education in sciences with her persistence and unique career. After her PhD, Meitner moved to Berlin to visit the lessons of Max Planck, even though early 20th century Prussian universities barred women from studying and did not even offer any paid position to them (Ogilvie "Meitner" 878). But Meitner's determination proved to be successful: In 1922, she was one of the first female physicists to hand in her *Habilitation*, a second larger publication needed in the German academic system to enter the ranks of a professorship. She then became the first female physics professor at a German university, a significant milestone in the visibility of women in scientific education (Ogilvie "Meitner" 878).

Apart from her impressive career, Meitner is probably known by most people for her involvement in the discovery of nuclear fission. Shortly before the First World War, Meitner worked at the Kaiser Wilhelm Institute, a private university that allowed for her to work on a paid position as a scientist. It was at this institute where she met and started

to work with Otto Hahn, a young chemist who had previously worked on radioactivity (Friedman *Politics* 233). Hahn profited from Meitner's vast knowledge as a physicist since the study of radioactivity sat at the crossroads between physics and chemistry, especially in nuclear physics, the field that Hahn and Meitner were focusing on (Friedman *Politics* 233). Scientists had achieved fission beforehand yet were unable to explain this phenomenon, let alone put a word to what was happening when heavy elements are bombarded with neutrons (Friedman *Politics* 234). Meitner and Hahn were fascinated with the experimental results of fission that Enrico Fermi, an Italian physicist, had reported in his publications (Sime 29). Their collaboration was forced to split up by the time that Germany annexed Austria in 1938, when the German racial laws decreed Meitner a Jew regardless of her being baptised. Meitner fled without any resources to Sweden via Holland in 1938 and was consequently separated from her research group (Friedman *Politics* 234-235). She kept in contact with Hahn via letters, even spoke with him in a clandestine meeting in Copenhagen in 1938. Meitner was key in providing Hahn with the knowledge in nuclear physics that he needed to understand that what was happening. He was conducting experiments the instructions of Meitner from afar, which ultimately proved to be experiments involving nuclear fission (Sime 30). Or, as Friedman rightly observes: "Without her guidance on the physical interpretation, he was losing confidence in his finding. […] She gave him courage to interpret the results." (*Politics* 236). Despite Meitner's invaluable input, Hahn did not mention her in any of his publication of nuclear fission. As a Jew, Meitner was considered an enemy of the German Reich and Friedman speculates that Hahn knew exactly that any collaboration with her would be considered treason. Even more, the German authorities where highly interested in the potential that fission would hold for modern warfare and its success would secure Hahn a safe position in the difficult political climate of the German Reich (*Politics* 237-238).

In Sweden, where Meitner had fled to, she found refuge at the Nobel Institute for Experimental Physics, led by Manne Siegbahn, who did not welcome her all too friendly (Sime 29). Instead of appreciating Meitner for her expertise, Friedman wagers that Siegbahn felt threatened by her competence and refused to provide her with any sufficient funding or materials beyond the obligatory office and a basic equipment (*Politics* 238-239). She felt the hostile atmosphere towards her as a capable woman in a man's institute and lost faith when she heard of Otto Hahn perpetuating this narrative of him being the one to have discovered nuclear fission all alone (Friedman *Politics* 238). Hahn "never

wavered from his claim that fission belonged to chemistry" (Sime 30) and subsequently was the lone recipient of the Nobel Prize in Chemistry for this discovery in 1944. Meitner was forgotten and simply referred to as an assistant instead of the equal collaborator that she had been all these years (Sime 30). After the Second World War, Meitner managed to move to another Swedish institute where her talents were much more appreciated before settling in Cambridge, in close proximity to her former colleagues from Berlin. She died in 1968 at the ripe age of 90 (Sime 30). Her life's story is eerily similar to that of Rosalind Franklin, who, decades later, would also be betrayed by her male colleagues and cheated out of recognition. In both stories, the betrayal is only realised decades later through the work of historiographers who used biographical material to pursue the truth. Franklin's story is part of a later chapter of the analysis.

Meitner is described by her colleagues and also shows herself in her surviving personal correspondence as a shy and at times very insecure woman, presumably due to the difficulties that she faced in the male-dominated field of physics (Ogilvie "Meitner" 878). As a professor, her family describes her as assertive and bossy (Sime 28). Having found her place in the physics department in Berlin, Meitner bloomed and became close friends with many of her colleagues. Even though she and Hahn long continued their very formal relationship, she soon considered him one of her best friends and even became his son's godmother (Sime 29). His betrayal must have stung even harder because of their long collaboration and eventual tight friendship. Being thoroughly rejected by Siegbahn despite her excellent achievements in the field shattered her confidence even more (Sime 30). While Otto Hahn has been able to bask in all the glory, Lise Meitner spent years without credit and only the recent work of feminist historians such as Ruth Sime or Robert Marc Friedman have moved her back to the forefront of public recognition.

4.1.2 Framing Speeches and Reader Address

Friedman's play *Remembering Miss Meitner* is a prime example of a meta-theatrical revision of history. His characters are based on their historical counterparts yet are apparently also set up to star in a play about their lives. The reader is pulled into the action on stage by repeatedly being addressed by the three characters of Meitner, Siegbahn and Hahn. The characters move from the intradiegetic to the extradiegetic and break with the theatrical illusion when directly addressing the imagined audience or readership. This is

analogous to what Genette refers to as metalepsis, where characters in a play suddenly find themselves aware of their theatrical setting. The characters can then reflect on their actions on stage on a metatheatrical level, mirroring the Brechtian alienation effect (Richardson "Drama" 153).

This can be applied to *Remembering Miss Meitner* as well. In the grander sense of the diegesis, Meitner, Hahn and Siegbahn are merely convening as an interim step, waiting, so it seems, for other characters to come on stage in order to enact a play that they all have been given the script for (Friedman "Remembering" 3). All three of them, Hahn, Siegbahn and Meitner, enter the stage with the script in hand, almost as if they were ready for rehearsals like actors and actresses on stage (Friedman "Remembering" 3). Siegbahn is incensed at the "[l]ies and distortions" that have fed into this play that they are supposed to enact now that they are back, and Otto refers to the history books that this play bases itself on as "vindictive" (Friedman "Remembering" 4). The script is clearly a metaphor for a historical retelling that will now happen between the three. Lise even offers to replace Siegbahn should he not wish to join their play, but Siegbahn refuses, claiming that "[n]o woman takes [his] role" (Friedman "Remembering" 3). This clearly has double entendre if we consider the animosity and rivalry between the historical Siegbahn and Meitner during her stay in Sweden. In contrast to Siegbahn dismissal of the ridiculousness of the play, Lise is "only all too happy to perform this play", waiting for "the others [to] arrive, Planck, Bohr—" (Friedman "Remembering" 17). Both Max Planck and Niels Bohr would be, historically speaking, valuable assets in Lise's quest for vindication. The historical Max Planck was one of the first physicists to recognise Meitner's talent and to give her a place at a university and the historical Niels Bohr was one of the first whom Meitner told about her epiphany about nuclear fission and therefore counts as an important witness to Meitner's involvement. Additionally, the historical Bohr nominated her for a Nobel Prize (Jaeger 115). Their fictional counterparts would probably support Lise in her efforts to set the historical records straight, yet they never appear throughout the play.

The drama is framed by an opening and a closing soliloquy of the fictional Lise Meitner. In both cases, Meitner is still alone on stage, as Hahn and Siegbahn either have yet to arrive or have already left the stage, respectively. The closing moments will be looked at more closely in a following subchapter but the opening monologue of Lise Meitner is equally interesting. For once, she immediately recognises the audience in front of her, breaking the fourth wall and thereby the theatrical illusion in true Brechtian fashion

(Richardson "Drama" 153). She speaks directly to them, politely asking them whether they would mind her smoking and immediately realizing "[m]uch has changed in the forty years since I died" (Friedman "Remembering" 3). Despite her correct assessment and apparent knowledge of how smoking is by now forbidden indoors, she "*begins to light up anyway*", refusing to forego a guilty pleasure she has enjoyed her entire life (Friedman "Remembering" 3). When Lise is still alone on stage, she ponders her return from the dead: "I've been summoned here… to play a roll… a character on stage *(shakes her head disapprovingly; puts out the cigarette after a few puffs; flips through the pages of the play)* A play about me." (Friedman "Remembering" 3, emphasis in original). In the beginning, Lise does not seem convinced of the necessity of a play about her, mentioning how she had always resisted any attempt at fictionalizing her life (Friedman "Remembering" 3). This opening scene with her sets the tone for the upcoming play for the reader and also, narratologically speaking, breaks down the imaginary fourth wall between the characters and the reader, allowing for metalepsis (Richardson "Drama" 153). The reader is encouraged to share in the story and it is Lise specifically who invites them into the fictional world by immediately addressing them. If the public had been kept in the dark about her fate for forty years since her death, then it is only justified to now make them aware of what has transpired outside of the historical canon. It is even more concurrent with the topic of this thesis that it is the fictional Lise Meitner, the female scientist who had been omitted and even silenced by the common historiographic canon, who draws in the audience and prepares them for her own story.

However, both Siegbahn and Hahn are also keenly aware of their audience as soon as they enter the stage. They take special time introducing themselves with all their scientific achievement. Otto Hahn addresses the audience for the first time when he confides in them about how much Lise's resentfulness bothers him. Almost as if he only now realises that he is standing in front of an audience, he immediately apologises and proceeds to introduce himself as "Germany's leading physicist" and the one who "discovered nuclear fission, *die Kernspaltung*" and was subsequently "crowned with a Nobel Prize" (all Friedman "Remembering" 5, emphasis in original). His choice of words highlights his own sense of importance, implying that he is crowned almost like a ruler or a king is crowned and therefore endowed with influence and might. Manne Siegbahn is very blasé about his introduction and states that it does "[n]ot matter" whether the audience even knows who he is (Friedman "Remembering" 8). He knows his own worth and enumerates his achievement, ultimately culminating in justifying his lead position as

the Nobel institute for experimental physics through winning the Nobel Prize in Physics in 1937 (Friedman "Remembering" 8). Similar to Hahn, Siegbahn is painted in an air of superiority. While Hahn is still more subdued and almost bumbling, Siegbahn appears callous and vain.

In contrast, Lise is not nearly as concerned with how the audience sees her as her two male colleagues are. She does not introduce herself to the audience and seems entirely unconcerned with whether they know who she is or not. She does not give them her name, either because she does not think it would matter or because she secretly knows that her name has been overlooked in the annals of history (Friedman "Remembering" 3). It gives her a very confident streak, standing there in front of an audience all alone and not succumbing to singing praise about her own achievements to the unknowing members of the audience, in contrast to her colleagues who will join her later. One might interpret this as confidence, others might see it as rude or standoffish not to offer one's name when first meeting someone, even if it is a larger group of people. But there is also a certain bitterness in her refusal to discuss her life. Her tone shifts from unconcerned to sad when she recounts how she made "a discovery that changed the world", a discovery so monumental that "[a] new world opened…just as [hers] slammed shut" (Friedman "Remembering" 3). The discovery and subsequent use of nuclear fission might have opened new doors in physics that were unimaginable beforehand, yet Lise knows exactly that her world collapsed the moment that Otto decided to keep the recognition for himself.

The audience addresses and the different ways in which the characters introduce themselves serve important purposes. First, the audience is immediately pulled into the action, be it on an actual stage or as a reader of the dramatic text. They are practically invited to share in this dispute between former colleagues; almost even asked to take sides or comment among themselves about the opinions of the scientists. Secondly, they serve as an important contrasting of characters. Hahn and Siegbahn are immediately associated with their obsession with their reputation whereas Lise is more modest yet at the same time surprisingly aloof. These differences between the characters signify their own perception of importance. They value their work differently, some of them as markers of distinction, while Lise knows that hers will not be a distinguishable trait for the larger audience.

4.1.3 GENDERED IMBALANCES OF POWER

A topic that has heavily influenced the life of the historical Lise Meitner are the different positions of power that men and women hold in academia at that time in Germany and Sweden. This is also a key issue of the drama. The historical Meitner had to concede to the whims of male professors who did not value a woman's contribution to the sciences, such as the Prussian academic system that allowed no women to study or then men she had to work under, such as Manne Siegbahn, refused to treat her as more than an assistant despite her expertise. She had to accept the rules of the game, so to speak, that she was involved in as a woman in science but nevertheless tried to break the glass ceiling and pave the way for other women to follow in her footsteps. In contrast, the fictional Lise Meitner has had several years to look back at what happened in her time of living and to critically assess all that was wrong with this biased system. The play even provides her and her two colleagues with an opportunity for retrospection by supplying them with historical and contemporary materials: "*In the middle of the stage is an old desk/table covered with old papers, notebooks, and journals; also a few history books from the present*" (Friedman "Remembering" 3, emphasis in original). The characters are apparently aware of the time that has been passed and of the corrected narrative of history but these additional sources lend a scientific source to these claims, backing Lise's complaints and serving as physical reminders for Siegbahn and Hahn. Lise even uses the material that the stage has miraculously provided to call Otto out on his blatant lies. Manne and Otto try to discredit Lise by assuming that she drew false conclusion back when nuclear fission was still unheard of and that Otto alone had the sense to see the truth. Before Meitner and Hahn had devised that atomic nuclei could be split, Meitner had proposed, based on the experiments of Enrico Fermi, that the fallout of shooting neutrons at heavy elements could be referred to as transuranic elements which scientists believed to be new elements beyond the periodic table (Friedman *Politics* 234). The fictional Otto condescendingly claims that Lise "only produced nonsensical results" and that it was her who "would not allow [them] to consider that possibility" of a nucleus being split (Friedman "Remembering" 13). But Lise knows how to defend herself and produces one of Otto's own publications from the materials on the desk:

> MEITNER. Look here. In case you forgot. Here, [*rummages through some of the volumes on the table and grabbing one*] yes, here Otto, in your own

> article: In *Chemise Berichte*, 1937 – black on white, you wrote that the new man-made elements were now a chemical fact. Yes, look, you wrote this yourself about the transuranic elements: '…their position in the periodic table is no longer in doubt.' And you underlined, 'Above all…'
>
> HAHN. (*takes journal from MEITNER and reads*) … 'their chemical distinction from all previously known elements need no further discussion.' Did I actually---
>
> MEITNER. You had no reason to re-do again and again all those painstaking analyses. I was the one who kept urging you to press on.
>
> (Friedman "Remembering" 14, emphasis in original)

Hahn appears genuinely surprised to see such a statement in his own work, almost as if he never considered any other possible truth than the one he kept telling until his death. He seems so convinced of his own superiority that he forgot about his own ignorance at a certain point in time. It is possible that the fictional Hahn offers an explanation for the blatant disregard that the historical Hahn showed towards his colleague: Maybe Hahn kept to his original story of being the sole discoverer of nuclear fission for so long that, after a certain time, he started to believe it himself. At first he convinced others of this false narrative, and, at a later point, ended up accepting it as his own truth. He reminds Lise that this false narrative has been commonly accepted, that "[e]verybody knows [he] discovered fission. […] You [Lise] were simply not present", to which Lise replies that the only place that she was no longer present in was his memory (Friedman "Remembering" 16). This theory of Hahn having told a lie so long that he accepted it as irrefutable proof is supported by a later dialogue between the two in which Lise recounts their secret meeting in Copenhagen. Otto is astounded to hear that such a meeting took place and, in a rare moment of honesty, admits that he simply does not remember this happening (Friedman "Remembering" 20).

Even though Otto is the true perpetrator of the slight against Lise, he is the one complaining about his lot in this entire play. He laments in the face of "these accusations" about "what a man has to put up with" (Friedman "Remembering" 5) as if it was him who was defamed and cheated out of his due recognition. He leaves the impression that he is long past the old story and ready to move on, turning to the audience and informing them that "[Lise] is still so bitter" (Friedman "Remembering" 6), showing complete disregard for the slight that he has committed against his former close friend and colleague. He even

introduces himself to the audience as "Germany's leading chemist" and that it was him who "discovered nuclear fission" and was subsequently "crowned with a Nobel Prize" (Friedman "Remembering" 5) despite Lise standing right next to him on stage as the visceral proof of the fallacy of this tale. When discussing the threat that the German authorities presented to the works of scientists during the Second World War, Hahn surprisingly considers himself the true victim of the Nazi regime. He admits, without shame, that "[f]ission was [his] defence against those who wanted to get rid of [him]" and that his lies secured him his comfortable position as the leader of the institute (Friedman "Remembering" 12). It is incredibly tone-deaf to speak to Lise like this and to complain about the supposed difficulties this presented to Otto. As a woman of Jewish decent, Lise faced much more serious consequences than just losing her job, such as public humiliation, deportation and, above all, death. Even her excellent work would not have saved her from the baseless quest of the German Reich for the Aryan race. That Otto was afraid of siding with Lise at that time when she was considered an undesirable human being in Germany might still be understandable. But, as Lise reminds Otto upon his admission, he could have always rescinded his lies after the war ended and welcomed Lise into the circle of those celebrated scientists (Friedman "Remembering" 12), yet he simply chose not to share the glory.

The fictional Lise is surprisingly direct given the assessment that historians have given on the historical one. There is no longer the shy historical Lise who kept quiet all those years and not caved under the pressure. The fictional Lise is painfully aware of her missed chances, how she "never made a fuss" and that she "understood that it made no difference what she said" (Friedman "Remembering" 10). At her time of living, the canon of science was male and the authority behind these male voices made it nearly impossible for her to protest against it without endangering her own career. But this is no longer the historical but the fictional version of Lise Meitner. This fictional Lise is ready to collect her dues and does not shy away from calling out Hahn and Siegbahn on their behaviour. Hahn is more than willing to leave this entire story behind and would rather leave the stage than discuss what happened in those years before and during the Second World War. But Lise has other ideas: "Oh, I don't really mind being dragged from the dustbin of history, Hähnchen, where you left me." (Friedman "Remembering" 5). Her choice of words is indicative of the way that she feels. Hahn's betrayal and omission of her from the public records has left her in the dustbin of history, a literal place for things that are no longer of use or for things that are broken to be deposited into and forgotten. She not

only criticises Hahn for his omission but especially turns her gaze onto the entire male historiography, claiming that it is rich of Siegbahn and Hahn complaining when "it was perfectly fine when you and your boys told the story" (Friedman "Remembering" 4). Men have long led the field of historiography and have therefore not bothered to ask the male voices of authority in the sciences whether what was told was even remotely true. But not only the historiographers controlled the narrative. Hahn himself continued to write Lise Meitner out of the narrative of nuclear fission in an "eccentric desire for self-mythologizing" (Zehelein *Science* 229). Hahn published his own biography, as he mentions in the drama, and controlled the narrative around not only his life but also around the discovery of nuclear fission by adhering to this false tale. The historical Lise Meitner did not write a biography and also rejected being biographed by anyone else while she was still alive. It was only after her death that scholars found her private correspondence and thereby concluded how this important discovery really had been made (Sime 27). But, as the fictional Lise rightly puts it, "deceit can no longer masquerade as truth" (Friedman "Remembering" 10). Both Siegbahn and Hahn "tried to make [Lise] feel incompetent" (Friedman "Remembering" 17), Otto by denying her valuable work, Siegbahn by denying her any access to funding for her to continue her research.

The play ends on a bittersweet note with Lise alone on stage, reflecting on all the missed opportunities and the gendered imbalances. She asks no-one in particular "[h]ow could one woman stop them" (Friedman "Remembering 27), and thereby refers to the overall unfair power structures: How could one woman, even one who has succeeded to break down barriers that women long had had to overcome in science, overthrow such a well-connected and intricate system of those in power staying in power, especially when she was also politically prosecuted by a totalitarian regime. The enduring message, however, that Lise leaves the audience with, is one of admiration towards her chosen profession. Even though her story might not have the happy ending she would have deserved, she "would do it all over again and again and again" for "[p]hysics[, her] only love" (Friedman "Remembering" 27).

4.1.4 MANNE SIEGBAHN AND THE NOBEL PRIZE POLITICS

In the play, both Otto Hahn and Manne Siegbahn enter the stage as place-holders for men doubting women in science, the woman in this case being Lise Meitner. Otto Hahn appears to be a simple-minded opportunist. He is naïve, determined to bask in the glory all alone and shares his love for his home country in a non-nationalistic way (Zehelein *Science* 232). Whereas he is "never evil; of course not […] a good man, but… but so weak, so--- childishly self-centred" (Friedman "Remembering" 19), it is Manne Siegbahn who is the true villain of this tale. The fictional Otto Hahn seems harmless compared to the viciousness and condescension of the fictional Manne Siegbahn.

The historical Manne Siegbahn was an experimental physicist in charge of the Nobel Institute for Experimental Physics in Stockholm and had even received the Nobel Prize in Physics in 1924 (Friedman *Politics* 238). This nomination and awarding of Siegbahn's work did not go without controversy. Several members of the committee opposed his nomination, claiming that "he had neither made a significant discovery nor created a new instrument" but instead had "perfected that which others had begun" (Friedman *Politics* 238) which specifically went against the stipulations for the prize. But, according to Friedman, Siegbahn had powerful and influential friends on the committee and they advocated for him despite these misgivings (*Politics* 238). While Siegbahn may not have been the most gifted theoretical physicist himself, he understood the value and influence that certain field of physics held for the larger society and he was able to use this public interest to be awarded funding and prestigious positions.

He was particularly fascinated by the field of nuclear physics and spearheaded a campaign for expensive equipment to be designed and built at his own institute, ensuring the favourable support from the Swedish government who was heavily involved in joining the atomic race that had broken out in Europe (Friedman *Politics* 238). On paper, accepting the German refugee Lise Meitner, an expert in nuclear physics, into his institute might have been a breakthrough in his support for the Swedish nuclear campaign. But Meitner and Siegbahn were two sides of the medal of physics, her a planning theoretician, him a practical experimentalist. Meitner was good at designing experiments but less adapted to conducting them, while Siegbahn was all about conducting experiments with little to no knowledge of the theories behind them. Both of them had long held leading positions in their respective institutes and Meitner now came into Siegbahn's laboratory with the expectation of being treated as an equal, which Siegbahn did not and would not

concede to (Friedman *Politics* 238). Even though Meitner was the more experienced scientist in the field of nuclear physics, Siegbahn, who had next to no knowledge of nuclear physics, was her superior and therefore in charge of the funding. Meitner had to ask for any kind of monetary means and was thoroughly dependent on his assessment of the value of her work (Friedman *Politics* 239). Robert Marc Friedman assumes that Siegbahn was also involved in the Nobel campaign for Hahn or rather in the deliberate omission of Meitner, as "giv[ing] a Prize to Meitner would inevitably elevate her from a powerless, despairing, and dependent refugee in Siegbahn's laboratory, into a recognised, leading authority in nuclear physics, even in Sweden" (*Politics* 239). This could sabotage Siegbahn's own staging of himself as the head of the nuclear physics programme, which is why he used his influence, according to Friedman, to vote against including Meitner. But Siegbahn "was not alone in working against Meitner", as many of the other members of the committee also refused to acknowledge her work, believing the narrative of Hahn (Friedman *Politics* 239).

In the face of this historical background, it is no wonder that the fictional Siegbahn and Meitner share no love for one another. The fictional Lise Meitner mirrors Friedman's impression of Siegbahn's incompetence: Her assessment of Siegbahn's work is cruel, calling "[h]is grasp of physics: uninspired" and "[h]is own Nobel prize: controversial", claiming that all Siegbahn did in his life was "just an improvement of others' instruments" with "[n]o real discovery" made by himself (Friedman "Remembering" 10). The allusions to Siegbahn's controversial Nobel Prize and his work are obvious. For a theoretician like Meitner, Siegbahn's limited understanding of theoretical physics would seem uninspired and the fact that he received a Nobel Prize when he neither discovered nor built anything new is controversial at best. One could argue that Meitner's own history with the Nobel Prize is controversial as well, if only for the opposite reason than Siegbahn's. Her not winning the Prize is controversial, while him being awarded is questionable.

The fictional Siegbahn is not too happy about meeting Meitner again. He is violently opposed to going over history once more and is shocked at discovering that this version of himself is how he remembered, showing his vanity and his obsession with his reputation (Friedman "Remembering" 4). This supposed re-enactment, to him, is a "farcical attempt to distort history" (Friedman "Remembering" 17). He likes to control the image that people have of him, which he clearly shows when he introduces himself to the audience. It does not matter to him whether any audience members know him, he refers them to "any Swedish physicist" that they can ask, wholeheartedly assured that his

legacy has secured him a spot in any Swedish physicist's common knowledge (Friedman "Remembering" 8). It is this sense of grandeur that lends him an explicit vein of arrogance. He continues to portray himself in a much better light than Lise does, staging himself as her saviour who graciously shared his funding with her and gave her, a refugee with no means, a home in his institution while conveniently forgetting that he also made her beg for any scrap of material and money (Friedman "Remembering" 8-9). Ironically, Otto Hahn takes Lise's side in this argument and acknowledges her worth by stating that "Lise Meitner was worth more than money" and a "present" sent by fate, implying that all the funding Siegbahn was able to accumulate was worthless compared to Meitner's extensive knowledge (Friedman "Remembering" 8). He even attacks Siegbahn when the latter argues that only one of the prizes, chemistry or physics, could have been awarded for the discovery of fission and that the committee must have deemed Hahn as a chemist worthier. Hahn is shocked, noting how "Meitner could have had the physics prize for *explaining* fission while [he] took the chemistry prize for making the discovery" (Friedman "Remembering" 24). Again, Hahn appears to have conveniently forgotten that he himself forgot to give credit to Lise. Siegbahn is just as hostile towards Lise as she is towards him. He supports Hahn's delusional narrative of having discovered fission only when Lise left Berlin and dismisses her work entirely (Friedman "Remembering" 10, 13).

Naturally, Siegbahn signifies and functions as a stand-in for the entire Nobel committee that kept Meitner from receiving her due. It is not just Otto Hahn who let her down, it is an entire section of the scientific community, in the play portrayed through the character of Siegbahn, who himself historically held close ties to the proceeding behind the doors of the Nobel committee. It is evident that Siegbahn holds the Nobel committee in the highest regard and places a lot of authority on their decisions. As stated above, he supports Otto in his false narrative of being the sole discoverer of nuclear fission and justifies this opinion by citing the Nobel committee as the deciding force. When Lise is again distraught over Otto's rejection of the truth and omission of her from his work, Siegbahn cuts in and reminds her that the "Nobel committee decided who made the discovery" (Friedman "Remembering 20). Normally, a decisions as significant as this would need to be based on hard facts and evidence. Lise even mentions all the letters that she sent Otto which irrefutably proved that she was key to discovering nuclear fission but Siegbahn stoically sticks to his beliefs (Friedman "Remembering" 20). He falsely prioritises the decisions of a single committee when we consider that these Nobel committees are only rarely impartial and usually do not represent the majority of the

scientific community involved in active research. It is, as Friedman himself said, a privileged close circle of members, often from Sweden, who tend to favour their own countrymen or neighbours before considering that there is work worth of merit outside of their own circle (Friedman *Politics* 2, 54). The Nobel Prize has a long history of controversial decisions that have historically been linked to the exclusivity of the members of the respective committees, see the respective chapter of this thesis.

It is exactly this exclusivity that Lise decries. In the very beginning of the play, Siegbahn displays his vanity by complaining about how he is nowadays portrayed in history books. As Lise reminds him, Siegbahn seemed "perfectly fine when [he] and [his] boys told the story" (Friedman "Remembering" 4), implying that Siegbahn only cares about fallacy in history when it is out of his and his associates' hands to control the narrative. Historiography and by default also the scientific community have long discredited Lise as a mere assistant to Otto when she was actually an equal. Siegbahn did not seem to bother with the "[l]ies and distortion" (Friedman "Remembering" 4) when these lies benefited himself. But now that he is on the receiving end of historical criticism and historiographical research, he suddenly seems to mind if a scientist is portrayed unfavourable. The historical accounts are adding insult to injury by stating the truth about Siegbahn when they, for so long, perpetuated lies about Meitner. Lise Meitner is apparently fed up with this small number of men in power. She "[doesn't] care what a handful of Swedish men think" (Friedman "Remembering" 6), alluding to the Nobel committee and its larger-than-life authority in the scientific community. They have dominated her life for far too long, even after her death, and it is about time that the historical records are set straight. She "*gestures to recent history books*" and says that she "cannot prevent all those once hidden secrets from being discovered" (Friedman "Remembering 7, emphasis in original) and, my guess is, she does not want to, either.

It is not only the secrets of the past regarding her involvement that may finally be discovered. The Nobel protocols are stored for 50 years, according to the Nobel foundation to protect the decision-making process. What this long secrecy also does is keep the entire nomination and awarding from being transparent to the larger public (Friedman *Politics* 24). Candidates may long be dead when these protocols are released and those who have been nominated may never find out why they were not considered worthy of the prize. In the case of Lise Meitner, these protocols can finally divulge why her contribution was not considered and who influenced whom in this political game. In the play, this non-transparency is the climax of this one act play. After a long discussion,

the three characters finally turn to the involvement of Siegbahn and his Swedish atomic programme. Meitner recounts a visit to America, where she was met with enthusiasm and respect after her long stay in Sweden where she was treated as a second-class scientist instead of as the stellar scholar that she was. Siegbahn visibly reacts to this, betraying his envy and that he felt threatened by Meitner's success (Friedman "Remembering" 24-25). In that moment, Meitner makes an important observation: "A Nobel Prize would have made it impossible to ignore me even in Sweden" (Friedman "Remembering" 25). Siegbahn's grand plan of leading a Swedish nuclear programme might have been all for nought if the Nobel committee gave Meitner her due recognition. It is then that Siegbahn finally admits:

> SIEGBAHN. Yes, the prize would have given you authority and prestige. Don't I know? What right did you have to come here and think you could steer our science? Your friends – Bohr, Klein, Petterson, and the other, they were eager for you to get a prize… weren't they…eager to use you against me and my plans- […] You, you would have just moralized… waved your little finger at us, running to the newspapers, the politicians. No; Miss Meitner could not receive a Nobel Prize.
> HAHN. Of course… she…naturally could not share my prize, but…
> SIEGBAHN. Precisely. You were our hope for the rebirth of German science. We all understood that. […] And as neutrals, we could show the Americans that we could give the prize to whomever we choose. And now… I've said more than enough. Much too much.
>
> (Friedman "Remembering" 25-26)

Not only Lise has arrived at an important moment of truth, but Otto also understands now that his nomination and awarding had less to do with his chemistry and more with a political agenda behind the entire prize. It was all part of a larger plot behind the Swedish plan to secure their neutrality by starting their own atomic programme based on nuclear energy, in which the fictional Siegbahn saw himself secure as a leader (Friedman "Remembering" 25). What Siegbahn reveals in these few lines is his obvious envy of the sway that Meitner held in the scientific community. Powerful friends such as Niels Bohr, Hans Petterson or Oskar Klein had advocated for her when Siegbahn's own prize had been met with so much resistance. He must have soon realised that the poor refugee he

had let into his laboratory was more of a threat than he had calculated. If he truly believed her to be incompetent and insignificant, then he would not have bothered to discredit her or to keep her from winning prizes. Instead, his mistreatment of her stemmed from his own personal insecurities in which he saw her overtake a project that he had spent years involving himself in. So, instead of acknowledging her work, he and, as he implies by using the first person plural, the committee decided to award Otto Hahn alone, conveniently playing into his narrative of discovering fission all by himself. Sweden thereby was able to secure their own atomic programme with Siegbahn firmly in place and, in the meanwhile, tied Otto Hahn as the discoverer of fission to themselves by awarding him a Swedish based prestigious prize and thereby discrediting Meitner even further. Otto Hahn as "[their] hope for the rebirth of German science" would be their key to save the "special relation" Sweden and Germany always had and indebt Germany to Sweden for many years to come (Friedman "Remembering" 26). He may have shared too much about the political agenda behind the Nobel Prize but as these matters are long past, he does not seem too worried. In Siegbahn's final words on stage before he exits and leaves Hahn and Meitner alone, he reminds them that "[t]here are certain matters that should never be discussed – ever" and that the Nobel Prize belongs to Sweden alone, being their "prerogative" (Friedman "Remembering" 26).

What we as readers and especially what Lise finds out in these final moments is that there was an almost insurmountable number of opposing figures stacked against her. Otto Hahn was trying to protect himself from the Nazi regime by denying any association with Meitner, who, as a daughter of Jewish parents, would be branded an enemy of the state. He chose his comfortable secure position over collegial trust. Even after the war, once he might have been safe to reveal Meitner's involvement, he had told the lie for such a long time that he had started to believe it himself and would no longer accept any other accounts of how fission was discovered. Siegbahn had similar material motivations for denying Lise Meitner her due fame. He saw his influential position in danger and was threatened by Meitner's success and knowledge. If Sweden wanted to launch a nuclear programme, then they needed the German expertise to further their research, and Otto Hahn, who had already separated himself from Meitner, seemed the obvious choice for the recognition that a Nobel Prize would bring. It is perhaps more realistic than one might believe just how politically motivated the awarding of the Nobel Prize can be. Friedman as a scholar has published extensively on the machinations of the Nobel committee and has obviously used his knowledge and research to offer an explanation for Meitner's

rejection. As he himself observed, [t]he history of the prize is a history of using the prize" (*Politics* 4), just as Manne Siegbahn has just admitted. Friedman has not only included a more personal side to the betrayal, namely that of Otto Hahn's lack of solidarity with his colleague, but also that of greater international politics in the face of the Second World War in which new weapons and technologies might save a country such as Sweden from extinction. He competently "initiates the reader and audience into the mechanisms behind the scenes of the Nobel decisions" (Zehelein *Science* 231). Meitner, in this fictional version, was the unfortunate pawn caught in between political agendas and has suffered the consequences of it.

4.1.5 MEITNER'S SOLILOQUIES

At the heart of this one-act play are the soliloquies of the character of Lise Meitner, in which she recounts the history from her point of view after being denied for such a long time. She divulges on her personal history and on the making of science at her time of living. These are intimate insights into her personal feelings, shared with the audience and the other characters on stage. The fictional Meitner is on stage with the other two characters and they even interrupt her first monologue with interjections while she holds it. Yet Meitner does not react to those interruptions and speaks very candidly about her fellow scientists almost as if they were not present. She talks about them in third person (cf. for example Friedman "Remembering" 10, 19) and then seamlessly returns to their dialogue as if these moments of her speaking continuously never happened. They therefore give the impression and nature of a soliloquy instead of a monologue, as Meitner is apparently unaware of her audience. Her monologues echo a stream of consciousness because of their unfiltered nature, as she dives deeply into her feelings of personal betrayal (cf. Nünning and Sommer 117-118). In Richardson's typology of dramatic narrators, the character of Lise Meitner can therefore be counted as a monodramatic narrator, who is usually only one of very few characters who occupies most of the play with their speech and thereby assumes the main role in the drama ("Point" 209-211).

In her first longer soliloquy, Meitner draws parallels between her first arrival in Berlin and her flight to Sweden, 31 years apart, which were eerily similar to one another: "I came to Berlin in 1907 with hardly a coin in my pocket and was forced to flee in 1938 without much more" (Friedman "Remembering" 8). A lot has happened in these 31 years

that Meitner stayed in Berlin. She rose through the ranks of the German academic system and moved from a destitute student who was barely tolerated because of her sex to one of the first female professors of physics in German academia. But all these accomplishments seem insignificant to the German totalitarian government because "[her] biology became [her] fate" (Friedman "Remembering" 8). It did not matter what Lise had achieved, she would always remain a Jewish person before the law of the German Reich and therefore a second-class citizen who was barely tolerated at best. Despite her impressive career, at the age of 60, Lise had to flee. The fictional Lise is understandably shocked at this development:

> MEITNER. I lost my job, my pension, my belongings. In Germany non-Aryans became non-persons. I could not stay; I could not work; I could not leave. My friends smuggled me across the border to Holland […] I abandoned everything… my laboratory, my notes, my equipment… my reputation. I left it all behind in Berlin. […] [In Sweden] I was never allowed to be part of the research. I had to ask for everything from paperclips to the smallest instrument. If I was allowed to borrow an instrument in the morning, it was gone by the time I returned from lunch. Everything went on behind my back.
>
> (Friedman "Remembering" 9-10)

This is a rather long quote but the enumeration serves an important purpose. In a very dry and almost academic way, Lise gives the audience a list of all those things she had to leave behind. It is not just the material loss that she has felt during her exile – relinquishing her equipment, her work material, her monetary means – it is also the loss of anything that gave her the feeling of value as a person that Lise had to let go of. She will receive no pension from the German state, leaving her without any protection against old-age poverty. She has lost her job which had not only been her occupation but her calling for several years. And, most of all, she lost her reputation. She was a celebrated physicist in Berlin up until the German Nationalist Party ascended to power. Her work gave her life an enduring meaning and a purpose, which she now had to leave behind in a country that had turned from home to mortal threat in the matter of a few years. It is the unembellished, simple words that she used that give insight into her absolute depression and Friedman's "short, precise, matter-of-fact style […] succeeds in conveying the utter

sadness and deep feeling of loss and emptiness Meitner must have experienced and suffered from" (Zehelein *Science* 227). What is happening here is that the author offers a testimonial a historical Meitner might have never been able to give, now embodied in the fictional Meitner trying to emote to the audience what this true loss of everything that she was and owned truly felt like. The soliloquy in combination with the historical retrospective serve their combined purpose of giving insight into a point of view that had been unheard for far too long.

The next soliloquy is another short moment of introspection, yet this time the staging and stage directions frame it accordingly. Meitner and Hahn had been lost in memories of their collaboration when Hahn ultimately directs the conversation to Adolf Hitler and his rise to power, which consequently forced Lise Meitner to leave Berlin. The moment Hahn segues into the topic of the former German dictator, "*HAHN [goes] rigid*" and the "*light [centers] on Meitner*" (Friedman "Remembering" 19). For a moment, it seems, Otto is frozen in time, rigid in his stance as the staging grants Lise an uninterrupted moment of introspection on stage. After she has finished, the "*light returns*" and Otto Hahn "*continues as before*" (Friedman "Remembering" 19), almost as if time stood still for Lise's memory of this worst moment in German history and the potentially worst moment in her own personal life as well. This is a more traditional soliloquy compared to the other two, as Lise really receives a moment of her own, alone, without Otto or Siegbahn listening on. Siegbahn sits at the edge of the stage and reads, therefore seemingly unbothered by Lise's speech (Friedman "Remembering" 17). It is not surprising that the mentioning of Hitler would force Lise to take a moment for herself. She dives into a short monologue, needing to process the painful memory in peace without interruption. Otto and Siegbahn are not allowed to hold control over those moments or to interrupt her soliloquy as they have done beforehand. This is her moment. The political climate and fear, she claims, "brings out the worst in some; the best in others" (Friedman "Remembering" 19), which she takes to be the explanation behind Otto's cowardice and betrayal. Lise reflects on the unfairness of her lot and her inability to protest:

> MEITNER. Why should one old lady be allowed to get in the way of Otto Hahn? Why should one little old lady be allowed to get in the way of the leader of Swedish physics, Manne Siegbahn, who had his own ambitions for nuclear physics? Ssshhh… Only Otto did not actually understand what he finally had discovered. Ssshhh…Only Siegbahn feared little old ladies who

> knew more physics than he… So what could be done with the little old lady? Dump her.
>
> (Friedman "Remembering" 19)

The derogative way in which Meitner describes herself here must mirror the impression that she received from those around her: She was nothing but a 60-year old lady in the way of men destined for grander things than her. At least that is what is perpetuated in the canonical historical accounts, namely that she was simply no match for the genius of these two. But, almost conspiratorially, Lise shushes the audience and, one might imagine, leans in to tell them the truth. Otto Hahn was out of his depth without Lise Meitner's guidance. Manne Siegbahn showed his insecurities by being so utterly afraid of a German refugee scholar arriving in his laboratory when he knew full well that she was infinitely more talented in nuclear physics than he was.

Lise's final soliloquy follows only a couple of scenes after the second one, this time triggered by a discussion with Hahn about giving credit. In this soliloquy, Lise is much more emotional and discusses her feelings when she finally understood what was happening in the until then unnamed fission (Friedman "Remembering" 21). She recounts a walk in the snow with her nephew Robert Frisch during which everything finally clicked into place for her to understand how a neutron could possibly split a heavy atom. In contrast to the subdued, emotionless style of her first soliloquy when she was talking about seeking refuge in Sweden, this soliloquy about conducting science bursts with emotions:

> MEITNER. How was it for you, Otto? What did you feel when you and Fritz realized you indeed had barium, had found something unexpected? For me, when I found the last piece of the puzzle… it was sublime. My greatest moment. […] Oh, those of you who never worked in science have no idea what it feels like. To break loose! Cut the moorings! Throw yourself in the untouched snow…wave your arms and legs… and to leave *your* impression; your own impression and become… a snow angel.
>
> (Friedman "Remembering" 22)

Oddly enough, Lise now seems aware of Otto or she at least tries to have him react. It is unclear whether this transgresses the boundaries between soliloquy and monologue. Nünning and Sommer claim that these kinds of speeches in drama can transcend the boundaries of monologue and soliloquy by exceeding the boundaries of consciousness, for example when characters hold a soliloquy on stage yet then expect their fellow characters on stage to react afterwards without having acknowledged them in their soliloquy in the first place (117-118). Either way, it is a highly emotional recollection for Lise when she remembers how she felt during the height of her scientific career. Discovering fission and finally figuring out what was behind this enigma of physics is described as her "greatest moment" and even "sublime". Strikingly, Lise is much better at expressing her emotions when talking about the happiness and elation she felt when she had a major breakthrough. Compared to her cool and collected retelling of the worst moment of her life, her displacement because of her heritage and the betrayal by her former colleague, Lise here is positively passionate. The trauma that her flight and the Swedish rejection must have caused in her are palpable in this contrast. At that point in time when she understood what was happening in nuclear fission, she still held hope that her work could mean something and that things would turn out for the better for her. In hindsight, it seems easier for her to compartmentalise these feelings and separate the joy of working as a scientist from the personal losses she had had to face when she fled to Sweden. The analogy that she draws of her leaving her marks in the snow evokes an image of untouched ground in physics. She and her colleagues "were making [their] trail where nobody previously had journeyed" (Friedman "Remembering" 22). This field of nuclear physics was terra nova for most of the scientific community and she, together with a few select others, were the first ones to set foot in the "virgin snow" (Friedman "Remembering" 22) of unchartered territory. This analogy of footprints in the snow soon turns ironic when we think of how fleeting these impressions can be. Once the snow melts, her impression will be gone, just as much as her credit and recognition will be gone once Otto decides to cut her out of the narrative. These moments of happiness are, in hindsight, short-lived and cannot be held onto. It is only through the work of historians of science and in fictional re-imagining such as this drama that the historical Lise Meitner, now fictionalised, can return to these happier moments and set the record straight. Historiography will unearth the forgotten accounts; a drama will imagine all that was in-between and could not be gleaned by studying sources.

Remembering Miss Meitner gives a voice to the historical Lise Meitner by extended monologues and a metaleptic view on history that breaks the theatrical illusion and invites metahistoric commentary. In contrast to this drama, which takes place forty years after Meitner's passing, the next play, *Comet Hunter*, accompanies the astronomer Caroline Herschel during her actual lifetime.

4.2 "MADAM, YOU HAVE IMMORTALIZED YOUR NAME": CHIORI MIYAGAWA'S *COMET HUNTER* (2003)

One of the most well-known women scientists is arguably the astronomer Caroline Herschel, who has reached recognition through her discovery of comets and as one of the first women in science to be paid an annual wage by the crown of England (Hoskin "Unquiet" 26). She worked alongside her older brother, William, who himself was also a renowned astronomer. Her life has been discussed in several fictional accounts, one of them is Chiori Miyagawa's drama *Comet Hunter*, first produced in 2002 and then published in a collection of her plays in 2012, *A Thousand Years Waiting*[15]. The drama, accompanies a fictional version of Caroline Herschel from the time when William takes her with him to England to work for him until shortly after his death, when Caroline returns to Hanover. In this play, Caroline is accompanied by the meta-narrative character of Time, who represents both the actual time passing as well as a commentary on the history to follow, providing both metalepsis and introspection. This character serves as a narrative enabler of focalization into Caroline's thoughts and feelings, offering the reader an insight that history could not have given. The careers of the Herschel William and Caroline as well as Caroline's precarious position as a female astronomer are the topic of the play, with the character of Time being an essential part in the narrative arc of the drama.

4.2.1 BIOGRAPHICAL BACKGROUND

Caroline Herschel was born in 1750 as the daughter of an oboist and his wife. At the age of ten, she caught the typhus virus, which left her with no sight in her left eye and stunted her growth; she would grow only 1,30m tall and remained pockmarked throughout her lifetime from the disease (Hoskin "Assistant" 428). Her mother Anna Herschel, who is often portrayed in biographical accounts as a strict and old-fashioned woman even for her own time of living, wagered that Caroline would never marry due to her short height and marred skin and wanted her to be a servant in the household. It was her father, Isaac

[15] This thesis features other dramatic texts that were never published and were therefore assigned their year of first production as their year of conception in lieu of a year of publication, which is why I have decided to choose the year 2002 for *Comet Hunter*.

Herschel, who sometimes taught her in secret alongside her brothers, particularly in the study of music, against her mother's wishes (Fernie 486; Hoskin "Assistant" 425). William, the brother she felt closest to, was twelve years her senior and unhappy with his work in the regiment. He fled from his military duties and moved to England in 1757. In 1772, he came back for Caroline and invited her to stay with him in England as well to serve as his housekeeper and musical assistant in concerts. Not only did William provide Caroline with a career opportunity outside of her life as a servant, he thereby also gave her a way out of the restrictive household led by their stern mother (Hoskin "Unquiet" 22). As William's musical career took flight, Caroline soon joined him as a singer and even received invitations to perform as a singer outside of their home in Bath. She declined these offers and potential opportunities to start her own career and stayed by her brother's side, who by then had started to focus his career in astronomy (Hoskin "Unquiet" 23). William's scientific career fully launched when he discovered a new planet in 1781, namely Uranus, which he at first named *Georgium Sidus* for the then King of England, George III (Hoskin "Unquiet" 23; Fernie 487). Caroline and her brother worked in tandem, with Caroline providing an invaluable aid and, as was wont of women of her time, unpaid service: William would watch the sky at night with Caroline next to him taking notes of his recordings; by day, William worked elsewhere while Caroline was left to tend to the household and transcribe his notes into catalogues of the heavens (Hoskin "Unquiet" 23).

William often travelled in his line of work as a royal astronomer and during these weeks, Caroline had taken it upon herself to watch the night sky all by herself. The then standard catalogue to be used was the British Catalogue of Stars by John Flamsteed. Caroline found during her sweepings of the skies that this catalogue was organised by constellations instead of zones in the sky, which made it highly inconvenient to use. Her solution was to reorganise the entire standard catalogue by herself and to update it to the current standard. The Royal Society was so impressed by her work that she became the first woman ever to be paid to compile a scientific publication, namely a new index of the stars. The index was published at the Society's expense and Caroline made history as one of the first paid women in science (Hoskin "Unquiet" 22-24). She was so successful in her own work that William soon gave her better equipment to work with and, in the following years, she discovered eight comets, all of which are named after her (Hoskin "Unquiet" 24). The sibling partnership soon came to an end when William married the wealthy widow Mary Pitt in 1788 and Caroline moved out of the house to make room for

the new Lady Herschel. After having provided for William and running his household for so long, this must have been a terrible blow for Caroline who had devoted her entire life to her brother. However, what she must have thought or gone through back then will remain a mystery. There are no personal records such as diaries or letters of the first years of the marriage between William and Mary, since Caroline had destroyed them years later, as Michael Hoskin assumes, "because she was now ashamed of what she had written" ("Unquiet" 25). It was at that time that she started receiving her annual pay for her own work as an astronomer: Instead of accepting William's offer of "financial compensation[,] she asked instead that the Crown pay her as his assistant and so became the first remunerated woman in the history of astronomy" (Hoskin "Unquiet" 26).

Caroline returned to her hometown of Hanover at the age of 70 after William's death and continued her work for William's son John, who also worked as an astronomer, until her death in 1848. By then, she had received a gold medal from the Royal Astronomical Society and an honorary membership for their circle, an exception for her sex during her lifetime. She was held in high regard by her fellow male scientists and especially by the general astronomical scientific community and was honoured after her death by the Prince and Princess of Hanover when they "sent their coaches to follow her hearse" upon her funeral (Hoskin "Unquiet" 26).

The relationship of William and Caroline has been a favoured topic of authors of fiction and non-fiction alike throughout the years after their death. From what the available historical sources provide, Caroline had sacrificed her entire life's ambition and trajectory to her work as William's assistant. If William was working and too busy to take care of his basic human needs, Caroline would sit by his side and feed him so that he need not stop his work, or she would read to him while he built his new telescopes so that he would not waste any time (Hoskin "Unquiet" 23). It is argued by historians such as Michael Hoskin that the historical Caroline might have felt indebted to William for rescuing her from her life as a servant and supposed spinster in Hanover (Hoskin "Unquiet" 24). Others, such as Emily Winterburn, reject such a one-sided portrayal of Caroline Herschel as a mere supplicant to her brother; she laments the "Cinderella-like figure" of Caroline compared to William as "her heroic prince" (Winterburn 70). Such accounts would undermine Caroline's agency as a person and ignore socio-historical context much needed to understand the relationship of the Herschel siblings, according to Winterburn (72). Winterburn also specifically criticises Hoskin for trivializing Caroline Herschel's work, demoting her from an actual scientist to her brother's assistant.

Additionally, she doubts that Hoskin has properly understood astronomical work of the 18th century, which adds to the distorted image he paints as one of the major scholars on the Herschel siblings (cf. Winterburn 78).

Either way, William expected her assistance in his work and Caroline provided. She even gave up her chance at a successful musical career when it became clear that William would abandon his orchestral work and focus entirely on astronomy. She benefitted from William's tutelage and learnt mathematics, astronomy and basic physics. Sometimes, William would apply their lessons in everyday settings: When cake was served, Caroline was asked to calculate the number of degrees of the slice of cake she was served. If she guessed the right angle, she would be rewarded. If the number was wrong, however, William would let her go hungry and deny her the piece of cake (Hoskin "Unquiet" 23). Their relationship reads as heavily imbalanced and Caroline's own memoir even confirms their strict hierarchy as she self-deprecatingly notes: "I am nothing, I have done nothing; all I am, all I know, I owe to my brother. I am only the tool which he shaped to his use – a well-trained puppy-dog would have done as much" (Herschel 166). It is an interesting relationship between siblings, let alone between a man and a woman in science, in which Caroline occupies the aforementioned unpaid servant to her brother's work, who takes her labour and supplication for granted, so it seems. These impressions can only be made on the surviving material, however, and are therefore subject to discussion, as the debate between Hoskin and Winterburn has shown.

4.2.2 THE HERSCHEL SIBLINGS

A key topic of the drama centres around the Herschel siblings and their relationship, particularly Caroline's attachment to her older brother William. It is clear from the very beginning that Caroline thinks the world of her older brother, whom she describes as "handsome" and "splendid" (Miyagawa 39). What might be interpreted as sisterly affection soon takes on another quality as Caroline prioritises William's needs over her own. In a private conversation with Time, she highlights that William "deserves [her] complete devotion" and that she has "no illusions" about the fact that "[her] fantasies are temporary" (Miyagawa 46). Time has tried to engage her in imagining a life of her own, and to consider one of William's colleagues, Sir Watson, as a potential love interest for her, for whom she was polishing a mirror for a telescope. But all Caroline does is refer

back to her duty to William. When Time asks her if she is unhappy for being unmarried, all Caroline replies is that she is "only unhappy because [she] cannot do more for William" (Miyagawa 46). Caroline's happiness is not a matter to her, only William's success is. It is an unhealthy approach to a relationship if one party, in this case Caroline, prioritises the other person's happiness, in this case William's, over their own. She even confirms this to Mary Pitt, who at one point in her marriage asks Caroline if she is happy with her life, to which Caroline immediately deflects that it is "William's happiness, which [she] care[s] a great deal about" (Miyagawa 66). Caroline is obsessed with seeing William happy, probably borne from her feeling of indebtedness to him. But this obsession not only costs her her own life's choices. It will inevitably lead to heartbreak upon William's marriage to Mary Pitt later in the drama for the fictional Caroline. She will then have to realise that while William may have been her priority, William will continue to lead his life regardless of her own. This is not necessarily a fault of William's: He acts as any independent and happy person does, focussing on their own life's trajectory and putting their individual happiness first. It does however highlight the skewered relationship of Caroline and William. In her strife for making amendments for being saved from the life of an unmarried servant to her mother, Caroline has assumed that William is just as much focussed on staying with her as she is. She has been blind to William's needs outside of their relationship, as Mary reminds her when she says to Caroline in a private conversation that "certain things are only understood between a man and his wife" (Miyagawa 68).

It is the relationship between Mary and William that inevitably forces Caroline to come to terms with the imbalanced relationship of the two siblings. Caroline returns home from the market and stumbles upon William and an unfamiliar visitor in their home, whom William introduces as their neighbour, the wealthy widow Mary Pitt. They shortly engage in friendly small talk, before William accompanies Mary home to leave Caroline alone on stage with Time. As Caroline closes the door, comprehension dawns on her:

> TIME. Change is coming.
> CAROLINE. He called me Caroline.
> TIME. He usually does, when there is company.
> CAROLINE. Yes, but today, it was different. Distancing.
> TIME. As time moves, distance alters. Don't worry. This is neither the beginning nor the ending.

> CAROLINE. William has talked about that woman, Mrs. Pitt. She is the widow of a wealthy merchant. She is not as beautiful as I imagined.
> TIME. And you? Do you think you are as beautiful as she imagined?
> CAROLINE. Who am I that she needs to imagine? She will have everything and I will end with a void.
>
> (Miyagawa 59)

Caroline has been her brother's closest confidante for almost 16 years and she is immediately able to tell that something is different about this visit. The tone of a voice does not translate onto the written page, but the fictional Caroline provides a description to William's voice, noting that he sounded "[d]istancing" (Miyagawa 59) when he referred to her by her full first name instead of the affectionate nickname, Lina, that he usually uses. The pieces of the puzzle click into place for Caroline, who realises that William has already talked about Mary beforehand. As she begins to understand why Mary has been in their home, her tone turns hurtful and spiteful towards this unknown woman whom she just met. Caroline childishly reduces her to her looks and shows, in between the lines, her confusion over why Mary is not nearly as pretty as Caroline thought.

What Caroline inadvertently does is demonstrate her own insecurities by this petty comment: For Caroline, who has been told her entire life that she was too ugly to marry because of her short height und uneven skin, only an extraordinarily beautiful woman may be worthy of taking her place. Caroline is hard-working and loyal, but misses the required beauty to be of worth to society; if Mary does not look beautiful, then it is surprising that she would take the place of a wife in Caroline's distorted understanding of how merit works for women. The follow-up question of Time and answer of hers only confirm this: Caroline has everything to worry about, as the mediocre-looking and wealthy Mary will "have everything" while Caroline will lose everything she held dear and "end with a void" (both Miyagawa 59). This mirrors Caroline's insecurities as well as certain standards that have been put on women throughout the entire history of mankind, namely their worth on their exterior. Caroline has suffered from being reduced to her looks for such a long time, by society and her own social circle alike, that all she knows is to lash out at a woman that she perceives more beautiful who will take everything Caroline holds dear. All of Caroline's hard work, how she "arrived in England" and had "no knowledge of the language", "no friends" and "no time either" (all

Miyagawa 61) and how she quickly had to adapt to the demanding lifestyle of her older brother, all of these things Mary knows nothing about and yet will take it all away from Caroline. At least that is how Caroline perceives it in her momentary heartbrokenness. For her, it is easier to blame the harmless Mary for her loss of William, if one may call it that. It is maybe William who she ought to be mad at, for occupying her entire life and not making her realise sooner that she needed purpose outside of her work and their relationship above all. But maybe, deep down, Caroline even realises at this point that she is to blame as well for centring her entire life around one person who was bound to move on without her.

Caroline's mother's words from the very beginning of the play come back to mind, now as a warning and foreshadowing: "You have always loved him too much and forgiven him too easily" (Miyagawa 35). But later in the drama at the end of his life, it is William himself who warns Caroline of the danger of growing too attached to him: "Your attachment to me will cause you significant pain if you do not prepare yourself" (Miyagawa 86). Her brother may refer to his imminent death but there is an additional layer to his words with hindsight on their relationship throughout the years. William voices what their mother had long realised and maybe even tried to protect Caroline from, namely the unhealthily co-dependent relationship of the two siblings. Caroline undoubtedly has many things to be thankful for with William: how he provided her with a living and an education, with opportunities to pursue her own career as a singer and with the right contacts to secure a waged position as an astronomer at a time where women were rarely acknowledged as scientists and even more rarely paid for their work. But her complete and utter devotion to William may have ultimately cost her a life of her own. She has had the chance to become a singer, she has worked as a scientist herself under his tutelage, yet she has decided to remain by his side and now, at the end of his life, she may have to reflect on this choice and whether it was worth it.

William's struggles as a scientist are also a frequently repeated issue of the play. In this, William almost works as a foil to comically highlight the perceived difficulties that he faces as a man in science in contrast to Caroline's dire situation as an unmarried but talented woman. William is introduced early on in the drama as a young man who is fleeing from his duties during the war to pursue his career in England. William here is free to leave his responsibilities behind, abandoning his work in the military to start a career in music overseas. When a young Caroline confronts him about why he is leaving, William is adamant that he "cannot go back to war because it is not [his] life's purpose",

even though he is "not certain yet" what his life's purpose is, but he knows that he will certainly not find it in his military duty (all Miyagawa 38). When he asks the question to Caroline about her life's purpose, all she can reply is: "I am a girl. I have *duties*." (Miyagawa 38). William's grand speech about pursuing his purpose feels hollow next to his younger sister's lot in life. William may be free to follow his true calling, be that music or astronomy, yet Caroline is stuck with her mother at home, uneducated and without any prospect of leaving soon. William may talk about how stargazing is his purpose, a purpose he "was longing for […] and it was [his] right to have it" (Miyagawa 49) because he, as a man in his position, can just reach for what he truly desires in life without fearing for the societal consequences. He rejected his career in music because it took away time from his true calling, astronomy, yet he can always go back to composing should the work in astronomy ever prove unsuccessful.

In a short rant to Caroline when they are already working together as organist and singer, he reveals his dissatisfaction with his career's progress: "[Composing] is a burden. I am not satisfied with observing the universe that other men have seen and know already. I want to make new discoveries. I want to rewrite the map of existence. For that, I need time. I will make such telescopes and see to such things!" (Miyagawa 44). William is at a more than comfortable position: He is a successful organist who is receiving a steady income from his work. His paid work leaves him little to no time for his passion, astronomy, which understandably frustrates him. But this complaint does not carry the same impact it would have if William was talking to a man. He is talking to his younger sister, who would be considered lucky to have even a fraction of the success William is talking about. She will soon give up her singing career to assist William in his work in astronomy and that bereaves her of a steady income and a secure future. What William is complaining about is pure luxury compared to Caroline's life. William as a man is allowed to be dreaming of ascending to the halls of fame of science, of discovering new things and adding to the canon of information, whereas Caroline may fear that she will always only be considered his aid. Caroline, in her own words, "did everything for William" (Miyagawa 69) and has for a long time only stood by his side as he ventured into his chosen profession. But, as Time tells her in that same moment, she will have "made history through him, with him, and finally, without him" (Miyagawa 69) when she finally launches her career as a scientist without William's supervision.

4.2.3 The Public and the Private Lives of Caroline

As a typical woman in science in the 18th century, Caroline Herschel found herself in a dilemma that many of her fellow learned women have shared. They found themselves navigating the tightrope of wanting to partake in the public discourse of science while, as women, they were expected to remain in the private sphere of society. As discussed in the beginning, the historical Caroline has particularly faced the injustice of her lot as an unmarried woman: She was supposed to remain as a help in her mother's household, had it not been for William who offered her a way out of this fate. The fictional Caroline finds herself at a very similar impasse, with the dramatic text offering the additional insight into this struggle.

The fictional Caroline is fully aware of her position in society as a woman who is by now deemed a "spinster", an unmarried woman too old to still dream of finding a husband. She is as much a product of her time's societal standards for women as she is a product of the controlling of her mother who cannot fathom any other place for her unwed daughter. In an aside with Time, Caroline laments that she is "desperately uneducated" (Miyagawa 36), just as her mother had planned she would be. According to Caroline, her father, who was "too gentle to defy [his wife's] wishes" (Miyagawa 36), ceded to his wife's demands and only taught her in secret whenever he could. But these few lessons could never undo the damage of leaving a curious child such as Caroline without a proper education for such a long time. One may argue that if Caroline is a product of her time, then her mother certainly is as well. Caroline's mother embodies the societal expectations of Caroline's time that limited her options. Caroline's everyday life in her mother's household amounts to little more than being a servant to her family who is compensated with room and board in her own home. Her mother may be described as a villain in this particular context, denying her only daughter any chance of improving her lot, yet she also functions as a voice of caution from time to time, when she reminds Caroline that "dreaming up something" (Miyagawa 36) will lead to nothing. I would propose that there is more to the character of the mother than the simple antagonist that she is so often painted as. Her mother essentially lives a life that Caroline herself will never experience: She is married, has several children, some of whom she has seen dying in the war or of sickness at a young age (Miyagawa 35), and she is left to fend for herself now that her husband has died and left her with no income. It is ironic that she would keep her daughter from pursuing a path to financial independence, yet at times Caroline's mother also gives

caution to Caroline's dreams, maybe as a warning that they are indeed futile. Caroline's mother grew up in the same strict society as Caroline does and has already lived through a life as a woman in a men's society. It may be that her limitations for Caroline stem less from any evil intentions but rather as a sort of twisted protectiveness. If Caroline does not dream or try, then she will never end up as disappointed or disillusioned as her mother now is. Caroline with her small height and inexperience with the world is not safe, according to her mother who confides her fears to William: "I have always been afraid for her, she being so small. The safest place for someone like her is home. Without money or a father or a husband, how would she have survived in society?" (Miyagawa 43). All these fears are of course deeply rooted in the prejudices of Caroline's mother, who has been taught from a very young age that a woman without a man by her side, be it a relative or a husband, is nothing. But she does reveal her worry for her daughter underneath all her unfairness towards her.

It is a dire fate that Caroline has to face as an unmarried woman with no education that her mother warns her of. In an act of self-defence, Caroline often reverts to repeating what her mother has told her all along, namely that she "shall never marry" that she is "a girl [with] duties" that keep her from finding a life's purpose (Miyagawa 37-38). If she is aware of the futility of dreams, then she will not be disappointed by her own life. She is unmarried and without education; Caroline knows her place in society and it is not a comfortable one:

> CAROLINE. An unmarried woman is a defective element in society unless she has a title. I am not a full member of society. When I am at a dinner, I wait for all the married women to enter the dining room and take their seats before I proceed. I keep silent when told in insincerity that my life must be a luxury without a husband and children to look after. But these are rare occasions, I have so little time for dinners and friends. […] I have no choice but to be lost in the continuum.
>
> (Miyagawa 45-46)

The circumstances she describes are humiliating at best. It is horrible to hear a capable woman speaking of herself as "defective", as if her marital status or lack thereof denies her any kind usefulness to society. We know from previous chapters that women have often been referred to as flawed by scholars such as Aristotle, who calls a female a

defective male, yet hearing Caroline herself refer to her situation with so little indignation at the injustice of it shows the deep-seated prejudice that is held against women in her own generation. If women in marriages or with children are already on the margin of society, then one can only imagine what this might entail for unmarried women, especially at Caroline's advanced age at that point in the drama. Her little speech reveals that she can tell that the jealousy towards her freedom by others is faked, that it is insincerity in people's tone when they envy her lack of attachment to anyone. It is worse than being invisible in her own family; she exists on the outer corner of society and is even overtly pitied for it. Her mother's warning words once again prove to be clairvoyant, when she told her younger daughter that "[a] woman needs to be humble. She invites difficulties if she is outlandish in any respect. It is better to live life unnoticed, quietly and protected" (Miyagawa 55). These foreshadowing words only support the theory that it is fear for her young and inexperienced daughter that motivates Caroline's mother hostile behaviour towards any of her daughter's ambition.

Ironically, despite the first animosity between Caroline and her future sister-in-law, Mary Pitt, the two women have a short instant of bonding over their situations as women in society. As the two women share a moment alone without William, Mary confides that she "never had [her] own money" as it was always "either [her] father's or [her] deceased husband's money" and, after the marriage, all of it will become William's money (Miyagawa 69). Given Caroline's rejection of Mary on the basis of her having everything that Caroline has not, this is a special moment between two women who, on the surface, seem to find themselves in two completely different situations. Mary was married and is now widowed with money at her disposal, whereas Caroline has always been moneyless. But now Caroline learns that Mary is just as dependent on any other member of her family or her spouse even though the money ought to be hers to spend. Ironically, with her newly appointed salary from the King, Caroline is at an advantage compared to Mary, despite her being unmarried and therefore supposedly of a lower social status. She has earned this money with her own labour and is free to spend it. Those mentioned beforehand who had insincerely envied Caroline for her freedom might regard her differently on the basis of this independence her salary offers. Mary, without knowing what Caroline may have experienced beforehand, confirms this envy without any bitterness to it: "It must be extraordinary to have your own money that you made with your work", to which Caroline can only reply: "Yes, it is extraordinary" (Miyagawa 70).

It is exactly this labour, which will later even be paid for Caroline, that enables her to leave the constraints of her life as a spinster and pass over to the public sphere that has so long been out of her reach. She may be invisible to her family as the youngest and most expendable child, but her work in astronomy will keep her from being forgotten. The short prologue to the drama provides this important key moment in Caroline self-perception. The prologue is set in 1786, when Caroline is alone at night, using a telescope without William by her side to sweep the skies (Miyagawa 34). Accompanied by the character of Time, Caroline appears to make her first discovery:

> CAROLINE. There was a motion since last night! It *is* a comet!
> TIME (*affirming*). It is.
> CAROLINE. I have discovered a comet! *I* have discovered a comet.
> TIME and CAROLINE. I exist.
>
> (Miyagawa 34; emphasis in original)

In a Cartesian moment of affirmation, Caroline cements her existence by discovering a comet, one which will be named after her and remain for generations to be studied. Descartes famously stated *cogito ergo sum*, meaning "I think, therefore I exist" (cf. Buckingham et al. 116-123). Caroline is very clearly capable of thinking, yet her thoughts may be fleeting and private to herself. What supports her existence is her work as an astronomer, as someone who participates in the scientific discourse and who contributes to it. Caroline as a private person, as a daughter, sister or even just as a servant and housemaid, will cease to be remembered once those who knew her have died. But Caroline Herschel, the female astronomer, is immortalised by her discoveries. Time, as the all-knowing narrative instance, confirms her as they both simultaneously manifest her existence. Her work gives Caroline meaning beyond that of the unneeded servant and sister.

This discovery of Caroline's will feature as the climax of the play later. As William is away on business, Caroline sits in the garden together with Time, observing the sky through one of William's telescopes (Miyagawa 55). When Caroline sweeps the sky, as she is wont to do, she tells Time that she "ha[s] been waiting since last night for something. A change […] [i]n the order of things [she] thought were permanent […] the order of [her] life" (Miyagawa 55). It is almost as if Caroline can sense that this will be the night that changes her life's purpose in anticipation of William changing her life for

her. She does discover a comet and Time confirms that she is “Caroline Herschel, Comet Hunter, the first recognised woman astronomer in the world” (Miyagawa 56), highlighting not only the title of the play but also the unique position that Caroline will occupy in history. She has made history and will continue to do so. In a dialogic reading of the letter the historical Caroline has sent to the Royal Observatory to confirm her finding, Time and the fictional Caroline take turns citing Caroline’s letter of discovery and the answering letter from Dr Blagden at the Royal Observatory respectively. It is in Dr Blagden’s answer, which he signs with “great esteem”, that Caroline receives her first confirmation of her talent from an outside source when he says: “Madam, you have immortalized your name” (Miyagawa 56-57), confirming that with this discovery, Caroline has indeed secured her place among the greatest minds of her time. She will not be forgotten and is no longer expendable, for she is the one to discover this comet and to be filed for all the centuries after her death as the astronomer who first saw this very comet fly. Additionally, this is an achievement that she has made without William by her side and without him guiding her in her work. She is the one who has discovered the comet all on her own and has even had the courage to write to the highest national authority of astronomy to confirm her findings, in a time where women were neither welcome nor accepted into the Royal Society. Yet she is met with nothing but acceptance and admiration for her work, which can only add to her confidence as a budding scientist.

It cannot be incidental that Caroline will discover the comet shortly before William decides to Mary Pitt and Caroline thereby loses her main focal point of her private life. The drama gives the exact times for both of these, with Caroline discovering her first comet in August of 1786 and William marrying Mary in 1788 (cf. Miyagawa 56-59), indicating that two years pass between these incidents, yet they are framed as scenes in the drama occurring immediately after one another. By having the break of the siblings follow Caroline’s emancipation as a scientist, the drama gives additional meaning to her work in astronomy. William may leave her and take away her whole life’s purpose, or so she perceives it, yet it is only after she had found meaning in her work that she will have to come to terms with her brother’s marriage. Her work and her discoveries are, in this case, her support system. Compositionally, the drama could have featured any content from the life of the Herschel siblings between 1786 and 1788, Caroline’s other discoveries for instance, yet this placement and framing appears purposeful. If her work gives her meaning and cements her existence, that it may have come at a fortunate time when she would have to find meaning outside of her work for William. William cannot be her entire

life's focus, as she now has to acknowledge by moving out and making way for his wife running the household, but Caroline is no longer without focus, nor is she dependent on William's work. She has discovered a comet in his absence and has found her purpose for existing. Her work can give her life meaning in a much more lasting way than William ever could have. She will go through the emotional journey of having to let William go, as the previous subchapter has detailed, but it is her work that will provide her with enough stability to do so.

4.2.4 TIME AS A NARRATOR

I will now come to the arguably most important narrative feature of this drama, namely the character of Time. Speaking in narrative terms, Time is an intradiegetic narrator figure, best described by two of Brian Richardson's six types of narrator roles in drama, namely the internal narrator and the generative narrator. According to Richardson, the internal narrator is a figure that recounts to other characters on stage what has happened off-stage or prior to the drama. A generative narrator, on the other hand, is a reliable or unreliable narrator that engenders the action (Richardson 209-211).

In her role as a narrative figure with all these functions according to Richardson, Time fills several important positions. She both recounts actions off-stage and those that have happened before or after the plot while also enabling the action further. Gendering Time as female is appropriate because the stage directions themselves call for Time to be played by a "woman of colour [of] [a]ny age" (Miyagawa 33). First of all, she is only visible to Caroline and accompanies her through her life. There is no mention of Time ever leaving the stage for any scenes, so it can be assumed that she stays on stage throughout the entire drama, providing a constant witness and commentary to the events on stage. Secondly, as Time is only seen by Caroline, the character of Time sometimes provides an almost comical tone to the interactions between Caroline and the other characters. Time, being visible and therefore audible only to Caroline, will react to something Caroline has said when they are in the company of others. Caroline will then reply sharply to Time, admonishing her to "[p]lease be quiet" or that she "[does] not understand" (Miyagawa 42, 44) which the other characters such as William or Caroline's mother will then take personally, leading to a confusion among everyone present. Thirdly, Time's described appearance makes an important addition to her character: She can be

played by an actress of any age, highlighting the literal timelessness of her. Time might be a young woman or an elderly one and both can be, depending on the staging and production, interpreted as such. This is an aspect that can more closely be analysed in terms of a specific production and I would like to offer a couple of potential angles for interpretation of this. As a younger woman, Time might signify an eternal youth to the concept of time, the eternity that does not age and is continuous, as time has no end of beginning and simply exists. The older Time is portrayed to be, the more experienced and wizened she might appear, having seen and lived through a much longer life. Both concepts can be fruitful to support the respective aim of the staging of this play.

The casting also calls for a Woman of Colour to portray Time. This diversification of the cast can be a double-edged sword, depending on the staging. Any casting of Black, Indigenous or other People of Colour can only ever be supported and especially a role as significant to the drama as Time would mean a major casting opportunity for any actress. Yet the other roles have no specific race assigned to them. In the best case, the casting is left open to all races and only Time needs to be specifically portrayed by a Woman of Colour. In the worst case, Time might be the only non-White character on stage, which would only further highlight the skewered erasure of Black, Indigenous or other People of Colour from the contemporary stage. What is more, if Time is the only Person of Colour in a play that is otherwise portrayed by White people, this all-knowing character of Time might be reduced to the stereotypical role for People of Colour of the "'magical negro', a stock character of a spiritual African American often possessing magical powers or otherworldly, mystical insights who assists the White protagonist in some way either practically or emotionally" (Bernardi and Green 11). Popular examples of this trope can be especially found in cinema, with Whoopi Goldberg's role in 1990's *Ghost* or even as recently as 2011 in *The Help* where a Black nurse played by Cicely Tyson enables the character growth of the White protagonist (cf. Bernardi and Green 18). Such a reductionist portrayal would not be in the sense of the casting and of the play in general and a prudent casting choice would be needed in order to avoid such pitfalls. The following analysis is only text-based, therefore the potential skin colour of a character cannot be considered[16].

[16] In contrast, race is a topic of the analysis of *Uniform Convergence* because it is explicitly discussed and highlighted by the characters themselves and is part of the written text, as opposed to *Comet Hunter* where race is only a casting choice.

Time's main function, so to speak, is to enable focalization, as is wont of a narrator. She thereby surpasses the narrow concepts that Richardson offers in his publications on narrator figures in drama and carves a new category for herself (cf. Richardson "Voice" 209-211). Time is distinctly tied to Caroline and therefore a key in providing insight into her thoughts and feelings. In a scene from the beginning of the drama, Caroline is confronted with the stagnancy of her own life. She is arguing with her mother about the latter's role in Caroline's situation of being uneducated:

> CAROLINE. Yes, and I have yet to use my skill to make one dress. I have been busy keeping the house. I am as uneducated as you wished.
> MOTHER. Pardon?
> *The moment with Mother pauses, but time flows.*
> CAROLINE (*to Time*). I am desperately uneducated. (*Pause.*) I have not done much besides knitting in my life. Oh, I also wash, cook, clean, all that. I am very dependable. But there is no meaning.
> TIME. What would you like to do?
> CAROLINE. Leave. Go far away from here so nothing will remind me of this time and space.
> TIME. Why?
> CAROLINE. I do not understand why as I stand still, my loved ones disappear. If I stand still any longer, I shall lose everyone.
>
> (Miyagawa 36, emphasis in original)

In this very first moment on stage, the role of Time is artfully established. Time is here for Caroline and for Caroline only. There is even a direct word play on the concept of passing time: "*The moment with Mother pauses, but time flows*." (Miyagawa 36, emphasis in original). Time with a lowercase initial is the concept of time we are familiar with, but Time with a capital letter here is not only a metanarrative but also metadiegetic character. Time functions as both a character and a personal narrator to Caroline. The action of the drama does not continue but "time", for a lack of a better word, continues for Caroline, who now finds herself in an inner monologue with Time itself. This short pause in the story allows for a moment of introspection into Caroline's anger and resentment in that moment. She is given the chance to express how unhappy she is with the state of her life, similar to how the internal focalization in a novel would work. She can say how it hurts

her to see her loved ones, William, leave and thereby leave her behind. Her life, in the meanwhile, is stuck right where she currently finds herself. Time can stand in for the questions we as readers might wish to pose and Time specifically goads Caroline into divulging more of her feelings: “What would you like to do? [And] why?” (Miyagawa 36). She does not simply occupy a passive role of allowing introspection, she actively even asks for it, transcending the boundaries of a regular narrator with focalization. Where a novel or any other traditional narrative media would allow introspection through focalization, this drama employs the character of Time as a sort of mediator. For Caroline, time – with a lower case first letter – stops at the command of the character of Time – with an upper case first letter – for her to express her feelings in that moment. As opposed to other characters whose motivations and fears remain unexpressed, Caroline receives her chance to describe the dilemma of her life, namely that she accomplishes nothing of value compared to her older brother. It singles out Caroline as the main character. Even if Caroline is not explaining herself, Time does it for her. When Caroline praises her brother for his greatness at another point in the drama, Time supplies her adoration with reason behind it: “You love him not because he understands you, but because you sense an important future in him.” (Miyagawa 39). By supplying this additional knowledge, Time uses her full potential as an omniscient narrator. Even if Caroline is not willing or planning to reveal her motivation, Time is nevertheless prepared to because she knows all about Caroline.

This also allows for an additional metahistorical angle on the history of Caroline Herschel. She had destroyed many of her diaries that she had written in the years after William had married, maybe in anger, maybe because she later regretted what she had written. Either way, in posterity we cannot fathom what she might have gone through at certain emotional points in her life. This is where Time as an enabler of focalization comes into play. Caroline is, at times, highly irritated with her figural shadow on stage. As Time keeps giving her vague answers and remains illusory on the topic of William’s and Caroline’s future, Caroline soon figures out that Time may know more than she lets on:

> CAROLINE. Why do you have to be so strange and say strange things as if you were Jesus?
> TIME (*mock-appalled*). Caroline!
> CAROLINE. I have another question. Are you my guardian angel?

TIME. No. I'm *Time*.

CAROLINE. So you have told me. Does everyone have *Time* of his own?

TIME. *His*?

CAROLINE. Why are you with me? Are you my imagination? Are you illusory?

TIME: Ultimately, everything is a figment of human imagination.

CAROLINE. Please do not get philosophical with me. I have little time before William returns.

TIME. Why is this so urgent all of a sudden?

CAROLINE. Because I realize that you know about Mrs. Pitt and I do not.

(Miyagawa 59-60, emphasis in original)

After spending much time with Time, Caroline has realised that Time is, in fact, ephemeral and all-knowing, similar to how an omniscient narrator would work. Time has lived through it all and knows what will happen, yet is smart enough to let Caroline choose her own path without guiding her. For Caroline, this must be terribly vexing to have the answers in person at her side, yet Time refuses to tell her again and again. What Caroline also reveals in this short dialogue is an assumption of male greatness or rather female insignificance. She specifically refers to a generic masculine form when asking whether everyone has "his" own Time at their disposal, almost as if only men might be important enough to warrant such a guardian at their side. But Time is here for Caroline and tells her in the lines following the scene quoted above why she follows her: "You need me to understand history beyond what is apparent at this moment. I need you because you will, in turn, move time forward" (Miyagawa 60). Time is imparting knowledge to Caroline here, telling her that she deserves being guided by time because she, in turn, will make a lasting impact on time itself. What before seemed like a one-sided relationship is now turned into a symbiosis: Time is there to allow Caroline moments to herself outside of the diegesis where she can vent and express her feelings. Caroline, in turn, will be an important scientist and her work will move time or even Time forward.

This also represents a confusion of the different parts of the diegesis, with Time being both extra- and intradiegetic. Caroline is able to converse with her, yet the other characters are unaware of her and therefore of the world outside of the diegesis. Outside of the diegesis, Time also fulfils other narrative purposes in the drama, such as that of a messenger. She "*hands Caroline a letter*" from William at times or reads out loud

messages that Caroline receives from the Royal Observatory (cf. Miyagawa 52, 56-57). At other times, Time provides prolepsis by foreshadowing what Caroline will achieve in her life and how her life will continue. Time repeatedly tells her that she "will travel" (for example Miyagawa 42 or Miyagawa 71), either when Caroline still resides with her mother or when a change of scenery is about to happen to her in the course of her moving throughout England. Time also tries to soothe her later, when William announces his marriage, that she might be "sad now and will be for some time" (Miyagawa 63). On a grander level, Time informs Caroline about how the world has and will still evolve: "Times were different in her [Caroline's mother's] generation. They will be different still in the future. Humans do make progress" (Miyagawa 72). The foreshadowing of what is to come both in Caroline's life and in the history of the world in general underline the importance of Time at Caroline's side. If Caroline doubts her progress or is hesitant to give herself credit, Time will be there to remind her of the greatness that is to come of her work: "Lina. You're no longer invisible" (Miyagawa 67).

Time is all-knowing, an omniscient narrator who exists outside of the intradiegetic time frame and even though she is prudent and often refrains from telling Caroline how a particular problem will play out, she nevertheless tries to instil confidence in Caroline. What Caroline accomplishes will matter over the course of time and Time is there to reassure her of it. Time's prophecies are at times harshly contrasted with the mundane tasks that Caroline is forced to do in between her great accomplishments. Shortly after Caroline has discovered her first comet and has communicated her discovery to the Royal Observatory, Time indulges in a rare moment of prophecy. She tells Caroline what will become of her discoveries:

> TIME. Your second comet will come on December 21, 1788, around one degree south of Beta Lyrae. You will follow it until February 1789. One hundred and fifty-one years later, on July 28 1939, Roger Rigollet will discover an eight magnitude comet. The orbital calculations will suggest that this new comet is identical to your comet from 1788. You will have been gone from this planet for ninety-one years. The next return of this Comet 35P/Herschel-Rigollet to the inner solar system will be at the end of the twenty-first century.
> CAROLINE. I baked William's favorite cake.
>
> (Miyagawa 57)

Once again, Time fulfils the role of the internal narrator coined by Richardson, narrating actions off-stage and, in this case, in the foreseeable future to Caroline, to provide her with a proleptic vision of what her work will inspire (cf. "Point" 209-211). Time's prediction is both tragic and electrifying in its prospect. For once, Caroline learns that she will discover more than one comet, an extraordinary feat for a woman in the 18th century. But it is not only that, Caroline's comet will continue to be spotted almost a century after her own death. As grim as this prediction might be – it does give Caroline a morbid prediction of her life span and her probable year of death – it also strengthens her impact on the world of astronomy. Long after Caroline's death, her comet will be rediscovered and it now carries her name. A century after her lifetime, her discovery will still be relevant. And even a hundred years later, by the end of the 21st century, a time we as contemporary readers can hardly imagine, her comet can still be spotted once again. Caroline will be relevant for centuries after her death. As Dr Blagden answered in his letter to her a couple of lines earlier, Caroline has immortalised her name (cf. Miyagawa 56). It might be also interesting for Caroline to hear how technology has advanced, how astronomers are by 1938 able to predict a comet's orbit and to roughly calculate when the comet will be seen again. But Caroline appears deaf to Time's prediction. She is transported back to an earlier moment in the drama, in which William came back to Hanover to fetch Caroline from her mother, when Lina had baked her brother's favourite cake as a treat for him. The monumental monologue of Time on Caroline's comet stands in stark contrast to the mundanity of her baking a cake for her brother like the housekeeper that she so often has been and still is at the time of the discovery. These two moment are, of course, thematically connected, as Caroline is only able to work as a freelance astronomer because William rescued her from her life as her mother's carer. Without his guidance and support, she would not be in the position of discovering comets that will be rediscovered throughout the centuries. Still, the juxtaposition of Caroline's services to astronomy to her services to William highlight the pitfall of working as a woman in science. It is both extraordinary and painstakingly ordinary at the same time. Time's role as a metaleptic narrator enables both the foreshadowing and the flashback in order to service the contrast that makes up Caroline's life.

In *Comet Hunter*, Caroline Herschel is a humble woman who is aware of her position in society, even if she was unhappy with it. The character of Time offers a voice

to the fictional Caroline as a generative and internal character. The scientist of the next section, Émilie Du Châtelet was also disappointed by her lot as a woman in science and her fictional equivalent takes matters into her own hand as a generative narrator in *Emilie: La Marquise Du Châtelet Defends Her Life Tonight*.

4.3 "AND TONIGHT IS *MINE*": LAUREN GUNDERSON'S *EMILIE: LA MARQUISE DU CHÂTELET DEFENDS HER LIFE TONIGHT* (2010)

To a wider public, Émilie du Châtelet is probably best known as the mistress of Voltaire, as she is often commonly referred to. Her scientific achievements are only mentioned as an afterthought even though they ought to be treated as her main identifying characteristic. Émilie du Châtelet was a successful science translator as well as a published author of scientific papers that went against her contemporaries' canonical opinion. She deserves to be more than a mere addendum to Voltaire.

Lauren Gunderson's play *Emilie: La Marquise du Châtelet Defends Her Life Tonight* takes place at an unspecified point in time after Emilie's[17] death. She returns to life, with a body and her memories in place, and finds herself on an empty stage where she is able to relive certain key moments of her life. The authorial notes on the setting specifically leave a lot of room for interpretation. As the author explains, the empty space "is memory – as much or as little set as you want" (author's note in Gunderson "Emilie"). This fictional Emilie spends the first couple of scenes on stage trying to learn what her role might be in this unfamiliar setting: She discovers that there are other characters on stage who function as players whom she can direct and set into place in order to re-enact scenes from her own life. Apart from herself and Voltaire, all the other characters have unspecified names and are merely phenotypical stock characters in order to fill certain roles: Soubrette, who is described as a young woman, Gentleman, a middle-aged man, and Madam, an older woman. Depending on the scenic requirement, these players, as they are referred to, occupy different roles that fit their general descriptions. Emilie also learns by accident that she is not allowed to physically interact with anyone else on stage. Each time she tries to touch another character, the lights go out and the scene is reset. It is Emilie's stand-in, Soubrette, who does the touching for her in scenes where this is needed, with Emilie confined to the side lines only to direct but not to directly interact. She occupies the role of a generative narrator, according to Brian Richardson's categorization, transcending the different layers of the diegesis both as a character and as

[17] Even though the historical Émilie du Châtelet is spelled with an accent over the first e, the author has not used this spelling in her dramatic texts, which is why I will adhere to the character name instead of the historical one when discussing the play.

a narrator and stage manager who engenders the action of the drama (cf. "Point" 209-211). Several important moments in Emilie's life are played out in this manner, accompanying her from her earliest memories through her tumultuous relationship with Voltaire until her death. By the end of the drama, however, Emilie defies the rules that are set upon her and manages to physically connect with Soubrette, who in that scene stands in for Emilie herself. The drama ends with Emilie realizing that it was she who gave her life meaning and who validates her work in the sciences.

4.3.1 BIOGRAPHICAL BACKGROUND

Gabrielle-Émilie le Tonnelier de Breteuil, by marriage to a Marquis later the Marquise du Châtelet, was born in 1706 and died in childbirth in 1749 (Ogilvie "du Châtelet" 378-379). Emilie du Châtelet profited from the intellectual climate of her time and of the wealth and prestige of her own family. In the early 18th century, as discussed in the earlier chapter on women in science, women were able to influence and partake in scientific discourse as wealthy benefactresses or as leaders of scientific salons where the elite came together to discuss and make new discoveries. Another advantage that du Châtelet profited from was the broad schooling that she was given as a child born to an influential aristocratic family at a time in France where both boys and girls of a certain social class were sure to receive an extensive education (Hagengruber 1-2). Her father, a high-ranking courtier with Louis XIV, supported her thorough tutoring (Eschner). It was only after her marriage to the Marquis du Châtelet and after the birth of her two children that she ventured into a more professional pursuit of mathematics (Ogilvie "du Châtelet" 379).

What du Châtelet is undoubtedly best known for is her work on Isaac Newton's *Principia*, which she translated in its entirety into the French language for the first time since its publication. Her translation allowed for a more widespread access to this important text in scientific history, especially for a public who did not speak Latin (Museliak 1). Her translation is one of the most canonical ones and it is still used in French education today (Eschner). Private correspondences with friends of her reveal that she considered the work of translation as a side gate for women into the sciences: If they are educated so thoroughly in languages, why not use this knowledge to access important philosophical and scientific texts and make them more accessible for the general public.

Even though it might entail less glory, it is nevertheless a way to engage in the public scientific discourse, according to du Châtelet herself (Eschner; Zinsser "Genius" 171).

Another part of her life has garnered much attention and has long overshadowed her career as a mathematician. Women's historian Judith Zinsser, who coincidently also published several monographs and articles on the life of du Châtelet, laments that Émilie du Châtelet has not been given justice in the traditional historiography of her time: "[I]t is her liaison with Voltaire, not her own accomplishments as an interpreter of Newton's natural philosophy and Leibniz's metaphysics that has justified her inclusion" ("Genius" 168). Rather than honouring du Châtelet for her genius and gender-norm-defying work, she is most commonly known as a mistress and benefactress of Voltaire. Many biographies, such as for example the one given by the Encyclopaedia Britannica, do mention her work as a mathematician and philosopher, yet apparently have to immediately associate this with her relationship to Voltaire (cf. entry on du Châtelet in *Encyclopaedia Britannica*). According to Zinsser, what du Châtelet ought to be known for is her daring behaviour to "write for publication" as "an aristocrat, a woman educated for entertainments and intrigues of the court", thereby specifically challenging the societal expectations put upon her ("Genius" 168). In an even bolder move, du Châtelet supported intellectual ideas from German and English philosophers, which directly undermined the Cartesian course set by the French Royal Academy of Science, which means that she knowingly went against the prevalent discourse of her own time and focussed on her own studies (Zinsser "Genius" 169). Much of Émilie du Châtelet's private correspondence, especially her private notes on her work in the Newtonian translation, have sadly been lost since her death, proving once again that the eradication and devaluation of important source material can support the marginalization of women in the history of science (Zinsser "Genius" 177). Additionally, many of her scientific papers have yet to be published which further erases her from the scientific canon (Zinsser "Genius" 177).

Concerning her own sex, the historical du Châtelet displayed ambiguous tendencies. She refused to be referred to as a genius, claiming that she was only rehashing what other scientists had discussed long before her. However, she also vocally complained about the restriction set upon her as a female in the sciences, demanding that "woman have a right to protest against their education" (du Châtelet as quoted in Zinsser "Genius" 173) if this education proved to be lacking and if it left the women in question unfit for any scientific feats (Zinsser "Genius" 171-174). If she were king, du Châtelet is quoted, she would "give all the rights of humanity to women, as this new system of

education would be beneficial to the human species in all respects" (as quoted in Hagengruber 1). Yet instead of preparing her own daughter for a life outside of the limited options for intellectual purpose at court, she raised her in the traditional style of a woman fit for court life, even more so than she herself had been raised (Zinsser "Genius" 170).

4.3.2 The Life of a Woman in Science in the 18th Century

As with any of the dramatic texts that are analysed throughout this thesis, *Emilie: La Marquise Du Châtelet Defends Her Life Tonight* thematically centres on the experiences that Emilie makes as a woman in science. Her life is re-enacted and that means that the trials and difficulties she faced as a woman in a male-dominated field are also relived.

Her contact with fellow scientists is strictly limited to contact with other men in this drama. The men's roles in her life vary from mentors and teachers to collaborators or even to competitors who doubt her competence. One of the early supporters that the fictional Emilie mentions is Maupertuis, who was her "mentor" and the "first man outside [her] family who respects [and] challenges [her]" (Gunderson "Emilie" 14). From the very beginning, their relationship is skewed: Emilie knows that she is dependent on Maupertuis to have access into circles of science that she otherwise would never be able to join. Her tutors have long been unable to teach her anything new and Maupertuis is her "only vein into the heart of academia", but the sad truth is that Emilie depends on him while he does not need her (Gunderson "Emilie" 14). It is insinuated by the stage directions that Maupertuis and Emilie engaged in a romantic relationship as well, as the directions describe them "*kiss[ing] all over the books*" which Emilie describes as "[a]n academic relationship[, n]ot without its own distinctive benefits" (Gunderson "Emilie" 14). Even though they were historically pupil and tutor, they were not nearly as far apart in age as these terms seem to suggest. The historical Pierre-Louis Moreau de Maupertuis was 35 when he taught the 27-year-old Émilie in the early 18th century. He was heavily involved in the Parisian intellectual society and "cultivated the members of one of Paris's most prestigious cafés, the Gradot on the quai du Louvre" (Zinsser "Mentors" 93). As a high-ranking member of the Royal French Academy of Sciences, he was a very influential and advanced tutor and mentor for the young historical Émilie du Châtelet and for other young women of her social status as well (Zinsser "Mentors" 93). Zinsser, however,

describes their relationship as amicable with no sign of a romantic involvement between the two (cf. “Mentors” 94).

The fictional Emilie is aware of the imbalance of their relationship, of her depending on him. She longs to join the intellectual circles that he so easily has access to and laments that she as a woman is hindered by her sex:

> EMILIE. As a lady, I’m in no position to run out to cafés and mingle with these minds, or god help me, *think out loud… […] (EMILIE changes SOUBRETTE into man’s clothes as…)* But I want to go where science is *done* – which is not in courts or academies, but in the Café Gradot – an all-male, all-night establishment wherein my sex is restricted to various services unbecoming of my class. And my patience. So we do what we must. *(EMILIE sends SOUBRETTE through the doors.)*
>
> (Gunderson “Emilie” 14-15, emphasis in original)

What is quite blatantly insinuated here is that women may only have had access to these male-only salons as a prostitute or some other kind of paid female escort. Emilie is rightly appalled by this and refuses to stoop to this assessment of female value. There are, of course, other salons, as discussed in an earlier chapter, which are mixed-gender and offer women a place in scientific discourse. Some of these were historically even led and sustained by wealthy female patrons, whose access to science came in the form of being a benefactress for less privileged male scholars. As Emilie rightly frames and as science is, at that point in time, still so thoroughly male-dominated, these all-male salons are the hub of the making of science. It is where acknowledged and successful scholars such as Maupertuis will convene, where science is discussed in an informal but very important setting of exclusivity among scientists. Therefore, Emilie takes matters into her own hand and cross-dresses as a man – or rather cross-dresses Soubrette as a man in her role as Emilie – to sneak into these hallowed halls of science and to be a part of an exchange that her sex would have otherwise kept her from joining. This does not seem to have a happy ending: In another stage direction only a couple of lines later, Soubrette “*is kicked out again*” (Gunderson “Emilie” 15, emphasis in original) and Emilie is left to complain that “[w]omen determine the fate of great nations, of the human race itself but for us there is no place where we are trained to think, much less to think for ourselves” (Gunderson “Emilie” 15). Similar to the above quoted historical Émilie, the fictional Emilie has

decided to take her tutelage into her own hands and to protest against the insufficient education she has been offered, yet has repeatedly, as the stage directions imply, been unsuccessful. It is her collaborator and partner Voltaire who makes a change in her view of men in science for once because he appears to be the one person who "*likes what he sees*" in Emilie as an educated woman (Gunderson "Emilie" 15, emphasis in original). The relationship of Emilie and Voltaire will be covered in more detail in a following chapter.

As a woman, Emilie is forced to make certain choices regarding her own life. The incompatibility of work and family life is one of the topics that is discussed repeatedly in the dramatic text. After she and Voltaire have established their own scientific society at her château in Cirey, Emilie ventures to ask Voltaire about whether he would consider having a baby with her. She hesitates at first to breach the subject but Voltaire goads her into confessing that she had thought about it (Gunderson "Emilie" 32-33). At this point, Emilie already has two children with her husband the Marquis du Châtelet, who is currently at war, whom she has given to "the nursemaid which leaves [her] free to study" (Gunderson "Emilie" 14). Her marriage to the Marquis is a marriage of convenience and therefore no love match but with Voltaire, she feels loved and secure enough to think of a child in the relationship. When Voltaire asks her why she would want a baby, she answers that she wants "progeny" (Gunderson "Emilie" 33), implying that she dreams of leaving a living legacy of their collaboration and maybe even love. Voltaire is hesitant, to say the least. He remains quiet after her admission and Emilie seems to feel that he is unconvinced. Voltaire suggests that their "progeny is thought and theatre" (Gunderson "Emilie" 33). To him, their work is enough of a legacy to last. The issue at hand is not just Voltaire's rejection of Emilie. He "*sees her disappointment*" (Gunderson "Emilie" 33, emphasis in original) and knows that she expected another answer.

This entire conflict, as minor as it is, stands for the incompatibility of family and career that many mothers still face today. Having both a successful career and a fulfilling life as a parent is, not just for women, often impossible. It is however harder for many women because they are, by societal standards of heteronormative relationships, expected to take care of the children in more capacities than their male partners. Either the career or the parental life usually has to suffer and since women are generally associated with the role of the mother, many women decide to forego a career in order to raise children. Emilie has chosen to dedicate her life to her study of mathematics and physics and therefore had to rely on the aforementioned nursemaid to take care of her children. In this

scene, it seems as if she regrets this focus now. Even with someone she loves and cherishes at her side, she has no opportunity to incorporate both her career and a life as a mother. Voltaire does not wish to give in to her and she herself knows about the societal consequences such a thing would entail:

> EMILIE: It was a thought experiment. Not a real thought. And I know it's impossible. I couldn't pull off legitimacy with my husband at war. The rumors would be mortifying, and the theatrics to fool the neighbors – it'd be Olympic. […] I thought and to my credit quickly *re*thought with much better judgment, that if we were to do such a ridiculous thing, it would be… generally unstoppable.
>
> (Gunderson "Emilie" 33, emphasis in original)

If Emilie expected Voltaire to offer her support against the judgmental reactions of having a child out of her marriage, then she is sorely disappointed. Voltaire only comments that she apparently has thought this idea of a child through and remains quiet after her long rambling about the consequences. This exchange is emblematic for a reoccurring problem for women in the workspace, both historically, as in Emilie's case, and even today. Society expects a certain behaviour from women and Emilie has already been ridiculed, "mocked, scorned" (Gunderson "Emilie" 15) by her fellow scientists for daring to work as a scientist despite her sex. Now, after she has made this decision and thinks of maybe being a mother present in her child's life as well, she is also left alone to fend for herself.

Emilie's family life as a working woman is also a reoccurring topic of the drama. Similar to the historical Émilie, the fictional one also has chosen to raise her daughter for married life at court. Gabrielle, her eldest daughter, is described by Emilie as "pretty enough" and Emilie is sure that she will "marry well" (Gunderson "Emilie" 26). This presents an inversion of the stereotypical parental roles that we as readers would expect from a supposedly feminist icon of a mother. Emilie is concerned with the looks of her daughter and her marriage prospect, instead of allowing her daughter to have the same opportunities that Emilie has had and which are usually denied to their sex. While we do not have any historical accounts of her daughter's reaction to this decision, the dramatic text gives space to a conversation between mother and daughter, a "scene in which the daughter is seen and finally heard […] on her wedding day" (Gunderson "Emilie" 42). It is Soubrette, in her role as Gabrielle, who announces this scene by interrupting Emilie,

indicating that for once, Gabrielle will take charge of the action and have her due. As this announcement implies, it seems about time that this other unheard female voice gets to be recognised when it has been historically ignored for centuries.

The scene is short yet encompasses a lot of feelings and resentments that Emilie's daughter might have had towards her absent mother. For once, she blames her mother for not allowing her to choose: "Why don't I get a choice? […] I want a choice. *Your* choice." (Gunderson "Emilie" 42-43, emphasis in original). If Emilie had decided to forgo societal rules and follow her calling, then it is only natural for her daughter to demand the same rights. Emilie ought to know how deeply this must have hurt Gabrielle; it was after all Emilie herself who felt the bitter sting of rejection by her fellow scientists when they disregarded her choice of career because of her sex. Yet Emilie appears to be blind to her daughter's feelings and continues to see her in the limited options for woman of their time: "She is all woman, and will have a much easier life for it. She is loyal, demure and… entertainable." (Gunderson "Emilie" 42). Emilie gives the perfect description of a docile wife who was so desirable to many of her contemporary men looking for a partner. Emilie falls into the same trap that she has been prey to all her life by underestimating the demands of women for freedom of choice. Gabrielle has not been taken seriously by her mother and accuses her of doing the same thing that parents and most of all mothers have been doing wrong for so many years: "A chance. You got one. And you could've given me mine. Instead. You gave me what every other *kept* woman gives her stupid daughter" (Gunderson "Emilie" 43, emphasis in original). The contempt in her words is evident. The disdain she feels for other women who have settled for kept married life can now only be directed at her own mother who, despite her intelligence and wealth of experiences, has decided to let her daughter be resolved to the fate that Emilie so desperately tried to avoid. Soubrette, as Gabrielle, leaves her mother with these final words and, after a hug that once again lets the light go out because of forbidden physical contact, Emilie is alone on stage. Her daughter has held up a mirror to the double standards of her mother who has allowed herself all the freedom and rebellion that one could desire while keeping her daughter stuck in the endless cycle of women being left uneducated. It is with regret that Emilie realises what her thoughtlessness has caused: "And I see what I missed: myself in her. What have I done? What any thoughtless *man* would do. I assumed and missed a woman of my own element. I'm sorry, I am so sorry" (Gunderson "Emilie" 43, emphasis in original). It is presumably Gabrielle's wedding day and therefore already too late to pine for the forgotten experiences she could have made

if her mother had recognised the fellow feminist spirit in her daughter. In this sad moment, Emilie must face the ironic twist of her own role as a mother: Even though she has rebelled against the conventions of her sex for her whole career, she is, as a mother, no better than the men she has so long tried to prove wrong.

4.3.3 EMILIE AND VOLTAIRE

Similar to the historical Émilie's life, the character of Voltaire occupies a large role in the fictional Emilie's retelling of her life. The historical Voltaire needs only a little introduction, as his work in science and philosophy is canonised in almost every kind of secondary education. Born as François-Marie Arouet in 1694, Voltaire joined the contemporary philosophical and scientific movement of the Enlightenment that questioned authority and reason. He is probably best known for his proclamation that certainty is absurd, highlighting that "[e]very idea and theory can be challenged" (Buckingham 146). Eleven years after his death in 1778, the French Revolution would ground itself on these principles of questioning the authority of the government (Buckingham 147). In the historical Emilie du Châtelet's life, Voltaire entered as a guest at her father's scientific salons and later as a friend when Emilie returned to public life after giving birth for a third time (Zinsser "Mentors" 101). They sustained a fifteen year-long partnership, both romantic and professional, in which Voltaire not only published alongside her but also lived part-time at her chateau in Cirey (Zinsser "Mentors" 96).

The first thing that obviously stands out with the fictional Voltaire and Emilie is that they are the only two named characters in the drama. The players whom Emilie so artfully directs are named as well, yet they are named vaguely and to fit general categories of people that have entered Emilie's life. The authorial notes specifically cast the phenotype that the different players are supposed to assume: There is Soubrette, who is "a young woman, mid-twenties, plays Emilie and others", namely every younger woman who will be important throughout Emilie's life, such as her daughter who is cast as "direct and strong" and Mary-Louise, Voltaire's cousin and eventual lover, who is described as "simple and stupid" (cf. author's note in Gunderson "Emilie").

All of these attributes refer back to the original archetype of a soubrette, a role used in opera, theatre and nowadays in musical theatre (Schrader 78). Mozart's operas and operettas offer several examples of the soubrette, such as Despina in *Cosi Fan Tute*

or Papagena in *The Magic Flute* (Schrader 80). The soubrette originates from the Italian *commedia dell'arte* and has since then evolved from the quick-witted servant in opera and the merry seductress in theatre to a more well-rounded character in contemporary theatre and opera, defined by her distinctive vocal range and timbre (Schrader 78-80).

In this stage play, Soubrette has to stand in for any young woman that is not Emilie. Her eponymous role model of the archetype of the soubrette discloses the true role that she is occupying: She is the seductive young woman from the theatrical history in her role as Marie-Louise, with whom Voltaire cheats on Emilie, and the sharp-minded girl in her role as Emilie's daughter, who is forced to adhere to the social standards set upon her by society even though her mother clearly defied them (cf. Gunderson "Emilie" 41-42). The Gentleman, another player described as a good-looking man in his thirties, has an even larger plethora of characters to portray, ranging between "young and doting", "sincere", "snide and proud" or even "serious but warm" (all cf. author's note in Gunderson "Emilie"), covering all the male, grown-up figures in Emilie's personal life that are not Voltaire. Madam, the final player, is resigned to embody all the elder women with whom Emilie came in contact, such as Emilie's mother or an "obnoxious and rich" elderly lady (cf. author's note in Gunderson "Emilie").

These multitudes of portrayed roles that are distributed to three players leave only little room for an individual character trait of the three players and nor are they supposed to. Their respective roles are announced at the beginning of scenes or in the stage directions peppered throughout the dramatic text (cf. for example Gunderson "Emilie" 68). The only place where we find any characterization of the players in in the stage directions, which occupy a narrative role in giving introspection into the players' reactions. The directions exhibit "many of the characteristics of the fictive discourse of other genres: most notably, of the novel" (Suchy 80) and therefore supply a narrative act of character description that is usually missing in dramatic texts. They describe how Gentleman, as Emilie's husband, is "*not entirely sincere about*" playing a scene where Emilie's husband is happy for her relationship with Voltaire (Gunderson "Emilie" 25, emphasis in original) or how Madam answers "*with complete lack of nerve*" to Emilie's proclamation that Voltaire will be fine after feeling sick (Gunderson "Emilie" 23, emphasis in original). When Gentleman "*enters as NEWTON with trepidation [because] these are big shoes to fill*" (Gunderson "Emilie" 53, emphasis in original), the stage directions offer a meta-commentary on the players as nervous actors on stage, mimicking the mimetic atmosphere of a theatre play within the actual play. These insights are brief

and serve more as a comic relief than as a genuine characterisation of the players. As Manfred Pfister stated, this "preimposes an interpretative perspective on the dramatic presentation that follows" (72), not only giving the written text more dimension but also providing additional aspects for a potential staging that go beyond mere description.

The players are the stand-ins, they are exchangeable and the roles that they occupy were of little to no consequence in the long run of Emilie's life and career. Their interchangeability stands in stark contrast to the specific roles that are given to Emilie and Voltaire and this drama. They are no placeholders for others; they are the two defining characters in this drama that shape the relevant actions. This distinction is even made in the authorial notes, in which Emilie and Voltaire are subsumed as "Characters" while the other three are merely "Players" (cf. author's note in Gunderson "Emilie). It not only further highlights the importance of Emilie as a narrator figure on stage but also throws her relationship with Voltaire into greater relief.

At the heart of the conflict between the fictional Emilie and Voltaire sit both their personal as well as their professional connections. As explained before, this fictional version of Émilie du Châtelet reappears after her death on an empty stage, surprised by having a body and a perception of time and space once again (Gunderson "Emilie" 9). After a quick moment of familiarizing herself with her surrounding, she returns to her life's work, the *force vive*:

> There are things called living and things called dead that exist as people. Hearts and the squaring of hearts. (*She draws a simple heart. Then squares it:* ❤^{2}.) (*She finds* ***F=mv*** *is written.*) Then there are the things called 'living' and things called 'dead' that exist as Force and the squaring of Force. Motion, mass. Squared. (*She squares it:* ***F=mv²*** *remembers this now…*) *Force Vive*, it's called. *The Living Force*. 'Living' because of that little 2. (*She erases the* ***²:*** ***F=mv***.) Now it's dead.
>
> (Gunderson "Emilie" 9; emphasis in original)

Force vive or *vis viva*, as it is commonly referred to, is a concept of force that stems from the earliest conceptions of the studies of kinetic energy and is, by now, outdated (Museliak 13). The questions of *vis viva* were at the heart of a lively debate among followers of Newton, Leibniz and Descartes in the 18th century, when Newtonian metaphysics and Leibnizian physics clashed over the question of the conservation of

energy in bodies in motion: "Leibniz' concept seemed to oppose Newton's theory of conservation of momentum, which Descartes advocated. […] For Leibniz the metaphysical principle established the priority of the conservation of living forces in changes of motion" (Museliak 13). Both Newton and Leibniz were concerned with the question of force, yet disagreed on what this force of a body in motion consisted of. Newton believed that force was conserved in the body, yet calculated it by mass by velocity. Leibniz was equally convinced that this force was conserved in the respective body, but insisted that mass by velocity needed to be squared. This squaring of velocity renders it the *force vive*, the living force (Museliak 11-14).

What appears to be a trivial or superfluous addition to the tally of Emilie's work is actually an important intersection in both the fictional and the historical Marquise du Châtelet's life. The historical Émilie du Châtelet opposed not only her life-long collaborator Voltaire by siding with Leibniz in this debate. In her monograph *Physical Institutions,* she dedicated an entire chapter to the question of *force vive* in which she defended the theories of Leibniz. By supporting the Leibnizian theories this publicly, she went against the current standard held by the Secretary of the Academy of Science in France, the highest possible authority of scientific standard in the French community of physics and astronomy at that time (Museliak 12). The secretary, Jean-Jacques d'Ortous de Mairan, publicly responded to her criticism with a "rather long letter regarding the question of the *forces vives*" but, instead of caving to the pressure, the historical Émilie "fired back" and offered Mairan to explain her work to him, should her theories prove too difficult for him to understand (Museliak 13).

In the drama, the beginning of the second act consists of a quick retelling of this dispute between Mairan and du Châtelet but this time the dramatic texts adds a historically uncovered layer to this story by centring on the reaction of Voltaire in the aftermath. In a heated discussion after Emilie has publicly denounced the Newtonian school of thought, she accuses Voltaire of taking her stance too personally:

> VOLTAIRE. I have to defend the truth! They respect my opinion.
> EMILIE. I gave you your opinion.
> VOLTAIRE. And then turned your back on it.
> EMILIE. On *you*. It's not the little 2, it's not Newton, it's you I've betrayed, correct?
> VOLTAIRE. This isn't ego, it's fact. My ideas match the entire continent's.

EMILIE. Which makes you popular not right! […] No man can know all.

VOLTAIRE. But a woman can?

(Gunderson "Emilie" 50-51; emphasis in original)

Voltaire has responded to Emilie's public dispute with Mairan with a letter of his own, in which he sides with the French Royal Academy of Sciences and therefore denounces Emilie's theory. Instead of taking the side of his close confidante, both personal and professional, Voltaire has opted to stick to the comfortable truth, as Emilie rightfully points out when she reminds him that siding with the majority does not automatically guarantee correctness. Since Voltaire is closely associated with the Newtonian school of thought, he takes her rejection of Newton as a personal attack on his own work, calling it "irresponsible" (Gunderson "Emilie" 50) to do such a thing. In this exchange, both attack their respective opponent for their conceit in thinking that they alone can be right. History would prove them both wrong, as neither $F=mv$ nor $F=mv^2$ have proven to be accurate assumptions for the conservation of energy nor for the laws of motion. But this exchange is less about the factuality of their arguments and more about their personal interaction. Public discourse and work bleeds into their private sphere as Emilie, as a woman in science who goes against the grain of her contemporary discourse, has to prove herself against an armada of male scientists who are used to being right and unquestioned. Instead of accepting Emilie and her opinion, Voltaire bounces back into a state of superiority of men over women, doubtfully asking that, if men cannot be right all the time, then surely neither can women. Emilie is quick to defend herself. She insinuates that without her work, Voltaire would have never arrived at his status and recognition, claiming that it was she who gave him his opinion. She sees Voltaire's rage for what it is, namely a bruised ego of a person who is unwilling to let someone they perceived as a student now move on to being a scholar of their own, even if it entails separating oneself from the opinions of others. To Voltaire, Emilie did not simply reject Newton and his school of thought; she rejected him, her lover and colleague, and thereby their connection through close collaboration.

Even before, Voltaire has displayed the typical dismissive tendencies of many men in science of his time towards Emilie, even though he as her colleague and partner should know better. Emilie tells the reader in a direct address that she and Voltaire have been working on proving that fire is a material of its own for a publication to submit to the Academy of Science in a competition. Voltaire, in contrast to Emilie, has been lacking

in conducting the experiments according to common scientific standard and Emilie confronts him on the discrepancies in their results. If their work is not yielding the data they expected, then they will need to start the experiments over (Gunderson "Emilie" 37). Voltaire, steadfastly sticking to Newton's belief that fire is a material, refuses to accept Emilie's deduction that fire itself has no weight and is therefore no material and a dispute breaks out between the two. In the end, Voltaire decides to publish their findings without Emilie because she does not want her name to be associated with a study that she deems wrong. Voltaire here uses their shared work for his own purpose, publishing against his collaborator's will and going against her better judgment. Emilie is astounded by his mulishness:

> EMILIE: For *once* just consider the idea that you *could* be mistaken, that you *could* be fallible in this one scenario, lonely as it may be in the immensity of your usual correctness. Science isn't theatre, you can't pick the ending because it sounds nice. Listen to me.
> VOLTAIRE. Listen to *me*. You think The Academy would ever *ever* give this prize to a woman? If you want to do this work, you got to do this with me. You're nothing to them. A rich courtier with no reputation except as a card shark and a…tramp. Who are they going to validate, you or me?
>
> (Gunderson "Emilie" 38, emphasis in original)

What has started as a scientific disagreement on the qualities of fire has quickly turned into an acrid personal dispute. Emilie shows herself to be a dutiful scientist who is faithful to the principles of deduction: If an experiment yields certain results, then the scientist cannot randomly choose the results that match their preconceived theory. An experiment can give proof for a theory but an experiment may not be bent to fit a fixed notion that already existed beforehand. Voltaire, in his anger, stoops to an ugly personal level. He may be entirely right when he claims that the Academy would never publish a woman's article. Yet instead of acknowledging the unfairness and standing by his partner's side, he repeats this narrative of women's unworthiness in science and, almost haughtily, considers himself Emilie's only chance at publishing. History will prove Emilie's deduction right and she does not give up. Instead of accepting Voltaire's benign offer of mentioning her in his dedication when he publishes their findings, she secretly publishes her own article on their experiments behind Voltaire's back, in which she sticks to her

convictions. The Academy awards them both honourable prizes and their relationship bounces back into its usual dynamic of amicable companionship and collaboration (Gunderson "Emilie" 39-40).

In contrast to canonical historiography, in this drama Emilie herself dictates the way her life is portrayed. Where many biographical publications limit her work to the context of Voltaire, as Judith Zinsser decries (cf. Zinsser "Genius" 168), this fictional rendition of her life puts her in the most important role for once. In the very beginning of the drama, the character of Voltaire still tries to assume the dominant position that he always occupied in Emilie's life and the way it is told. The players come on stage and Emilie tries to make sense of who they might signify, respectively. As she recognises Voltaire and tries to speak to him, "*the PLAYERS hand EMILIE and VOLTAIRE scripts from which they read right now*" (Gunderson "Emilie" 11, emphasis in original) and Emilie is dumbfounded when Voltaire steps up to the centre of the stage and announces the reading of a play that he apparently has crafted in homage to Emilie. For the first few lines, Emilie suppresses her confusion and allows the strange lines that Voltaire has written to be acted out, "*reads* [them] *unenthusiastically*" (Gunderson "Emilie" 12, emphasis in original). But after just a few lines, she begins to realise that something about this retelling is wrong and starts to interrupt Voltaire in his re-enactment of her life:

> EMILIE. Wait, why are we starting here? […] Who wrote this? […] Okay – *Stop*. Stop. This isn't right. (*Realizes as she looks at her script.*) Because *this* isn't my story. (*to V*) This is *yours*. (*She tosses the script. V is insulted.*) And tonight is *mine.* From now on? My story. My life.
>
> (Gunderson "Emilie" 12-13; emphasis in original)

Emilie's life did not begin with Voltaire entering her social circle, nor does the role Voltaire played in her life give him any right to dictate a retelling of it. It is not, for once, men who decide how her life is told. Emilie is in charge of what is happening on stage, which assigns her the role of a narrator and even directorial stage manager.

4.3.4 EMILIE AS A STAGE MANAGER AND NARRATOR

What is perhaps most striking about this dramatic text is the meta-theatrical quality of the character of Emilie. As described before, Emilie is in the unique position of a figurative stage manager who has players at her disposal to re-enact those incidents of her life that were either the most important ones or that are worth revisiting for her to find clarity. The empty stage that she returns to is only adorned with a blackboard that has three things written on it: The equation F=mv, which Emilie will square and un-square throughout the course of the drama, depending on the scenes she is replaying. This equation, the *force vive* as it is referred to, sits at the heart of a long scientific dispute between herself and the French academic society, as has been mentioned earlier. What is also written on the blackboard are the words "love" and "philosophy", indicating that these will be the topics that Emilie will deal with on her quest for an answer to what makes a life a living force (Gunderson "Emilie" 9-11). This question has been unanswered in her life as she died too young to have finally found a solution, but Emilie decides that "[t]onight, [she] may finally know and finally, finally rest" (Gunderson "Emilie" 11). If she is given this chance of a metaphorical rebirth and a metaphorical second try at her life, then she will put it to good use.

Emilie's quest to evaluating her life post-mortem begins with her needing to learn the rules, so to speak, of her new environment. After returning to the stage at the beginning of the play, Emilie tries, in a very scientific manner, to take account of her new situation:

> EMILIE. Breath. (*She flexes her hands, testing, getting her bearings*.) Body. Again. (*She steps out of her spotlight, then steps back in*.) Space. And Time. Again? Life again? But I'm dead. I'm here. You're here. You're dead? No. Poor logic. Back to facts.
>
> (Gunderson "Emilie" 9, emphasis in original)

It appears that Emilie has unknowingly returned to the living, if we can refer to her state as living. Like the methodical scientist that she is, she first assesses her new state of being by enumerating all the functions she has regained: A body, the ability to breathe, her perception of time and space. She questions whether this consists a new life for her, asking whether she might actually be alive despite fully knowing that she has, in fact, died. Upon

this apparent logical conundrum, she returns to what she can work with best: Facts. She recurs on her research of *force vive*, reminding herself of what something living can consist of. It is then that she realises that this question is not only "[her] life's work – No, [her] life's *question*" (Gunderson "Emilie" 10) and that it has been left unanswered. Similar to a game of trial and error, Emilie learns that she may be back to re-evaluate her life, yet is not allowed to physically interact with the other characters on stage. In a retelling of her first meeting with Voltaire where she tries to touch his knee, she is stunned when she realises that "*[i]mmediately upon their first physical contact, the lights, music, and all breath in the space are gone with a crackle and a spark*" (Gunderson "Emilie" 18, emphasis in original). Voltaire and the other players do not seem concerned or even appear to have noticed any changes, whereas Emilie is nonplussed. She tries to touch Voltaire one more time, yet once again "*the lights go out more violently*" (Gunderson "Emilie" 18, emphasis in original). Harkening back to her predecessor's studies, she realises: "Descartes was right; mind and body are distinct. In this case profoundly so. I understand now. No touch." (Gunderson "Emilie" 18). It is a reference to the earlier discussed distinction of René Descartes, who claimed that the mind was sexless as it was separated from the body and that access to knowledge was to be given without prejudice (cf. Sheffield 12).

Once she has settled in this new unfamiliar environment, Emilie quickly takes to directing the players around her to re-enact key moments of her life. The players, Soubrette, Madam and Gentleman, are at her disposal and listen to her every spoken or unspoken command. In the very beginning of the drama even before she realises that she is not allowed to touch anyone, Emilie directs and assigns the players to their roles and identifies the players for the stand-ins that they are. She knows that Gentleman will occupy the roles of elder men such as her husband or Newton; she also knows that Madam substitutes for women at court or her own mother and, of course, identifies Soubrette as the young woman who will occupy Emilie's own place (Gunderson "Emilie" 11). It is ironic and maybe even a metahistorical nod to canonical historiography that Emilie recognises Soubrette as her double when she sees Soubrette making out with Voltaire on stage (Gunderson "Emilie" 11), almost as if the fictional Emilie knows quite well that this emotional and physical connection between her and Voltaire will always be the most significant identifier of her own history. Emilie directs the players either by physical or vocal cues, such as a quick nod to Soubrette to write a letter in her stead (Gunderson "Emilie" 39) or when she decides to translate Newton's Principia, she loudly demands:

"Give me Newton!" upon which "*GENTLEMAN enters as NEWTON with trepidation*", cowering at her demanding tone (Gunderson "Emilie" 53, emphasis in original). At times, she chooses to use the players to enact any physical reactions she may have to what is happening on stage, for example when she sends Madam to deliver a slap to Voltaire when finding out that he cheated on her with his own niece: She "*whistles to MADAM who charges V and slaps him hard*" (Gunderson "Emilie" 56, emphasis in original).

In this function, Emilie as a character adheres to what Brian Richardson has coined as the generative narrator in his article "Point of View in Drama: Diegetic Monologue, Unreliable Narrators and the Author's Voice on Stage" published in 1988 in *Comparative Drama*. Richardson identifies six types of narrators in drama, one of which perfectly describes the role the fictional Emilie occupies, namely the generative narrator. Richardson is specifically careful with using the concept of the narrator for characters on stage, reserving it only for a "speaker of consciousness that frames, relates or engenders the actions of the characters of the play" (Richardson "Point" 194). A character may occupy different roles in different scenes, switching from being a mimetic character and a diegetic narrator when acting outside of it (Richardson "Voice" 683). Richardson's generative narrator occupies exactly this kind of hybrid role: The generative narrator functions both on the level of characters as well as on a higher level of communication, situated just on the margin of the fictional world yet firmly in the textual realm of the drama (cf. Richardson's graphic in "Point" 210). This generative narrator is "ontologically distinct from the figures who emerge from or are engendered by his discourse" (Richardson "Point" 209), meaning that the characters who work as generative narrators must work in a different manner from the other characters in the play. Notice also how Richardson, too, uses the generic masculine when referring to the narrator figure, once more undermining the male prerogative of storytelling.

The character of Emilie defies this generic male approach by occupying the role of a generative narrator as a female character. She fits the corner points of Richardson's category: She is part of the action as a character on stage, yet distinctly separated from the action by her physical restraint of not being allowed to touch the other characters. The players, who she directs and moves to her will, are the figures emerging from her directing this re-enactment of her life. She engenders the action by announcing the scene titles and by directing the characters who stand in for the phenotypical persons they are supposed to signify. Her role in this play is also fluid in the sense that she is the director of her own

life's retelling on the one hand, yet on the other hand also interacts with the players as a character herself (cf. Gunderson "Emilie" 74).

At the end of the play, when Emilie arrives at her premature death during the birth of her third child, this tight assignment of roles begins to dissolve. Emilie knows exactly what finishing her life's story might entail and therefore refuses to continue:

> EMILIE. I'm sorry. I'm sorry. (*Beat. She is alone. No one's coming on)*. Sorry, and running out of time and no closer to knowing anything new. (*giving up)* So STOP. Just stop. We don't have to go on anymore. I understand. (*Emilie's desk returns, two huge books as well – one is Newton's* Principia *and one is hers for writing.)* I said I understand. I don't want to do the rest. (*SOUBRETTE enters carefully.)* I know what happens! And I want to stop! *(pause)* WHY NOT? (*SOUBRETTE turns to her.*)
> SOUBRETTE. Incomplete.
>
> (Gunderson "Emilie" 68-69, emphasis in original)

Emilie has arrived at the end of her life, or rather at the end of her re-enactment of her life, and has, understandably, decided that she would rather not witness her death for a second time. Yet despite her assumed role as a director, there are certain things that she cannot forego. Like a petulant child, she refuses to continue and would rather stay on stage and continue translating Newton instead of facing the next and final step. The players, who so far have been under her command, are now living a life of their own. After Soubrette has entered, Madam, Gentleman and Voltaire return as well and specifically hinder her from exiting the stage. Her story, they claim, is yet untold and the questions that she left unanswered upon her first death still need to find their answers (Gunderson "Emilie" 70). Outside of the stage she may only find "Real Nothing", Soubrette claims, implying that once Emilie leaves the stage, she has left this second chance at finding answers for good (Gunderson "Emilie" 70). The roles seem to shift: Where before Emilie was in control and directing the course of action, the players and Voltaire now have a will of their own. They impart warnings on Emilie, acknowledging their roles in this retelling of her life and try to persuade her to allow this painful – both physically and psychologically – memory to play out.

Even as she fights tooth and nail, the players continue against her will: Soubrette leaves the stage and returns with a visibly convex belly, implying that she is far along in

her or rather Emilie's pregnancy. Emilie falls into panic, "*fill[ing] the walls with Force Vive equations* […]" and shouting: "WHERE IS THE ANSWER?" (Gunderson "Emilie" 72, emphasis in original). She feels her time drawing to a close and is no way nearer finding the answer to the meaning of life that has plagued her for all this time. None of the players can offer her any replies, though, and continue with the action. Soubrette delivers the baby off-stage and returns to the bed on-stage, visibly exhausted, while Gentleman, Voltaire and Madam leave the two of them alone on stage (Gunderson "Emilie" 72-73). In a moment of revelation, Emilie is alone with herself on stage, herself being represented by Soubrette in her dying moments, and Emilie realises what she ought to have known all along, namely that it is not important "*what* we mean but *that* we mean" (Gunderson "Emilie" 74, emphasis in original). She may not have found all the answers she was looking for in her lifetime but she has left a legacy that would be answered long after she had died. *Force Vive* might be by now outdated, but her work on the subject has furthered the academic discourse for centuries to come.

The final scene of the drama plays out as a cathartic moment for Emilie, in which she is able to comfort her own self, portrayed by Soubrette, in the moment of death. She even defies the earlier on established rules of no physical contact. Emilie reaches out and takes Soubrette's and figuratively speaking her own hand, upon which the lights immediately signal danger, almost in a warning to remind Emilie that she is not allowed to touch. But Emilie is not perturbed by their flickering and continues to hold Soubrette, reminding whoever is in charge that this will be "[t]he scene in which I die. But not yet." (Gunderson "Emilie" 74). The lights, anthropomorphised in the stage directions, quit their wailing and heed her request for a short postponement. Emilie can find peace in her final moments both on stage and in life: "The scene I never got. The scene that no-one does. The scene when *I* hold my hand – when I *am* all I need – because in this scene? Nothing gives me meaning but me." (Gunderson "Emilie" 74, emphasis in original). She holds Soubrette through her death and provides the comfort that she has not received in her life.

As this emotional ending shows, Emilie has evolved in her role as a narrator on stage from simply directing and commanding the players to understanding and giving meaning to her own life. Not only has she accepted the inevitability of time passing and of her life ending, she has most importantly found the answer to her question at the very beginning of the drama, namely the question of what gives her life meaning. She can now leave the stage in peace, knowing that even though she might not have been able to answer all the scientific questions that she came across in her life, she has nevertheless left a

lasting impact on the scientific world by posing the questions in the first place. It is a true catharsis for the character of Emilie to not only see her life play out once more but to be able to finish it with a comforting presence that she has found in herself, to die knowing that what she has contributed is enough. The play offers a metahistorical answer to the questions that might have plagued the historical Émilie in the face of her early death. It validates the work of Émilie du Châtelet not by the standards of her life-long critics or a male standard of science of her time but rather by herself. Only she can judge her life's worth and she has found it, in the end, to be meaningful. The title of the play finds its significance in this ending: Emilie is defending her life during this night that the play takes place in against any critics or historiographers who might deem her contribution too insignificant to be mentioned or who prefer to see her only as the mistress of Voltaire. The fictional Emilie gives her work value and thereby gives the historical Émilie the place in the history of science that she deserves.

The fictional Emilie du Châtelet refused to let Voltaire dictate how her science was to be conducted and, as a stage manager and narrator, directed her own life's retelling to tell the story accurately and how she remembers it. The scientist of the following section, x-ray crystallographer Rosalind Franklin, is not given this chance. In *Photograph 51*, it is the fictional equivalents of her male colleagues that serve as choral narrators who are reflecting on the race for the DNA of the mid-20th century.

4.4 "SHE DIDN'T STAND OUT, I SUPPOSE": ANNA ZIEGLER'S *PHOTOGRAPH 51* (2011)[18]

The case of Rosalind Franklin is often taken as the prime example for a male-dominated community of science that has excluded women from participation or, in Franklin's case, even used women's achievements without proper credit. She was a vital part of the race for the DNA, as it was called, which took place among biologists and chemists worldwide in the first half of the 20th century (Klug 17). Scientists were keen on solving the puzzle of the structure of the human DNA in order to enable new medical treatments. As an x-ray crystallographer, Rosalind Franklin worked on a special technique that captured strands of human DNA in pictures. One of her photographs, the famous and eponymous "Photograph 51", was the deciding picture to confirm the antiparallel double-helix structure of the human DNA (Jaeger 153). This iconic photograph was used by her competitors and colleagues without her knowledge to produce the now famous anti-parallel double helix model of the human DNA and she has gone without credit for her work for many decades. Only with the work of feminist historiographers and biographers has this oversight been acknowledged and her rightful credit has been claimed.

The drama *Photograph 51* retells the important years of two competing British teams working to figure out the structure of human DNA: Maurice Wilkins, Rosalind Franklin and Ray Gosling at King's College, who are later joined by Don Caspar, and James Watson with Francis Crick at Cavendish Laboratory. The drama opens with Rosalind Franklin being hired as a researcher to work with Dr Wilkins at King's College. After a rather frosty first meeting of Maurice and Rosalind, the two continue to work in the same lab, yet each on their own projects. At a conference in Naples, James Watson approaches Maurice Wilkins to propose a cooperation, but Maurice turns him down, leading to James Watson and Francis Crick teaming up. Maurice, who has been in contact with James and Francis, complains to them about Rosalind's attitude. Rosalind and her assistant Ray Gosling manage to capture the double helix of the DNA in a singularly brilliant photograph, which Rosalind refuses to share with Maurice because of their difficulties. Maurice, who knows of this picture because Ray told him, in turn shows James the picture in a moment of collegial banter. James immediately recognises the

[18] I am using the original version of the play from 2011 published by Dramatists Play Service Inc. An updated version has been published by Oberon Books in 2015, but this analysis is based on the first version.

significance of the picture and rushes off to tell Francis about what he just saw. While Rosalind continues to work on her own with her new colleague Don Caspar, Francis and James build a new model of the DNA. They publish their new findings, beating Rosalind and Maurice to the discovery. At the end, the narrators inform the readers that Rosalind has died of ovarian cancer, to which Maurice reacts quite violently with denial. He shares the final moments of the drama on stage with Rosalind, imagining how their relationship could have gone differently if they had become friends, leaving the ending open to imagination. The entire drama is narrated by the five men, Wilkins, Watson, Crick, Caspar and Gosling, who comment on the action from an unspecified point of time somewhere in the future. These male characters assume the role of narrators as well as a modern version of the chorus known from plays of the Antiquity, allowing for a metaleptic commentary on the action and for a shift from homodiegetic characters to heterodiegetic narrators.

4.4.1 BIOGRAPHICAL BACKGROUND

Rosalind Franklin was born in 1920 to a wealthy Jewish family and studied at Newnham College in 1938. She was thoroughly supported by her family, who "made no distinction in the upbringing and educational opportunities they offered their two daughters and three sons" (Jaeger 154). Jaeger claims that her family secretly would have preferred her to marry rich instead of pursuing a scientific career, which is hotly disputed by Franklin's own sister, Jenifer Glyn, who praised her family for the support they offered Rosalind (cf. Glyn 254). With a completed PhD in chemistry, Franklin spent a brief time of research in France after the Second World War had ended, which is where she acquired her advanced skillset of crystallography and x-ray diffraction. She moved back to the UK in 1950 to accept a fellowship at King's College in London where she would work together with Maurice Wilkins on the structure of DNA (Gaillet and Bailey 43-45). Their joint supervisor, John Randall, made the mistake of promising Wilkins an assistant while he assured Franklin that she would be an independent researcher. This misunderstanding severely hampered their cooperation (Jaeger 157).

At King's College, Wilkins and Franklin did not get along well and spent their time in the same lab "hardly speaking to each other" (Ogilvie 466). This is probably why, according to Ogilvie, Wilkins did not hesitate to show their immediate competitors, James

Watson and Francis Crick, photographs Franklin had taken of the DNA. This prompted Watson and Crick to conceive of their now famous antiparallel double-helix model (Ogilvie 466), which was published in an article in *Nature* in 1953. By then, Rosalind Franklin had moved to Birkbeck College to conduct research on the tobacco mosaic virus (Ogilvie 466). She died unexpectedly of ovarian cancer in 1958. Even though Rosalind Franklin is usually associated with the structure of DNA because of her unique story, her main research foci lay with viruses and their structures, and her findings continue to be used by scholars in the field even today (Gaillet and Bailey 47).

In 1962, only four years after her death, her former colleague Maurice Wilkins as well as their competitors James Watson and Francis Crick received the Nobel Prize in Physiology or Medicine for their discovery of the double-helix DNA structure. None of them mentioned Rosalind Franklin's contribution in their speeches or gave any sort of credit afterwards to her work that facilitated this major breakthrough in biochemistry (Ogilvie 466). As was stated before in the second chapter of this thesis, a Nobel Prize cannot be given to deceased scientists, meaning that even if the three men had planned on acknowledging her, she would have been ineligible anyway. Nevertheless, it is a dishonourable display of erasing a woman's work in such an important field of science. Her significance to their work only came to light in the following years because of an autobiography published by James Watson. In this, Watson blatantly shared how he and Francis Crick had been shown Rosalind Franklin's work by Maurice Wilkins behind her back and Watson shows no shame for their uncooperative behaviour (Jaeger 160).

The reaction to this confession was public outrage and disapproval of Watson's assessment (Zehelein "James" 90). Thanks to biographers such as Anne Sayre, a close personal friend of Franklin's, and Brenda Maddox, who has published the most extensive biography of Franklin's life to date, the historical wrongs have come to the forefront (Zehelein "James" 96; Gaillet and Bailey 44). Franklin was a respected and admired researcher before; in the light of these historical discoveries, she became an icon for the feminist movement overnight. In 2008, fifty years after Rosalind's death, her sister Jenifer Glyn shared her pride at seeing how the legacy of her sister inspires a new generation of girls to choose a career in science (255). She insists that Rosalind would much prefer being remembered for her work and would probably be "amazed […] and still baffle[d]" by the intense reaction of the public to her story (Glyn 255). Her untimely death no doubt cut short a promising scientific career, yet her posthumous acknowledgement has ensured that her work will not be forgotten (Glyn 254). Franklin's extensive written

correspondence with friends and family has luckily survived the decades since her death and has served as primary material for many of her biographers, who were able to capture her character on the basis of her own words (Gaillet and Bailey 43).

4.4.2 THE MALE COMPETITOR: JAMES WATSON

In Anna Ziegler's *Photograph 51*, the character of James Watson, named after his historical counterpart, is painted as the main antagonist who displays most of the misogyny and open hostility towards Rosalind Franklin, mirroring the historical Watson's chauvinism (Maddox 407).

James Watson, a geneticist from Cavendish laboratory, was one of the creators of the now famous Crick-Watson-model of the parallel double-helix structure of the human DNA. In their publication of the model in 1953, Watson and Crick gave a short thank you to the team at King's and claimed that they were "stimulated by a knowledge of the general nature of the unpublished experimental results and ideas of [Dr Wilkins], [Dr Franklin] and their co-workers at King's College" (Watson and Crick 737-738). He, his colleague Francis Crick and Maurice Wilkins from King's college received the Nobel Prize for their contribution in 1962, four years after Rosalind Franklin's death, which made her ineligible for the accolade. It only came to the public attention later that Franklin's x-ray photographs were not only a stimulation to Crick and Watson. They knew far more about the work at King's than in a "general nature". Watson retold their path to building the model in his autobiographical novel *The Double Helix* (1968) and revealed that Maurice Wilkins had granted him and Crick access to Franklin's unpublished photographs (Gibbons 66). She had kept these photographs to herself, unwilling to publish them without satisfactory knowledge of what they signified (Watson "Double" 69). Not only did this revelation shed a new light on Rosalind Franklin's contribution and the credit she never received, the book also contained some very misogynist comments on behalf of Watson. He clearly did not value Franklin as a person but only as a means to produce pictures they could use (Watson "Double" 17-20, 68). His attitude towards Franklin has not changed in the last decades, even after the backlash his book received. His colleagues and Franklin's contemporaries have severely condemned the account and how Franklin was treated in it (Zehelein "James" 90).

In the drama, the character of James Watson picks up on this kind of misogyny and mirrors his historical counterpart in tone and sometimes even in direct quotes. Already at the very beginning of the drama he is opposed to the fact that the story that is about to be told will be about Rosalind instead of him: "Why tell a story about someone who barely made a dent?" (Ziegler 11). When Maurice reproaches him and reminds him that the story should not be about Watson, Watson retorts that "it should be" (Ziegler 11). In James' eyes, the only story worth telling is the story of his own success, not Rosalind's failed one. It failed, according to him, because she was unwilling to settle for a position as an assistant to Maurice instead of being her own researcher, as she was originally promised (Ziegler 14). "The race is lost right there" (Ziegler 14), he claims, suggesting that because of Rosalind's difficult attitude she set herself up for failure right from the start. Watson thinks she does not deserve the place in the memory of history that the other men are willing to attribute to her because she did not contribute in the way he did (Ziegler 29). The fact that her male colleagues deem themselves important enough to decide whether she deserves credit or not is, of course, telling in itself, and contributes to the image of the fictional Watson as misogynistic and self-important.

Direct quotes and references are also taken from the historical Watson's publication on the race of the double helix, more precisely the ones that are made at the expense of Rosalind Franklin. In the drama, James and Francis are attending a lecture by Rosalind on her findings concerning the structure of the DNA so far (Ziegler 33-34). But, instead of listening and paying attention, they comment on her looks and do not take her seriously (Tiehen 133-134). The model they build afterwards on the basis of what they gathered from her talk is therefore faulty and Rosalind Franklin, both the character and the historical figure, commented on it and declared it wrong, adding to the irony of the moment (Klug 12-14). During this lecture in the drama, James finds physical traits of Rosalind's to critique, such as her hair and the glasses she wears. This mirrors a sentiment the historical James Watson expressed in *The Double Helix*, where he commented on Rosalind Franklin's appearance in a similar vein: "Momentarily I wondered how she would look if she took off her glasses and did something novel with her hair" (Watson "Double" 61). Similar to his historical counterpart, the fictional James Watson finds superfluous flaws with Rosalind Franklin's appearance instead of focussing on her work, reducing her to her appearance that is apparently not pleasing to him.

Rosalind even foreshadows the way that James will use her photographs for his own purpose. During their work together, Maurice gives a lecture and refers to the work

that Rosalind has done as his own work, which greatly angers Rosalind. Ray recounts: "He announced to great applause, that all the X-ray patterns *he'd* made indicated a clear central x, a helix." (Ziegler 28; emphasis in the original). Rosalind is furious at Maurice for stealing the credit from her while Maurice dismisses his blunder as "just a manner of speaking" (Ziegler 28). In a poignant statement, she defends her violent reaction saying: "I simply will not have my data interpreted for me!" (Ziegler 30). Similar to how she will later warn Don Caspar to only use her diffraction images if he can interpret them correctly, Rosalind is now just as afraid that her work will be taken out of her hands and used in a way that she cannot control. Unbeknownst to her, that is exactly what the character James will do, as did the historical James Watson in 1951.

James himself is greatly convinced of his own grandeur. He compares himself to the power of fate, looming behind Rosalind's back, insinuating that he is "a force greater than she was" (Ziegler 21) because he was working hard on building his models while she was not prepared to take that leap of faith. He places a lot of faith in own sense of self and in his competence and he relates this self-confidence back to the other men in the drama. That Maurice refused to work with him is, according to James, "the biggest mistakes of [Wilkins'] life [, w]ithout question" (Ziegler 24). Without the help of James, according to the undertone of the scene, Maurice was doomed to lose the race as well. It is hinted at during this scene where James approaches Maurice in order to work with him at a conference in Naples in 1951 that even at that time, James was already on the lookout for the work Franklin was producing. When Maurice dismisses James' warning that Linus Pauling is working on the DNA as well, saying that Pauling "doesn't have the samples [he has, o]r the photographs", James counters that Pauling doesn't have "the photographer" (both Ziegler 24) either. While Maurice is placing his faith in the research, James has already deduced that the researcher, in this case Rosalind, is the key to solving the riddle of the DNA. Despite the antipathy James feels for Rosalind, he is still convinced that her work is the most important aspect. One might even speculate if that is his main objective in asking Maurice for a partnership: Working closer with Rosalind.

That Rosalind's work is very important to James is mirrored in a scene in which James comes to see Rosalind alone in the laboratory at King's (Ziegler 39-40). In the same way that he had tried earlier to convince Maurice to share his work with him, he is now at King's to persuade Rosalind. He comes bearing gifts, namely the unpublished manuscript by Linus Pauling, another scientist working on the DNA structure and mocks Pauling for making the same mistakes that he and Francis did in their model. Ironically,

he omits that they made the mistakes they did because they did not listen properly during one of Rosalind's talks. Watson is obviously looking for a similar malicious joy in Rosalind at their competitor's failure. To his dismay, he finds her uninterested: "Pauling is going to be publicly humiliated in two weeks when it gets published and you don't even want to see it?" (Ziegler 38). Rosalind is not interested in this sort of gossiping. She disapproves of the way Pauling has "rush[ed] to publish" (Ziegler 38) and therefore has no interest in gloating with James. The work of others and also their failures, so it seems, are of no concern to Rosalind, only her own work is. Their work ethics are fundamentally different: Rosalind does not focus on her competition and is only concerned with her own failure or success, while James appears to thrive on the schadenfreude at their competitors' failures.

Yet she soon catches on that James is there for something more than just Pauling's manuscript. He has come to convince her to share her findings with him: "So, share your research with me. I mean, you're not going to get in on your own." (Ziegler 39). Without his help, if James is to be understood, Rosalind will not be able to understand her own research. The indirect insult in the second sentence is only one of many James deals out during this conversation, intertwined with his own sense of superiority. He understands the patriarchal structure of their field and knows that it works in his favour. He insinuates that Rosalind will need to "compensate for the things [she's] lacking" (Ziegler 39) if she wants to interpret her work properly and that he might be the one to help her do that. One might speculate that what Rosalind lacks, in James' mind, is an intellect such as his or even simply being as well-connected as he is, in contrast to her as a lonely woman in the department. James argues that what Rosalind reads into her pictures are only "distortions" (Ziegler 39) and that she is simply not capable enough to read them properly and identify the antiparallel double helix. He, James, has a "feeling that's divorced from reason" (Ziegler 39) that the DNA is structured in a helix. Just as he did earlier by claiming he was greater than fate, he places his own intuition and genius over trivial matters such as proof and reason. If he is convinced, it must be right, no need for support from science. Rosalind is not impressed and angered by his blatant disregard for her own skills. She throws him out of her office and rejects his offer (Ziegler 39).

4.4.3 Two Efficient Pairs: Cancer and Competition

Similar to her historical counterpart, the fictional Rosalind Franklin is dying of ovarian cancer in this drama. She receives her diagnosis off-stage after breaking down in pain during a dinner with a colleague, and then turns to address the audience to explain the cause of these pains:

> ROSALIND: *(To the audience.)* I have two tumors. Twin tumors. Twins scampering around on my body on tricycles, dropping handfuls of dirt as they go… For a moment I think of naming one Watson and the other Crick, but no, I tell myself; Rosalind, dispel the thought. *(Beat.)* No. I have ovarian cancer. A tumor in each ovary, one the size of a tennis ball, and the other the size of a croquet ball, and they are indeed an efficient pair.
>
> (Ziegler 55, emphasis in original)

In a rather plastic manner, Rosalind describes the hurt she suffers and how her tumours look like, feel like, even their size. This little passage is a hybrid of both a short speech by one character alone as well as a narrative moment of an audience address. It is rather clear that this short passage functions as a fourth wall break in the dramatic context, in which the character of Rosalind's breaks with the illusion of mimesis and turns to the audience, acknowledges their presence and directly speaks to them, as is also indicated by the short stage directions at the beginning of her speech. What is more of a question is whether this lengthy speech of hers can be counted as a monologue or a soliloquy. Whether it is a monologue because she is aware of her fellow characters on stage or whether the audience is witnessing a soliloquy remains unclear. Rosalind has never before acknowledged the other narrator figures on stage unless they are embodying their function as characters. In their function as narrators, Rosalind seems entirely unaware of them commenting on the action on stage. This would account for this short speech as a soliloquy since the character of Rosalind thinks she is alone on stage. What disproves this assumption is the end of the drama, where Rosalind actively engages in the act of narration while acknowledging Maurice Wilkins as another narrator on stage (cf. Baldick "monologue" and "soliloquy").

In contrast to the other narrator figures in this drama, Rosalind is not able to look at her situation in hindsight but rather turns to the audience and addresses them on the

spot. While she does reflect on her situation from the point of view at that time, she cannot look back on her feelings in hindsight. It disqualifies her situation as that of a narrator and justifies the analysis of this short segment as a monologue or soliloquy. The insight that the audience is given is not that of a narrator who looks back at her actions, but by a character who shares an intimate moment regarding her health. What she does is explain her diagnosis of ovarian cancer to the audience using the present tense. When the other men, say Ray Gosling talking about how he was able to feel the cutting of the X-ray beam through his flesh (Ziegler 22), comment on the actions, they use any given past tense to refer to what happened at that time in the drama, see the following section for more detail. But Rosalind, who is not given the same privilege as the men, can only look at her current situation in the present tense. She describes her pain, the feelings of her sickness and even her thoughts in present tense, as a sort of snapshot of that moment, rather than a reflecting look back at a situation that has long since passed. She embodies her character in that moment, not a narrator re-evaluating a situation in her past. In contrast to Richardson's definition of a narrator as a figure that "frames, relates or engenders the actions of characters of the play" (Point "194), Rosalind only relates her own thoughts and feelings. In this moment, her short speech has no direct consequences for the other characters or the action.

This, I would argue, only supports the idea that this speech of her can be counted as a soliloquy in this narratological analysis, as she is giving an intimate insight in that particular moment without being aware of the fellow men on stage. It functions similarly to an internal focalization at that moment, in which Rosalind opens her mind to the audience (Nünning and Sommer 117-118). She specifically references Crick and Watson without acknowledging their presence, even though they are standing right with her on stage. As provocative and entertaining it might be to name one's ovarian cancer tumours after two competing scientists in their actual presence on stage, her words are said with too little malice and without direct address to the two other characters, so that her awareness of them seems unlikely. Likening the tumours to her competitors also humanises her sickness while it also serves to emphasise the kind of damage the competition between the two teams has caused. They are, according to Rosalind's foresight of her sickness, an "efficient pair" (Ziegler 55) and it is left purposefully vague whether she is still referring to Crick and Watson or to her two tumours. Crick and Watson, as history will show, are undoubtedly the more efficient pair in terms of science, as they will go on to develop the double helix model of human DNA and receive the credit

for their work, while Rosalind will go unnoticed in the annals of history for a very long time.

On a more literal level of this speech, one can detect an eerie simile other than that of comparing her tumours to her competitors. Rosalind uses the image of two twins in her body, behaving like the little children that they are, "scampering around on [her] body on tricycles, dropping handfuls of dirt as they go" (Ziegler 55). This metaphor implies another human quality to the tumours, that of misbehaving children who wreak havoc on their mother's body. It is especially poignant because the cancer affects part of Rosalind's reproductive system, namely her ovaries. The two children are presumably of young age if they are using tricycles instead of bicycles, yet judging by the short time between the diagnosis and Rosalind's implied death on stage, the tumours are much more mature, so to speak, than two toddlers. The spread of the cancer in Rosalind's body is described as "scampering handfuls of dirt" (Ziegler 55), almost trivializing the impending damage the metastases will cause Rosalind's body, as if a quick sweep of a broom by their mother will undo the children's careless act. This trivialization is further supported by the reference point of their size that Rosalind uses, a tennis and a croquet ball, both children's playthings but also tools in a competitive game, where one party will leave as the definitive winner and the other as the definite loser.

As short as this soliloquy may be, it provides a vital moment of focalization into the character of Rosalind Franklin. Both the historical and the fictional Rosalind Franklin are struck by a fatal disease at a point in their life where their careers seemed to take a turn for the better, with potential new positions on the rise. The general public and historians have no way of knowing exactly what would have gone through the mind of the historical scientist in face of this devastating diagnosis. But this is where literature can ingeniously slot in: In a rare moment of narration during the drama, the character of Rosalind is apparently aware of her audience and turns to them, offering an insight into the fictional imagination of a historical character's trials. Letters and diaries may have survived of the historical Rosalind Franklin but those were testaments of their time back in the first half of the 20th century. The literary imagination here serves to shed light on the situation of Franklin from today's point of view, envisioning a reaction from the historical figure upon her diagnosis with the knowledge of today. This moment of focalization cuts deep: It highlights Rosalind's deep running aversion to her colleagues, perhaps painted more negatively by the knowledge of how history will have gone on after her death, comparing her closest competitors to her fatal tumours. The tumours signify

another efficient pair that is there to hinder her career, this time with a fatal disease instead of uncredited usage of her work. The trivialization of the two tumours by comparison to two little toddlers, her "[t]wins scampering around on her body" only further signifies how inconsequential a disease as deadly as cancer might be compared to having one's life's work used by competitors, who then would also garner all the praise for it.

4.4.4 THE MALE CHORAL NARRATORS

The characters in this drama consist of an all-male cast with the exception of the character of Rosalind Franklin. The male characters in this drama function as the narrators and also as a chorus through a re-telling of the history of the race for the DNA. The "Author's Notes" introduce the different narrative situations of the drama: There is a "choral aspect" of the male characters narrating, there is "contested narration" where the male characters argue over the truth of what is told and then there are "naturalistic scenes" in between the characters (all Ziegler 5).

The "choral aspect" (Ziegler 5) is a special narrating instance, namely the male characters Don Caspar, James Watson, Francis Crick, Maurice Wilkins and Ray Gosling. They function as guides through the plot of the drama and are both situated as narrative instances outside of the diegesis as well as characters in the drama itself. If we take the concept of a chorus as a narrative means in drama, then these male narrators fulfil many of the criteria: a chorus can be involved in the dialogue with characters but their main purpose is to have a distancing effect on the action on stage (Pfister 79). A chorus is supposed to break the fourth wall and provide critical commentary that allows for reflection from the audience watching the play or, in this case, the readers reading the play (Palleau-Papin 146-147). As Richardson has pointed out, a chorus in contemporary drama is a rare occurrence, yet can be substituted by characters situated between the diegetic levels that utter warnings, commentary or offer pro- and analepsis to the action on stage ("Voice" 686). All of these criteria are fulfilled by the five male characters and they even go beyond this. Their role is a hybrid between a modern chorus and Richardson's internal narrators, who recount to other characters what has happened off-stage or prior to the beginning of the drama ("Point" 209-211).

The placement of the choral narrators shifts seamlessly in between lines, where sometimes one line is directed at the reader and the immediate next is directed at a

character in the scene, turning them from heterodiegetic choral narrators to homodiegetic characters. In a scene where Rosalind Franklin and Ray Gosling are working on the set-up of their crystallography and Rosalind accidently moves through the beam of the x-ray camera, Ray Gosling displays this seamless shift:

> RAY. You can't move through the beam like that.
> ROSALIND. If I have to do everything myself, I will. […] What was that?
> RAY. I said I'm here to help you. I just don't want to…
> ROSALIND. What Gosling? Don't want to what?
> RAY. *(To the audience.)* I was going to say "endanger myself" but I didn't. I could have said, "put myself in harm's way", could have said that even though we didn't know it for sure yet. I could feel the way that the beam cut through my flesh. Instead I said: Yesterday's photographs *were* better, the best yet – did you see them?
> ROSALIND. Of course I did.
>
> (Ziegler 22)

In one moment, Ray is as much a character as Rosalind is. He interacts with her on the level of characters, he is involved in the actions and reacts to them. But when Rosalind reproaches him for his hesitation, he distances himself from the action and moves from the diegetic character to the extradiegetic narrator as a part of a chorus of male voices. In this "*To the audience*", he gives an insight into his inner turmoil and thoughts. He is unwilling to move into the x-ray beam because he can feel that the x-ray does his body harm.

In this particular quote, Ray as a narrator also shows another advantage over Rosalind: He knows of the future which she does not. Ray, and the men as the chorus in general, are their future counterpart from the characters in the story. On the one hand, they occur as the regular characters and go through the plot and events without knowledge of the end. But, on the other hand, they know as narrators how the story of Rosalind and the race for the DNA will end. Their repeated foreshadowing in the narration only highlights that they have an advantage over her, namely that they know their fate. They discuss the events of the drama that are happening with the knowledge of the future (Kramer 74). Ray can look back at that moment in time and knows now that his feeling

in hindsight was true, namely that an uncovered body is harmed by an x-ray beam. In 1951, he and Rosalind didn't know that unprotected exposure to x-rays may cause damage to the cells, can even cause cancer. But Ray, while he is on the narrative level and therefore the future counterpart of his character, says that he doesn't want to "endanger [him]self" because he "could feel the way that the [x-ray] beam cut through [his] flesh" (Ziegler 22), a knowledge that at that time was not yet given. He foreshadows not only the knowledge of the future but also in some way Rosalind's fate. She died of ovarian cancer and her sickness might have been caused by the exposure to the x-rays during her work, as this scene insinuates. This creates a "double temporal structure of the discourse and the story", a feature that is usually attributed to novels but can in this case also be applied to the dramatic text (Jahn "Narrative" 669). It plays both on what we as a readership may have known before about the historical characters but also on how we read the events from our knowledge of today.

Male and female characters are therefore not only separated by gender but also by their function in the drama. The men are the choral narrators of the story, it is their story to tell and to discuss and pick apart. The winners of the race for the DNA are also the ones who are allowed to tell the story of how it went, regardless of their limited view. This is referred to as the "contested narration" in the "Author's Notes" (Ziegler 5). The men are able to comment on what they did in hindsight and to evaluate what may have been. When Maurice dismisses James during a conference in Naples in 1951 and refuses to work with him, they wonder whether that was "the biggest mistake of his life" (Ziegler 24). Because if Maurice had worked with James, then he might have been the one who would be known for building the model and would have become even more famous (Tiehen 133). They have the chance to evaluate and consider what is happening. This chance is not granted to Rosalind: She is only a character and goes through the plot not knowing and unable to reflect. Thinking back to what was earlier discussed in terms of the privileges and authorities of the narrators in literature in general, this only further supports the theory that the narrator is, in terms of hierarchy, situated above other characters. In this case, it is the male characters that are at an advantage over the only female character of the drama, Rosalind. Apart from two scenes where Rosalind specifically addresses the audience at the beginning and at the end of the drama (Ziegler 11, 55), she is fully situated on the level of the plot and not on the narrative level.

This changes when the drama comes to an end. When all others except for her and Maurice have left the stage, Rosalind encourages Maurice to retell the story from a new

starting point, allowing their relationship to maybe go into a different direction. In that final conversation, Maurice refers to a past event that could have shaped their relationship very differently. Maurice had told her before that he almost went to see the same theatre performance of *The Winter's Tale* as she did and they discuss the play in one of their few friendly conversations. Maurice had highlighted then how "[their] paths so nearly crossed" (Ziegler, 18). Now, as the drama draws to a close, Maurice confesses that he not only almost went to see the same performance but that he actually saw Rosalind outside of the theatre. He had queued in order to buy a ticket to join her but then apparently decided against it (Ziegler, 58). He admits that he regrets not going and imagines what could have been:

> MAURICE. It's not what happened… It's what could happen. Now.
> ROSALIND. What are you talking about, Maurice?
> MAURICE. January, 1951. This time, I attend the play. And I see you across the theatre. *(He looks to her. She remains still, unmoved.)*
> MAURICE. This time, we make eye contact. And afterwards, we meet in the back. By the bar. *(She doesn't move.)* This time I say, "Did you enjoy the performance?" *(She stares at him. Says nothing.)* "Gielgud is excellent, don't you think?" *(Beat.)*
> ROSALIND. Yes, very lifelike. Very good.
>
> (Ziegler 58, emphasis in original)

This is the moment, which is referred to in the "Author's Notes" as a "dream space" (Ziegler 5), where Maurice is finally given the chance to rewrite the story. The other male characters before him had denied him the opportunity and also the general idea of rewriting what has already happened. Ray and James have accepted that the story has already happened, no matter how much Maurice may regret the course of action. It is indicated that Maurice has already tried several times before to retell the story, as James complains in the very first scene of the drama when Maurice starts to tell the story: "Not again, Wilkins. Really?" (Ziegler 11). But knowing just as the others that the relationship with Rosalind cannot be mended in hindsight and that she will die at the end, he is reluctant and still hopeful for another ending (cf. Tiehen 131). He even goes so far as to claim that "Nothing is inevitable" (Ziegler 14) with regard to how Watson and Crick published their findings first. When Ray Gosling announces in the last scene that Rosalind

died, Maurice immediately orders him to stop and not to speak any further. But Ray only replies that "[he] can't. It's what happened." (Ziegler 58). Because Ray, in contrast to Maurice, knew from the beginning that a retelling of the story is not a rewriting.

Rosalind in her final moments is at first hesitant but then allows for the imagined encounter to happen, even if only for a while. Similar to the men around Maurice before, Rosalind now seemingly agrees that rewriting of the story is not possible and that Maurice will need to live with how their relationship has played out during their lifetime. In this last moment, presumably after her death, she rises onto the level of the male choral narrators before her: She is now the authority that allows Maurice to do what the other male characters have forbidden, namely to imagine an alternative course of actions. In turn, she is also the one who ends the fantasy that Maurice has started of them meeting anew during the theatre production of *The Winter's Tale*.

There is an intertextual reference in Maurice's and Rosalind's discussion of *The Winter's Tale* that adds another layer to the relationship of Maurice and Rosalind. In both the actual and the dreamed conversation about the production of *The Winter's Tale*, Rosalind and Maurice discuss the story of Leontes and Hermione, the protagonists of Shakespeare's play (Tiehen 135). To quickly give the context, in *The Winter's Tale* Leontes, King of Sicily, suspects and accuses his wife Hermione of adultery and that the child that she is about to bear is not his, but the child of Polixenes, a childhood friend of Leontes and now King of Bohemia. Leontes imprisons Hermione and, after the flight of Polixenes, publicly accuses Hermione despite the Oracle telling him that both Hermione and Polixenes are innocent. Hermione, who has given birth to a daughter in jail, dies of shock and the child called Perdita is saved by a friend of Hermione's and abandoned to be found and adopted. In the end, Leontes and his daughter, who is now betrothed to Polixenes's son Florizel, are reunited and the two kings rekindle their friendship. At the sight of a statue of his deceased wife, Leontes is heartbroken but the statue suddenly turns from stone to a living woman; Hermione has risen from the dead. All together they celebrate the happy ending and the betrothal of Florizel and Perdita.

Upon their first discussion of the play, both Maurice and Rosalind comment on the story of Leontes and Hermione above all else. Rosalind praises the acting of John Gielgud as Leontes and says that she was really sympathetic and shared his grief at Hermione's death. When Maurice asks about the actress who played Hermione, Rosalind cannot remember. "She didn't stand out, I suppose" (Ziegler 19) she adds in an afterthought. The parallel that can be drawn here between the real-life history of Rosalind,

Maurice, Francis and James on the one hand and Leontes and Hermione on the other hand is apparent: While the men, such as the actor for Leontes or the male scientists, are lauded for their work and discovery, the women, such as the actress for Hermione and Rosalind, are forgotten. They did not stand out enough to be remembered. The sympathy Rosalind feels for Leontes at the death of Hermione is mirrored in how Rosalind treats Maurice at the end of the drama in the dream sequence after her own death. She "[g]ently" and "[s]ympathetically" (Ziegler 58, 59) listens to him and explains to him that, despite what they discussed earlier, Hermione is not really alive again at the end of *The Winter's Tale*. In contrast to her earlier behaviour, she exhibits emotions here that are stereotypical female: She is caring, soft and empathetic.

Maurice is unconvinced. He does not want to believe that Hermione does not rise from the dead, similar to how he does not want to accept that Rosalind has died and that what he is now experiencing is only a dream (Tiehen 69-70). In an earlier scene, he even referred to her as a "restless ghost" (Ziegler 21) because of her constant appearing and disappearing in the lab. This restless ghost is now back at the end of the drama. Similar to the scene from Shakespeare's play that both of them quote, Maurice to wants to believe that "The spirits o'the dead/ May walk again" (Shakespeare as quoted in Ziegler 59). But Rosalind disillusions him, explaining that what made Leontes see Hermione alive again, just as Maurice is now seeing her again, is hope. It is a hope for forgiveness for the deeds of both Leontes and Maurice that facilitates both Hermione's and Rosalind's reappearance at the end of their respective plays. Because if Leontes is forgiven for his distrust in and accusation of Hermione, then Maurice can be forgiven for going behind Rosalind's back and showing her pictures to James and Francis. Upon Maurice's question whether "*he* deserves to be forgiven" (Ziegler 59, emphasis mine), Rosalind only answers evadingly whether she forgives herself. Whether Maurice meant Leontes or maybe himself is left unclear and Rosalind does not give him the answer that he is searching for. The absolution he needed in this scene is not granted to him.

The scene and the drama at large close with Rosalind putting an end to Maurice's little dream by saying that one has to face the truth that there is no chance of beginning again: "[Y]ou've made the decisions you've made and then you live with them or you spend your whole life in regret" (Ziegler 59). Even though she had been a mere character the entire time, she is now seizing control over the course of action: She has allowed for Maurice to dream but it is now ending. The drama finishes on her terms and with her participation, an opportunity that was not given to the historical Rosalind Franklin.

Photograph 51 adds to the historical narrative by allowing for the perspective of other men in the race for the DNA while simultaneously leaving room for Rosalind Franklin's unheard perspective on how her life went. Whereas many of the personal correspondence of Rosalind Franklin has survived, the astronomer Henrietta Swan Leavitt, the scientist of the upcoming section, has left little to no traces for historians to analyse. The drama *Silent Sky* reimagines her work at the Harvard Observatory and fills in the gaps by use of narrated letters.

4.5 "I DON'T NEED A TITLE TO DO THE WORK": LAUREN GUNDERSON'S *SILENT SKY* (2015)

If there was ever a textbook example for the lacking material on important women in science, then it is Henriette Swan Leavitt. Hers is the story of a woman working as an underpaid assistant in the Harvard Observatory, whose findings were published – in this case with her consent – under the name of her male supervisor, a woman who died at a young age before she was able to see the fruit of her labour. Her contributions to astronomy have been monumental enough to further the work of astronomers such as Edwin Hubble, renowned astronomer and name giver to the famous Hubble telescope, who used her law to scale the galaxies outside of the Milky Way (Alan Lightman 29). Yet there is nigh to no surviving material of Leavitt's life which renders a biographical account of her life very difficult. Nevertheless, her contributions to astronomy were too immense to remain a footnote in the annals of history. As historian of science Alan Lightman puts it, she "gave astronomy the third dimension" by "develop[ing] an important new method for measuring distance in astronomy" (28). Without Henrietta Swan Leavitt, the sky might have remained a two-dimensional surface for many years to come.

Lauren Gunderson's play *Silent Sky* (2015) attempts to close the gaps left behind by the meagre material on Leavitt's life. As a post-graduate, Henrietta starts the drama back at home, convincing her sister of the importance of her new career. She has been asked by Harvard to join their Observatory. There, she not only meets Peter Shaw, a fictional astronomer and later love interest, but also Williamina Fleming and Annie Jump Cannon, with whom she forms a close friendship through their joint work. In between personal struggles with her family back in Wisconsin, Henrietta goes on to work after hours with the permission of Annie and discovers the pattern in cepheids that leads her to the period-luminosity relationship. Against the negative feedback on her findings from Peter, Henrietta continues to do the research until she starts showing symptoms that are later diagnosed as stomach cancer. Her sister cares for her at her house in Cambridge and Henrietta ultimately succumbs to the sickness, signalling the end of the play. In narrative terms, the drama employs letters as a modern version of a messenger report which inform Henrietta of her sister's life at home and signify the difficulties Henrietta has in maintaining both a private and a professional life.

4.5.1 BIOGRAPHICAL BACKGROUND

Since there is so little material of hers that has survived since her death, her biography can only be tentatively construed. There are many unanswered questions left in the accounts of her life, such as a life-long unidentified sickness that caused long years of absence from her work or the personal family crises that called her away from Harvard that were never disclosed (Johnson 39). Only a few letters have survived the decades since her passing and many biographers had to rely on other people's accounts of who Henrietta Swan Leavitt might have been: "No diary has been found recording what it was about the stars that moved her. One of history's small players, her story has been allowed to slip through the cracks." (Johnson 28). She was born in 1868, the eldest daughter of a Congregationalist pastor and his wife, her family lines going so far back as to the first settlers in Plymouth and to their respective ancestors in England before immigration (Johnson 25). Her education included a thorough foundation in classical literature and languages, as well as basic mathematics and history. She received her graduating certificate from the Society for the Collegiate Instruction of Women, today known as Radcliffe College, in 1892 after having "completed a curriculum equivalent to what, had she been a man, would have earned her a bachelor of arts degree from Harvard" (Johnson 27). Leavitt had been hard of hearing from a very early age on, losing her ability to hear entirely by the time she had grown up, even though an exact timeline for this cannot be construed in hindsight (Johnson 28).

Her first work undertaken at the Harvard Observatory was as that of a volunteer in 1895, gathering credits in photometry, a field that studies the brightness of lights, in this case the brightness of stars (Johnson 28). This would also be the field that Leavitt was later employed in when she started working as a computer at the observatory, a lowly paid job to catalogue and classify stars based on photographic plates of the night sky. This was a job usually given to women because it was, during that time, much easier to find women for these painstaking jobs than men, who would not be satisfied with such a low pay for such tedious work. Women in this field signified a cheap work force and that was what they were hired for (Alan Lightman 28). And since women were not allowed to use the great telescope of the Harvard Observatory, this work was their only way to conduct any fundamental astronomical research (Falkner 224). Leavitt's official title was that of an assistant but, almost cheekily, she once told a census taker who visited her neighbourhood shortly before her death that her occupation was that of an astronomer

(Johnson 120). Leavitt's pay at least slightly increased when she returned to the observatory for a full-time position with Edward Pickering after a short absence due to an unknown sickness in 1903. She was even awarded a grant to continue her work on variable stars called Cepheids (McNeill).

By observing the differences in the star's brightness while switching from different photogenic plates to others, Leavitt studied the pulsating stars and updated their magnitude in the Observatory's ledgers (McNeill). It was during this work on variable stars that Leavitt made a curious observation: The brighter the variables, the longer it would take their cycle of luminosity. (Johnson 39). This small observation, added to her results that were published under Pickering's name in 1912, had ground-breaking consequences that Leavitt herself might not have realised at the time. If a certain kind of star always pulsated with the same luminosity, then two stars of the same kind that pulsated in different cycles had to be at different distances from earth (Johnson 43-44). This law would soon be known in astronomy as the period-luminosity relationship or Leavitt's Law (McNeill; Falkner 224). Without meaning to and in a short afterthought only, Leavitt had handed astronomy the key to measuring the universe. Ten years after this publication, astronomer Edwin Hubble "was able to calculate Andromeda's distance from Earth with Leavitt's Law and prove that it lies far outside our Milky Way" in 1923 (McNeill). Leavitt was sadly no longer alive to witness the application of her work. She died of stomach cancer in 1921 (Johnson 29). Cecilia Payne-Gaposchkin, a fellow computer at Harvard, who arrived at the Observatory after Leavitt had died, notes that Pickering, despite his best intentions, had "condemned a brilliant scientist to ungenial work" (Jean L. Turner 63). He had practically wasted the talent that had slumbered in Leavitt, who Payne-Gaposchkin considers "the ablest of the women who have played their part in the Harvard Observatory" (Jean L. Turner 63). A bittersweet anecdote can be added to her posthumous legacy: Gösta Mittag-Leffler, a Swedish mathematician and member of the Nobel Prize in Physics committee, had heard of her work. He wrote her a letter, suggesting that he nominate her for the Prize in recognition of her discovery. Only by the time that he had heard of her work and had written to her, she had already been dead for three years earlier (Alan Lightman 29).

4.5.2 THE FEMALE COMPUTERS: FLEMING, LEAVITT AND JUMP CANNON

At the Harvard Observatory, the human computers were mainly women, providing ample material for a very female-centred story in *Silent Sky*. Two important female astronomers besides Leavitt were Williamina Fleming and Annie Jump Cannon, both of them honorary members of the Royal Astronomical Society working on the classification of stars (Bowler 3.14).

If finding credible and contemporary sources on Henrietta Swan Leavitt is difficult, then finding any accounts on Williamina Fleming and Annie Jump Canon is even harder. And even if one finds scholarly publications on either of them, then some of these publications tend to feed into the narrative of women's insignificance in science that has by now been overturned: In 1993, George Greenstein writes on Annie Jump Cannon and Cecilia Payne-Gaposchkin for *The American Scholar* and attempts to pit their respective works against each other. The article oscillates between the appreciation and demeaning of female labour in astronomy. Greenstein simultaneously compares Cannon to Carl Linnaeus, a scholar who originated the concept of taxonomy for animals and plants, claiming that "[w]hat Linnaeus did for the world of organisms, Annie Jump Cannon did for the stars" (439) and then, only a few pages later, doubts that her contribution to astronomy made her worthy of the honours she has received (cf. Greenstein 442). He laments that the system she devised was named the Harvard system instead of the Cannon system, leaving her invisible for generations to come, yet concludes the essay by assessing that Cannon did not deserve to be categorised with other professional astronomers (cf. 445-446). Greenstein appreciates the underpaid female workforce as "the invisible women who swelled the ranks of astronomy but remained forever on its periphery" but also claims that for half of the female astronomers of the late 19th or early 20th century, conducting science was only "temp work" (both 444), which grossly disregards that many women at that time had no real choice in pursuing a longer career in science. I could go on with more examples but I assume that the point is clear: This article, which was published 30 years ago and is one of the few scholarly accounts on Jump Cannon, further perpetuates the stereotype of women's insignificance in science instead of shedding light on the forgotten contributions. It is therefore no wonder that the work of Henrietta Swan Leavitt's close colleagues is known by so few people (Bowler 3.14).

Annie Jump Cannon (1863-1941) learnt constellations from a very early age from her own mother before proceeding to study physics and astronomy at Wellesley College (Bowler 3.14). Cannon was lucky to be born in the United States at her time, since "US women's colleges such as Vassar or Wellesley gave women the opportunity to study science and receive degrees" (Bowler 3.14) in contrast to their British counterparts such as Oxford or Cambridge. In 1896, Cannon joined the Harvard Observatory and started working on classifying stellar spectra, coining what is even today still used as the typical scheme for classifying stars according to their temperature (Bowler 3.14-3.15). Similar to Leavitt, Cannon lost her hearing during her time at college after a bout of scarlet fever. "[B]oth women learnt their profession among hearing students" (Bowler 3.15), with their universities accommodating their needs by providing classes held in a circle of chairs to facilitate lip reading (Bowler 3.15). She was also a lifelong supporter of the suffragist movement (Bowler 3.15).

Williamina Fleming found her way into science more by coincidence. Born in Scotland in 1857, she married James Fleming in 1877 and, in the same year, they both emigrated to the United States (Falkner 237). Williamina was pregnant at that time and gave birth to their son in 1877 shortly after their arrival. The marriage did not last and James separated from Williamina, who was now left to her own devices and in need for money to care for her new-born child. As coincidence would have it, Fleming became a housekeeper in the household of Edward Pickering, the then director of the Harvard Observatory (Falkner 237). According to popular history, Pickering recognised the intelligence of his housekeeper and deemed her too competent for such menial work. Instead, he offered her a position as one of the first Harvard computers (Johnson 20). Fleming ascended the limited career ladder available to her when she became the curator of the photographic plates used by the Harvard computers. She also aided Annie Jump Cannon and Antonia Caetana Maury in their endeavour to complete a compendium of classifying stars (Johnson 20). In addition, Fleming was one of the first scientists to work on white dwarfs, a stage in the evolution of stars (Physics Today 2019).

Annie Jump Cannon's involvement in the Suffragist movement is a reoccurring topic among biographers. As a member of the National Women's Party, the historical Annie Jump Cannon fought for the right to vote for women and was recognised in turn by the National League of Women Voters for her commitment to women's suffrage (Alexander). In the play, the topic of suffragists is covered even before we as readers are introduced to Annie as a character. When Henrietta explains to Margaret that she wants

to work at the Harvard Observatory as a scientist, Margaret's first reaction is to caution her sister against "wearing bloomers" because "[t]here are women these days, and they wear pants and it's ridiculous" (Gunderson "Silent" 11). Abandoning skirts and dresses, the societally accepted wardrobe of women, in favour of pants was one of the key protests of early women's suffrage (Marks 148). For Margaret, it seems the height of disobedience is to wear pants, as "*[i]t starts with pants*. It's a changing world. And some things should be sacred" (Gunderson "Silent" 11, emphasis in original). Margaret signifies the old societal standards and the old world, the conservatism that Henrietta, as an emerging woman in science, tries to escape. It serves the character arc of Margaret, who, as a woman of stout faith and musical talent, ends the drama with a more open mind towards a new world and writing a symphony, as, apparently, "[u]psetting tradition might just run in the family" (Gunderson "Silent" 41). She nevertheless remains sceptical when Annie and Williamina come to visit Henrietta at her sickbed and Annie is wearing pants, which Margaret detects with hesitation in a moment of comic relief (cf. Gunderson "Silent" 55).

Annie's own work as a suffragist does not go unnoticed by her superiors as well. The women's immediate superior Peter Shaw is decidedly displeased when he visits the lab and finds that Annie is missing yet again: "Where is Miss Cannon? Hm? Gone again? […] We all know where she is – She's out – *Making trouble for this institution.*" (Gunderson "Silent" 46). It appears that the political involvement of Annie might be tolerated, but nevertheless monitored closely. If she is acting up against the government and existing law, then a prestigious institution such as the Harvard Observatory might not want to be associated with her any longer. But Williamina, Annie's co-worker, covers for her, informing Peter in an acid tone that "[s]he's sick. Of you." (Gunderson "Silent" 46). When Annie returns only a few moments later, the stage directions describe her wearing "*her suffragette stash – 'Votes for Women!'*" (Gunderson "Silent" 47, emphasis in original), indicating that Peter was indeed right and that Annie was in fact at a rally for female suffrage. In a later scene, when Annie is able to offer Henrietta a better position at the lab, she takes the opportunity to hand out pamphlets:

> ANNIE. And if we use things like this and take a *real* stand –
> WILLIAMINA. She's about to give you a pamphlet.
> ANNIE. We can make a larger difference. *(Handing them pamphlets.)*
> HENRIETTA. What's all this about?

ANNIE: We need a vote, girls. It's about equality –
and it's about time! WILLIAMINA. "And it's about time!"
WILLIAMINA. I know all the slogans.

(Gunderson "Silent" 56)

Williamina's playful annoyance at the repetitive nature of Annie's political activism might offer a quick laugh but it also belies a deeper meaning. If Williamina has learnt all of Annie's slogan, then Annie must have repeated them ad nauseam to her colleague. Both of these scenes, the repeated absence from work and Williamina's good-natured mocking reveal that Annie is not just slightly involved in the suffragist movement. She is a professional campaigner for women's rights to vote and identifies with her fellow suffragists. She even invites the attending women at Henrietta's place to join them "marching in D.C. next month" (Gunderson "Silent" 56), indicating that this is not just a hobby of hers but a true passion that she pursues on the regular. This fictional representation of Annie Jump Cannon as a suffragist honours the historical one's activism and additionally infuses the drama with political issues of the portrayed time, allowing readers to sympathise with the struggle these women went through.

The fictional Williamina and Annie quickly become driving powers behind Henrietta's scientific achievement. They are the supporters of their colleague and friend who are always in her corner and ready to defend her. In the beginning, when Henrietta joins the Harvard computers, it is Annie and Williamina who encourage her after the much more dismal outlook that Peter Shaw gave her on their work. Where Shaw described their work as simple menial tasks in aid of the male scientists, it is Annie and Williamina who remind Henrietta that they are "essential" to the work done at the observatory and that they "are cleaning up the universe for the men [a]nd making fun of them behind their backs" which has "worked for centuries" (all Gunderson "Silent" 19-20). As dejected as Henrietta might have felt, Williamina and Annie bring her back to reality and assure her of the worth of her work. Annie especially serves as a leader of their trio of women, as she is described in the dramatis personae (Gunderson "Silent" 4). A few years Henrietta's senior, Annie has come to terms with the lot that has been dealt to women in science and has learnt not to let the discrimination place value on her work. When Henrietta angrily confronts Annie about why she does not demand a higher position, Annie very calmly replies that she doesn't "need a title to do the work" (Gunderson "Silent" 26). A title or a better position would of course be justified for the work the computers are conducting,

especially for Annie as their unofficial leader. But it seems that Annie is quiet self-assured enough to know that a title does not correspond to importance or intelligence. She knows her worth and does not need a plaque on her office door to signify it. It is also Annie who allows Henrietta to stay longer in the office to conduct her own research and who encourages her to follow her instincts, claiming that Henrietta is "in the middle of […] [t]hat chance" to have her scientific questions answered as Henrietta has long wished for (Gunderson "Silent" 32).

Williamina is the supportive counterpart to Annie's authoritative leadership. She signifies the emotional support of the trio and is not shy to defend her friend Henrietta against any unfounded critique or against any maltreatment from Peter Shaw. At one point, when Peter catches Henrietta asleep at her desk because of the many nights of additional research, Williamina is quick to push back:

> WILLIAMINA. And you know why she's got something? Because she's *not just* doing [her work]. Because she knows she's not getting anything handed to her except the corner of someone else's chance. Because we can't use that apparently hyper-sexed telescope you boys get to, but the mind is sexless and so is the sky – Are you made nervous by how many times I've said the word *sex*?
> PETER. Somewhat.
> WILLIAMINA. Oh good.
>
> (Gunderson "Silent" 30, emphasis in original)

When Peter tries to admonish Henrietta for doing work outside of what she was hired to do, Williamina calls out the hypocrisy of the clearance that is based on a person's sex. Henrietta is putting in extra work because she, as a woman in astronomy, cannot hope to be given the same opportunities that a man is given, such as using the renowned telescope that all the male scientists at Harvard have access to. Williamina is a true friend who is not afraid to fight her own superiors in order to defend her friend and colleague. In general, Williamina is very critical of Peter Shaw's attitude towards Henrietta. Even though Williamina is the first to recognise that Peter is in love with Henrietta, she is not convinced of his intentions towards her friend. In a scene where Henrietta's theory on period-luminosity relationship has been published and is read aloud in the presence of a very critical Peter, Williamina rightfully calls him "jealous" (Gunderson "Silent" 45). She

claims that he is only acting this way because he has not contributed anything nearly as progressive as Henrietta did (Gunderson "Silent" 45). When it is revealed in that scene that the male scientists have started a program on Cepheids without including Henrietta in it, Williamina loses her temper and calls Peter "a giant ass" and shouts at him to "GET OUT" (Gunderson "Silent" 46). This is very volatile behaviour towards her immediate superior, yet Williamina seems to lose all respect for Peter in the moment that he doubts Henrietta's importance and denies her any participation in a central project. These are just a few choice examples of the friendship that grows between Williamina, Annie and Henrietta over the course of the play. Their relationship and co-working in general are a shining example of women banding together as the disadvantaged in the field of science. Imagining that the historical counterparts were just as supportive of each other gives a sense of hope for the fate of women in science, who can always find allies in their female peers.

4.5.3 Women in Astronomy

Henrietta faces the same issues that many of her peers have faced before and will face even after she has died: She is meticulously excluded from participating in any significant science groups at work. Even the project that the Observatory has started on Cepheids, her great research focus, is off-limits to her only because she does not have an official degree (Gunderson "Silent" 45). She has her direct male colleagues contradicting her findings in public lectures, even though she has just published, under Pickering's name, the ground-breaking article detailing the period-luminosity relationship (Gunderson "Silent" 48). Having her work published under another name and having colleagues disputing their own team member's findings erodes any hold she might have had with her publication, further impeding her being taken seriously as a scientist. Her work is used by men all throughout astronomy, yet none of them deign to answer any of her letters asking for collaboration (Gunderson "Silent" 53). Her experiences are those of women in science that still happen today.

However, the drama also lays a clear focus on the importance of women in science, despite highlighting their apparent struggles. This starts very early on with the dramatis personae, which specifically describes the character of Peter Shaw as the "head astronomer's apprentice" and as "the man" (Gunderson "Silent" 4). This is his only

character description and, apparently, his only function. Compared to the description of the four female characters, who are characterised as "the leader […] smart as a whip and fun [...]" or "brilliant, meticulous, excited" (all Gunderson "Silent" 4), Peter Shaw's entry seems very lacklustre. The reason for this is simple: He is the only male character to appear on stage. Others may be mentioned, such as Dr Pickering or Henrietta's and Margaret's father, but they are never embodied or even heard off-stage. Peter is not given an extensive character description because he is not nearly as significant as his four co-characters. The play is dominated by the women in it, three of them women in science and one of them an artist, namely Margaret, and they are the focal points. Peter as a supporting character with little stage time is side-lined in order to leave more room for the important people, the women.

Even though Peter is set out to serve as a love interest for Henrietta later in the play, his importance as a character is echoed in the way that Williamina and Annie perceive him. During their first meeting, Henrietta is disparaged by the menial character of the work she is hired to do: Peter made her believe that the women computers were only doing the groundwork for the men, who alone would be allowed to use the telescope. She voices her dismay to Williamina and Annie, complaining that she was only hired "to 'bookkeep the stars', if you talk to Mr Shaw", to which Annie promptly replies that this "is why [they] try not to talk to Mr Shaw" (Gunderson "Silent" 17). Peter Shaw, in Annie's eyes, has no respect for the work that the women at Harvard do and therefore cannot be expected to be reliable source of information. He proves this during the brief introduction he gives Henrietta when she first arrives at the observatory:

> PETER. My name is Peter Shaw. I work for Dr Pickering.
> HENRIETTA. Oh. Lovely. Mr Shaw. Nice to meet you. Colleagues, then.
> *(Peter snorts.)*
> PETER. You actually work *for* me. And I work for him. So.
> HENRIETTA. So we're still colleagues it would seem.
> PETER. Technically yes but –
> HENRIETTA. And here I thought Harvard was such a technical place. […]
> PETER. Well, you'll fit right into the harem.
> HENRIETTA. The WHAT?

PETER. Oh – no – nono – it's just a name – a joke – "Pickering's harem". It's a compliment.

HENRIETTA. If you're a concubine.

(Gunderson "Silent" 14-15, emphasis in original)

The scene goes on in a similar fashion but I think the general idea of the conversation and therefore Peter's attitude become clear very quickly: He is well aware of the existing hierarchies between the male and female employees and as his derogative snort shows, he is not ready to accept a woman as his equal in their field of work, only as his inferior. The name for the women computers, "Pickering's harem", only underlines the demeaning attitude that is held towards the female workers. Luckily, Henrietta is quick to push back and puts him in his place: "Mr Shaw, I graduated summa cum laude, from Radcliffe, which is basically Harvard in skirts and lucky for us the universe doesn't much care what you wear, so my expertise and yours might just complement each other" (Gunderson "Silent" 15). She is determined to conduct science, with her superior's approval or not. Even later, when she and Peter have come to fall in love with one another, he still does not seem to understand that she is not nearly as free in her research as he is. He tries to convince her to abscond with him on an ocean liner to meet European astronomers together with him (Gunderson "Silent" 34). What sounds to him like an amazing career opportunity presents a problem for Henrietta: In contrast to Peter, she cannot just leave her work and come back to it because she is doing research on the side next to her everyday job as a computer. She does not have the time to wait or to dawdle because her research is only tolerated whereas his is funded and approved. If she leaves her work for too long and no longer produces any valuable outcome, then this tolerance for her endeavours might be quickly revoked.

A specific tool that the play employs to give women in science the kind of credit they were denied during their lifetime are anachronisms. One example is the continued mentioning of Radcliffe College, a women's college that grew out of a Harvard Annex. In 1879, the Annex was transformed into the Society for the Collegiate Instruction of Women (cf. Harvard Radcliffe Institute Website). Radcliffe, named so in 1894, is a household name in American and international college education as one of the Seven Sisters colleges, which are women's colleges, providing excellent education to women in an equivalent to the Ivy league colleges that are mixed-gendered (Harvard Radcliffe Institute Website). This college is specifically named by Henrietta in the play as she tries

to convince Margaret to let her leave for a job at Harvard Observatory, calling it a "blaze of learning" and highlighting that "Radcliffe is nearby" (both Gunderson "Silent" 11) as an additional advantage. Only Henrietta would not be able to refer to this prestigious school as Radcliffe at this point in her career. As outlined above, the historical Henriette Swan Leavitt obtained her education from said college in 1892, at which point the college was still referred to as the Society for the Collegiate Instruction of Women and she only started her career with the observatory afterwards. According to the stage directions preceding this scene, the conversation between Margaret and Henrietta in which this is discussed takes place in "about 1900" (Gunderson "Silent" 9), jumping a few years ahead and placing this fictional conversation in a time where Radcliffe was already known as such. This proleptic poetical license does not display any lack of knowledge on the author's side. It is specifically meant for the readers: As knowledgeable as the readers of the play might be, it is unlikely that they would know the name of Radcliffe college before it was coined as the eponymous college for women's education. It was not named as such during Henrietta Swan Leavitt's lifetime, which of course does not diminish her achievement and education. Yet by using the more commonly known name in an ahistorical context, the quality of the education of the protagonist is majorly elevated and signified as such to the wider readership.

Henrietta is not the only female scientist who is given this special treatment that highlights her significance beyond the historical context. Annie Jump Cannon's standardization of star temperature and the ensuing classification by letters are mentioned in the very first conversation that the three scientists have at Harvard Observatory. Henrietta is star-struck when she realises that it is Annie Jump Cannon she will work with and praises her idol by saying that she "created a… standard […] My goodness, I am so honoured!" (Gunderson "Silent" 18). Williamina echoes this sentiment, claiming that "the sky was a riot until Miss Cannon coded it" (Gunderson "Silent" 18). Annie returns the favour by directing the conversation to Williamina's achievements, pointing out that "Will was the first women to ever hold the title 'curator' in astronomy […]" and that "the Draper catalogue is all her work" (Gunderson "Silent" 18). Once again, the play is being creative with the historical timeline: The historical Williamina Fleming did work on the photographs made by Henry Draper and his wife Anna, which were donated to the Harvard Observatory after his death in 1882. Fleming started working on it in 1890 but the proper catalogue was only published in 1918, with its extensions succeeding in the following thirty years (Falkner 264-265). As influential as the work of Annie Jump

Cannon and Williamina Fleming might have been when we look back on it, it is highly doubtful that their significance might have been as apparent as it is made out to be at the time when these three women meet in the play. The praise is not meant for the characters; it is directed at the readers to underline the importance of what these three women have contributed to the greater discourse in astronomy. Outside of the astronomical circle of experts, most of the reader might not have heard about these three women until now and this purposeful ahistoricism credits them in a way that history and historiography have long failed to do. These liberties can be seen as the privilege of fiction. Whereas history still carries the tag of factuality, even though, as previously discussed, this tag needs re-evaluation, fiction has more leeway. This fictional account of these three women's story may alter the facts because it projects the author's own imagination as the proverbial meat onto the historical bones. Margaret foreshadows the meaningfulness of her sister's and her colleagues' work when she encourages Henrietta to continue her work: "It could mean that you may not know how you might matter to people right now, and you cannot know how you will matter in the future. But you are *already* connected – and you *already* matter. Because what you do outlasts you" (Gunderson "Silent" 54, emphasis in original). With the knowledge of the future, the fictional Margaret as an embodiment of the time of production can reassure her sister that her contributions will, in fact, matter to the world.

4.5.4 Henrietta Between the Private and the Professional

As significant as her contributions to science turn out in the end, it nevertheless does not ease the conflict that Henrietta finds herself in. The fictional Henrietta in this play is torn between the two worlds of her life: her private life and her professional life. Her private life is signified by her being needed at home with her sister and father, whereas her professional life is the work that she is conducting. The play employs letters read aloud on stage as a sort of conflicting narrative portraying the inner turmoil of Henrietta. In these letters, Henrietta, who is usually in a scientific setting, is interrupted in her thoughts or actions by the voice-over narration of the letters informing her of conflicts at home. Henrietta switches diegetic spheres in these scenes from line to line, one line answering the sender of the letter and thereby moving to the sphere of the narration, the next then turning back to her science explorations. The letters both occupy the roles of messenger reports, reporting from outside of the actual scene, while also providing narration and a

sort of pluri-temporality in which Henrietta's mind has to be at different spaces at the same time (Pewny 152). Additionally, the reader receives an inkling into the conflict in Henrietta's mind at her being torn between the private and the professional in an act of focalization (Muny 69).

The conflicting feelings Henrietta has towards leaving her family for work are already implemented in the opening scene and only reinforced through these letters. The play starts with Henrietta telling her sister Margaret of her aspiring career as an astronomer, to which Margaret reacts more than sceptical. Margaret admits to being "shocked" at her sister's sudden job offer but in the next line, admits that Henrietta has "always been leaving" (Gunderson "Silent" 10). It becomes obvious that Margaret is disappointed in Henrietta for leaving their home and their family behind so easily. Margaret is the steady child of the family, the one who feels closest to home and cannot imagine leaving her homestead for whatever might be out there. What is more, Margaret confesses to being worried about Henrietta out there: "It's far away, that place, and it's crowded, and you're still here in my sight and I worry" (Gunderson "Silent" 11). It is more than clear that Margaret disapproves of Henrietta's decision and dreads the potential loss of her sister to her work so far away from home. The voice-over letters dealing with this conflict arrive very early on in Henrietta's career at the Observatory. She has just had her difficult introduction with Peter and has met her colleagues Williamina and Annie and is now allowed to catalogue stars. A letter from Margaret with news from home arrives:

> ANNIE. Magnitude: point-six-five. *(Margaret appears in a letter.)*
> MARGARET. Henrietta! We miss you.
> HENRIETTA. Star Name –
> MARGARET. And I can't stand the conversation since you left.
> HENRIETTA. Alpha Andromedae 15.
> MARGARET. Everyone is so sensible.
> HENRIETTA. Eighty degrees declination.
> MARGARET. Please write back. […]
> MARGARET. You missed the news…
> HENRIETTA. Star Name.

MARGARET. I'm pregnant!

HENRIETTA. *(Finally stopping.)* Oh Margie, Oh my goodness!

MARGARET. I think Daddy is happier than I am. And to think of it, you're going to be an aunt!

HENRIETTA. I am going to be an aunt. And you. A mother? Congratulations Margie, that's such – *(Annie coughs at Henrietta, Henrietta hides the letter.)* Star Name: Alpha Cygnus.

(Gunderson "Silent" 21-22, emphasis in original)

Henrietta is torn between her two obligations: Her love for astronomy and her love for her sister Margaret. Margaret's life moves on as well but Henrietta cannot be present because of her work. The stage directions aid in creating this conflict: Henrietta has not reacted to Margaret's letter for a good while until Margaret discloses her pregnancy. This is something that, under normal circumstances, Henrietta would celebrate with her sister and it breaks her out of her work rut. Henrietta switches the levels of diegesis here, moving from the actual scene unfolding on stage to her sister in the voice-over, delighted at the good news. The happiness only lasts for a moment, however: Annie realises that Henrietta is occupied with things unrelated to her work and, with an admonishing cough, pulls her back into the scene. This two-fold dimension of the scene is supported by Margaret being present as a physical character herself: It is not just a simply voice-over narration from off-stage with Margaret unseen. Instead, she is a visible presence to her sister, a nagging reminder that Henrietta has left a family back in Wisconsin that misses her dearly and demands her attention, even if she has none to give.

Margaret remains on stage for another letter, announcing the birth of her son, Michael. Her tone has already changed from the first letter, her sentences growing brisker, intermingled with desperate pleas for her sister to acknowledge her. She repeatedly tries to interrupt her sister's work with apparently urgent news while Henrietta is completely immersed in her work. Once Margaret finally breaks through to her sister, she announces that she now has "a son. […] His name is Michael." (Gunderson "Silent" 23). Her lack of excitement when she presents these major news belies her disappointment in her sister. Normally, announcing the birth of one's child ought to be a joyful occasion, yet Margaret presents this fact as if it was simple a comment on the weather. It appears that she has little to no patience left for her sister's antics and her lack of interest in the family's business. She does invite Henrietta to come meet Michael but Henrietta remains

apologetic: "I should – I *will* – How did this happen already? […] I'm sorry – I'm just, so busy" (Gunderson "Silent" 23). Henrietta has lost track of time and completely missed the birth of her nephew, even though she was so excited earlier for her sister.

As a modern version of a messenger report[19], these letters not only report action that is happening off stage but also serve as an integral part of the narration on the dramatic stage that help to move the plot forward (Pewny 151-152). They drive forward the conflict that the character of Henrietta finds herself in. She partakes in two levels of the diegesis, on the one hand in the action on stage and on the other hand in writing these letters to her sister. Henrietta is encapsulated in a two-fold timeline, one of the actual time passing in her office, while the letters appear to be stretched out over a longer period of time. This pluri-temporality can be applied to the larger topic as well: Her private and her professional life are both developing, yet in different velocities. Time flies for her sister and her life, of which Henrietta cannot be really a part of because of her work, yet Henrietta's work seems to move at a glacial pace, even though it is her sole focus. Manfred Jahn has also highlighted the "double temporal structure of the discourse and the story" ("Narrative" 669) often featured in narrative drama, which can be employed in this example of *Silent Sky*.

The conflict between the sisters, and thereby by default the conflict between Henrietta's private and professional life, is about to reach its peak. Margaret remains disappointed by her sister at her lack of enthusiasm about what is going on in her family and Henrietta is torn between being a good scientist and a good sister. By the end of the scene, the stage directions describe Margaret as "*[c]old to her*" when talking to Henrietta and that she "*vanishes*" off stage instead of simply leaving, implying that Margaret has suddenly withdrawn from Henrietta's life (both Gunderson "Silent" 24, emphasis on original). By the time their father dies, the sisters reconnect and Henrietta is able to help her sister and reconcile with her, but in this moment in Henrietta's career, she is torn.

The play does not offer a solution to these conflicts and nor should it. There is no right or wrong in these decisions that women had to make back then and still have to make today. If Henrietta had abandoned her science career for her family or for her relationship with Peter, then she would have ended up resenting either of them for robbing of her of her opportunities. If she had chosen her career and had abstained from any

[19] A similar kind of messenger report through narrated letters is employed in *Ada and The Engine* (2018), which is also written by Lauren Gunderson and is analysed in the next chapter.

personal contacts at all, then she would have grown miserable and might not have had the kind of support system that she has found in her colleagues and family. The conflict displayed is an eternal one, one that does not necessarily involve only women. Yet women are often the one's bearing the brunt of these life-changing decisions, as they are expected to remain in the private sphere rather than in the public or professional one. One can extend this argument to taking care of sick parents, staying in close contact with one's siblings or even one's own family-building: How much balance is possible between the private and the professional is always a difficult question for anyone in the workplace but it often hits women and especially women in science twice as hard because they have a difficult start in their chosen profession anyway. In this way, the drama adds to the mystery left behind by the lack of the historical Henrietta's personal correspondence. Henrietta Swan Leavitt left work for longer periods of time, sometimes due to an undefined sickness and sometimes due to family issues, as the remaining sources tell. It is unclear what exactly kept her from pursuing her career uninterruptedly but it is clear that is greatly hindered her scientific research. The play offers an insight into the moral dilemma this must have created, filling in the gaps left behind by history.

In *Silent Sky*, the fictional Henrietta Swan Leavitt has to navigate the conflict between her private and her professional life which is represented in narrative letters. Ada Lovelace, historical mathematician and programmer and protagonist of the drama *Ada and The Engine*, finds herself in a similar conflict. In this drama, letters are also used as modern-day messenger reports in an intra- and extradiegetic way.

4.6 "I SHALL BE A BRIDE OF *SCIENCE*": LAUREN GUNDERSON'S *ADA AND THE ENGINE* (2018)

When we conceive of modern technology, a computer is critical to our everyday life, yet it is not just the hardware that facilitates our work. Without programming, the machine does not come to life. The woman who conceived of this kind of programming was Ada Lovelace, a science translator and mathematician of the 19th century. She and her colleague, Charles Babbage, conceived of the first prototype of a computer over a hundred years before the German engineer Konrad Zuse would built the first full-functioning computer, his model Z3, in 1941 (Strawn 57). Babbage had imagined the hardware, the Difference Engine and later Analytical Engine, whereas Ada Lovelace came up with a programme that would allow the machine to use the binary code to carry out the most complex tasks (Jaeger 72). She is, so to speak, the mother of computer programming.

A dramatic text following Ada Lovelace's career is called *Ada and the Engine* and was published by Lauren Gunderson in 2018. A young Ada Byron meets the inventor Charles Babbage at his house in London, where he is hosting a scientific salon presenting his Difference Engine. The two strike up a friendship and promise to keep in contact. Ada is soon married to Lord Lovelace, yet continues her intense friendship with Charles Babbage, much to the chagrin of her mother, who sees her daughter's relationship with Babbage as too intimate. Throughout their collaboration, Ada and Charles refine the Difference Engine into the Analytical Engine, whilst trying to manoeuvre their undefined relationship in between arguments and shared publications. By the end of the drama, Ada succumbs to an unnamed sickness and dies in the company of Charles. In the afterlife, she meets her father, Lord Byron, and glimpses into the future of her computer algorithm.

The drama is interspersed with highly narrative stage directions that occupy a space in between the intradiegetic and the extradiegetic sphere. The stage directions fill in the additional information that the play cannot give through lines, adding double entendre or clearing up any confusion as to the real intent of what has been said by characters. The narration of letters that overlay the action on stage also serve as a narrative means to this dramatic text. The letters are read out by the characters writing them and have an immediate impact on the action on stage, providing a sort of modern messenger report (cf. Pewny 151-152).

4.6.1 BIOGRAPHICAL BACKGROUND

To a larger readership, the history of Ada Lovelace, née Byron, is probably best known because of her simultaneously famous and infamous family history. She is the only daughter of Lord Byron and Anna Isabella Milbanke (Hargittai *Meeting* 35). Byron, a famous poet, had been involved with his own half-sister and, "to avoid scandal, he married the baroness Anne Isabella Milbanke" (Jaeger 72) to save face while continuing the affair. He even named Ada, whose lesser known first name is Augusta, after the half-sister that he had the affair with (Jaeger 72-73). Lord Byron, disappointed with the female gender of his only legitimate child, left his wife and daughter in early 1816, his reputation now permanently tarnished because of the horrid separation and rumoured incest. Byron never saw his daughter again and died in the Greek War for Independence without ever acknowledging his daughter's life and achievements (Ogilvie "Lovelace" 217).

Ada's mother, in contrast, proved a more dutiful parent and ensured that her daughter received the best education available. The young child was tutored six days a week in mathematics, geography, technology and the general arts. Some biographers speculate that poetry was purposefully left out of the curriculum as a late revenge from her mother to the adulterous father (cf. Jaeger 73, Hargittai *Meeting* 35), whereas others steadfastly refute this (cf. Hollings, Martin and Rice "Mathematical" 226). Similar to Émilie du Châtelet, Lovelace came from a wealthy aristocratic background and profited from her own mother's interest in science and the thorough education she was provided with. She grew up in an environment that fostered the interests of young children and, additionally, in a century that saw the rise of popular science, especially in mathematics: "Mathematics was surprisingly widespread in popular culture: young ladies did Euclid for pleasure; periodicals like *The Ladies' Diary* published mathematical questions and readers' answers" (Hollings, Martin and Rice *Ada* 5-6).

At the young age of 19, Lovelace was married to Baron William King and her ensuing new duties as a wife to an aristocrat kept her from pursuing her scientific career for many years to come (Jaeger 79). Only after the birth of her third child in 1839 did Lovelace take her education back into her own hands and specifically searched for a private tutor, which she found in Augustus De Morgan, a Cambridge professor of mathematics. De Morgan coached her for one and a half years, elevating her knowledge from beginner to ending up giving her his own papers and theorems to work with (Hollings, Martin and Rice "Lovelace-De Morgan" 221). Plagued by weak health

throughout her entire lifetime, which was worsened by her addiction to opium, Lovelace did not grow old. She died in 1852 and it is speculated that she succumbed to cervical cancer (Ogilvie "Lovelace" 217). Even though father and daughter never met again after Byron left the family in 1815, Ada Lovelace had decreed that she wanted to be buried next to her father's grave (Jaeger 80).

Her most famous collaboration was undoubtedly with the inventor and engineer Charles Babbage. Babbage endearingly referred to Ada in his private correspondence as an "enchantress of numbers" (Babbage as quoted in Hollings, Martin and Rice "Mathematical" 222). Lovelace had met Babbage in 1833 already, when she had been invited to witness the presentation of his *Difference Engine*, a mechanical calculation device of Babbage's that he had been working on for over ten years. The *Difference Engine*, never really took off even though it was Babbage's first major brain child. Babbage would continue to work on this machine until the early 1840s, even going so far as to utilise his own money after the British government stopped funding his project in 1834 (Jaeger 76). Mike Edmunds is convinced that his "ideas were a century before their time" and that Babbage and Lovelace would later conceive of the first prototype of a "programmable computer" (both 4.10). Together with Lovelace, Babbage started a new project in 1834, the *Analytical Engine*, a machine designed to conduct numerical calculations and that would be operated by punch cards (Jaeger 77). It was Lovelace who saw beyond the numerical tasks of the machine: The numbers could stand in for other information for the machine as well. Lovelace conceived of a programme for the device that would use the mathematical information and apply them to non-mathematical tasks, for example to handle musical notes or written language (Jaeger 79). In 1842, after her extensive tutelage under De Morgan, she translated Babbage's article on the Analytical Engine from French to English to make it available for a larger public and added her own notes on the design, expanding the article by twice its size (Hargittai *Meeting* 36). Lovelace is therefore historically the first person ever to produce and publish a computer algorithm at a time when computers were not yet conceived of (Jaeger 72).

Hollings, Martin and Rice praise Lovelace for the respected position she held in the scientific community, not just with her colleague Charles Babbage, but with other scientists and intellectuals of her time as well. She was closely acquainted with Michael Faraday, Charles Dickens and especially Mary Somerville, who became her close friend and influential role model (Hollings, Martin and Rice "Lovelace-De Morgan" 222, Jaeger 75). Her own tutor, Augustus de Morgan, considered her "power of thinking […] utterly

out of the common way for any beginner, man or woman" (De Morgan as quoted in Hollings, Martin and Rice "Lovelace-De Morgan" 203).

As was the case with so many female scientists before her, much of her personal correspondence has not survived the centuries since her death and if it has, it is only "fragmentary" (Hollings, Martin and Rice "Lovelace-De Morgan" 206). This lack of personal material has prompted a debate among her biographers, who, in hindsight, doubted her mathematical talent. Dorothy Stein, one of Lovelace's first biographers, falsely interpreted the letters between Lovelace and her tutor De Morgan as evidence for her lack of mathematical talent (Hollings, Martin and Rice "Lovelace-De Morgan" 204). Many following biographical accounts have followed suit and repeated "Stein's largely unquestioned downplaying of Lovelace's mathematical competence" (Hollings, Martin and Rice "Lovelace-De Morgan" 204), with only recent publications from the 2010s correcting the records of Ada Lovelace's evident talent. As it turns out, early biographers struggled with dating the letters correctly and therefore misinterpreted the course of her learning curve. Hollings, Martin and Rice highlight the difficulty in going through Lovelace's personal correspondence and decry that "Lovelace is particularly guilty of writing what is clearly the wrong day of the week for the day indicated" ("Lovelace-De Morgan" 207). One might speculate that Ada Lovelace never thought her private correspondence worthy of future scholarly studies and therefore never bothered with correct dates, rendering the work of historians interested in her life much more difficult.

Lovelace's life has been a recurring topic of literary imagination. The amount of recently published children's literature on Lovelace's work and life show her importance especially to a younger generation. These accounts make sure that her legacy will be known to the youngest members of society, thereby counteracting that she once again disappears from the historical archives. Furthermore, this proves that newer historiography and correcting of false narratives starts with children's education. Colourfully illustrated volumes such as *Ada Lovelace: Poet of Science* (2016) by Diane Stanley or *Ada Byron Lovelace and the Thinking Machine* by Laurie Wallmark (2015) provide the perfect reading material for young children to be inspired. This trend continues in the genre of young adult nonfiction, as publications such as is shown by *I, Ada* by Julia Gray (2020) or *Dreaming in Code: Ada Byron Lovelace, Computer Pioneer* (2022). Her story is that of an eclectically colourful woman in science who paved the way for twentieth-century computer algorithms, connecting the past with the contemporary and, in the children's case, future aspiring scientific community.

4.6.2 LOVELACE AND BABBAGE

Historically speaking, the relationship between Charles Babbage and Ada Lovelace is probably the most important one of Ada Lovelace's life, which is mirrored in the drama. Contrary to canonical history, the fictional Charles Babbage occupies more than the role of the mentor and collaborator; he serves in the drama as Ada's supposed true love, whose relationship was doomed because of their age difference. Judging from the biographical accounts consulted for this thesis, there are no hints at any romantic connection between the two. The drama rather uses its poetic license to add another side to their relationship.

Their behaviour and words towards one another are one part of the relationship, but it is veritably told in the stage directions, which serve as additional narrative pieces to the dramatic text, as seen in other analyses before. Moving beyond mere scene descriptions, the stage directions in *Ada and the Engine* carry out a narrative duty to fill in the blanks left behind by history and, in the case of the dramatic text, of the characters' feelings and thoughts, sharing "many of the characteristics of the fictive discourse of other genres: most notably, of the novel" (Suchy 80). The directions give an almost internal dialogue between the two, as is demonstrated very early on when the two characters meet during Charles' presentation on his idea of the engine:

> ADA. You know you might've just become, in this very moment, the single most interesting person I've ever met.
> CHARLES. How old are you, Miss Byron?
> ADA. Eighteen.
> CHARLES: Then you've got time to find better.
> ADA. Or perhaps I'll just have to get to know you… better.
> *"Is she flirting?" he thinks. "Am I flirting?" she thinks.*
>
> (Gunderson "Ada" 17)

A fairly young Ada meets a man who is much older than she is, yet is bold enough to not only approach him with questions on his own machine but also to talk to him rather candidly. Her directness apparently startles both her and Charles, as the stage directions reveal. In a dramatic text, we would usually not be privy to these private thoughts. Depending on the narrative situation of a prose text, we as the readers might only receive insight into one single character by internal focalization of one single character. However,

these short sentences in cursive add another layer to the scene beforehand. Ada's behaviour might have been interpreted differently in individual stagings of the play, but the stage directions are clear as to her own insecurity at her words. Both she and Charles are wondering whether their short banter and Ada's suggestive tone might count as flirting. If Charles was left wondering, it would be a one-sided issue. Yet, as the directions reveal, Ada is not sure what she is doing, either. There is no seductive purpose behind her words, nor does she appeal to Babbage's vanity with any attempt of swaying him in her favour. Both are equally surprised and unsure. It renders the scene much more genuine and proves Ada's young age, as she herself is not sure how to behave herself in the presence of someone she finds inexplicably interesting despite their age difference. In contrast to what her mother insinuates once she joins the scene, she is not "making progress at that aim" of finding a husband (Gunderson "Ada" 19); she is simply enchanted by Babbage's thoughts on his engine and the process behind any alterations that he has in mind. What adds to this genuine connection is Charles' later reaction when Ada, again very boldly, asks whether she may write to him and then tumbles into a short ramble on how she interprets mathematics as another form of music. Instead of being annoyed by being pestered by a young socialite, as Charles himself referred to her beforehand (Gunderson "Ada" 17), he is very much decided: "*That's it. He likes her very much*." (Gunderson "Ada" 18). This scene establishes their connection as a candid one that was not fabricated by societal conventions.

Characters outside of their relationship warn both of them to be reasonable and that they can never amount to anything more than colleagues. Ada's mother Annabella is particularly wary of the influence that Charles may have on her young and impressionable daughter. She cautions Charles against taking Ada's lively character for granted in their very first meeting: "My daughter's is a life besmirched by gossips and a wilder side to her character that does not heed. […] She will fall to a graceless fate if she does not marry well." (Gunderson "Ada" 19). The message behind the carefully chosen words is veiled but clear. Annabella counts on a suitable marriage to save Ada from the gossip that has surrounded their family. A husband of high social status will clear Ada from the stain attached to her through her irresponsible father and Charles, according to Annabella, is not the right choice. Annabella holds a grudge against Charles right until the very end of Ada's life. When Charles begs to be by Ada's side as her disease deteriorates, Annabella reproaches him that "[s]he was never going to leave [him], the grand man of science, the father she never had" (Gunderson "Ada" 60). Not only is Charles too old to be a suitable

husband for Ada, her mother also accuses him of only serving as a stand-in for the father Ada never had. In Annabella's eyes, Charles' maturity and wisdom might have only been appealing to Ada because she never had a male figure of authority to look up to. Annabella leaves this thread hanging as she leaves Charles to be with her daughter, who is now "[a]bandoned and ruined" because Charles never did "the honorable thing and left her alone" (Gunderson "Ada" 60).

Even one of their friends, Mary Sommerville[20], is quick to disrupt any untoward behaviour between them and to quell any ideas Charles might have of pursuing Ada. When Ada tries to comfort Charles during one of his many setbacks and "*touches his hand* […] *Mary sees this, intervenes, taking his hand instead*" (Gunderson "Ada" 22, emphasis in original). Mary is a married woman, at that point historically at least, and much closer to Charles' age than Ada (cf. Chapman 2.11). There is no harm in the two of them sharing a brief physical touch, whereas Ada and Charles' relationship is much more delicate in the societal context of their time. Once Ada has left the scene, Mary corners Charles and directly reminds him that Ada is "not going to be [his] wife" and that by pursuing her, Charles will "make a mockery of [himself]" (both Gunderson "Ada" 23). As a friend, she tries to warn Charles of the consequences any irrational desires may cause and reminds him how improbable any romantic relationship between them is. Charles is appalled at Mary's insinuations and plays dumb, denying any such aspirations, yet "*reaches for whatever wine was left and downs it*" in apparent dismay as soon as Mary has left the room (Gunderson "Ada" 24, emphasis in original).

Understandably, Ada's husband, Lord Lovelace, is also very doubtful of Charles' intentions. In a very direct approach, he confronts Charles one day before marrying Ada and makes it very clear that Charles will have to decide: "I don't think her constitution or reputation is strong enough for the both of us. And I have neither the time nor mind to… compete." (Gunderson "Ada" 32). Lovelace leaves the ball in Charles' court, making it abundantly clear that either Charles withdraws and leaves Ada to fall in love with her intended husband or that Charles occupies the role of her lover, with all the consequences that are attached to that. Lovelace respectfully asks Charles to abstain from any visits and to "contain [their] friendship to the epistolary […] [u]ntil she gets settled in the ways of

[20] Gunderson spells the name of her character, Mary Sommerville, differently than the historical counterpart, namely Somerville. I will use the different spellings to distinguish between the fictional and the historical characters.

a wife" (Gunderson "Ada" 32). Lord Lovelace is surprisingly candid in the face of his immediate competitor for Ada's affection. He knows that the connection between Ada and Charles might be much stronger especially if Charles does not give Ada a chance to accept Lovelace as her husband. Lovelace appeals to the older man's conscience by suggesting that he allow for Ada to find happiness somewhere else, somewhere more permanent and stable. Lovelace sees in Charles only a competitor for Ada's affection, not a catalyst for her scientific career. This is quickly remedied when Ada's husband realises that the contact with Charles breathes back life into his wife after the difficult births of her children. Her long absence from science has not helped Ada in her recovery. Showing great strength of character, Lord Lovelace specifically apologises to Charles for the aforementioned conflict and highlights how Charles has "been a great friend to her and a steadfast supporter" (Gunderson "Ada" 40).

By the end of Ada's life, Lovelace has to admit his defeat, though. Ada, in her laudanum-induced delirium close to her death, calls out for Charles, imagining him as her husband in an alternate future in which she and Charles had children. In the presence of her mother and actual spouse, Ada mentions how Charles and she will go to the Great Exhibition, together with *their* children. This is a direct reference back to when Charles found out about Ada's sickness. He promised her that she would live long enough to go and see the exhibition with him together, which has apparently stuck in Ada's mind long enough to now manifest in a sort of alternate reality (cf. Gunderson "Ada" 53-54). Lord Lovelace finally gives in and admits Charles Babbage to the room where Ada is dying, against the wishes of Ada's mother: "Someone should be here who cares", he concedes, clearly meaning Charles who has meant more to Ada than any of the other two ever have (Gunderson "Ada" 60). In contrast to her mother and husband, Charles does not forbid Ada to live in her fantasy, he encourages her with gentle words and plays along. For a short moment, the two of them are allowed to be together, even in an imagined world. Ada "*kiss[es] his cheek like a wife would*" and Charles rests beside her and reads her poetry to ease her mind (Gunderson "Ada" 62, emphasis in original).

This scene of Ada's death is the only moment in which the two forbidden lovers are allowed to live out a fantasy that has been hanging over their heads for their entire platonic relationship. In Ada's drugged head, things are as they ought to have been for many years: She is happily married to a man that she deems her equal as a scientist and they spend time together exploring scientific exhibitions alongside their children. Not only is their love now permitted, the fantasy also allows for Ada's work in science. What

has been impossible in history can now be realised in Ada's imagination, where she can be free of the societal restrictions because of her sex and her infamous father: She can marry whomever she wants and work as a scientist.

4.6.3 Wife and Science Life: Narrated Letters

Another narrative aspect that I would like to draw attention to are the letters mentioned in the introduction to this chapter. The makeup of the scenes involving them are rather similar: A regular scenic action will play out in the foreground of the stage, while letters are read out by characters involved in the scene. Sometimes, other characters outside of the epistolary correspondence are also involved in the action, yet unaware of the added level of communication. The letters both describe actions outside of what is happening on stage and tend to capture the interest of those on stage at a certain point, which then disrupts the action that is happening on stage.

One of these scenes occurs at the very beginning of the drama when Ada has just met Lord Lovelace and has agreed to dance with him while Charles and her mother watch them. As Lovelace and Ada swirl on the dancefloor, she and Charles converse in the style of letters to each other which centre on their newfound shared interest in Charles' engines. Two layers of diegesis are involved in this scene, one is the actual action of the drama, the dance, and the other is the narrative layer outside of the action, namely the letters between Charles and Ada. Ada dancing symbolises the courtship of Lord Lovelace that she currently finds herself in, a sort of chaperoned meeting deemed fit by her time's social standards. Ada's written correspondence with another man shows a progress in her work as a woman in science, which superimposes as a metaphor for her scientific career. Additionally, both signify the passage of time encapsulated in one single scene, which bridges the gap between the men's first meeting Ada and the development of their individual relationships with her.

In narrative terms, these performed letters can be read as a hybrid between messenger reports, signifying actions off-stage, as well as perfunctory narrative instances, as they provide an external narrative to the internal action on the level of the diegesis. Thematically, they foreshadow the imminent conflict that will arise in Ada's life. The scene is preceded by the first interaction between Charles and Ada, which was discussed earlier, and represents the conflict between the two interests in Ada's life, namely her

marriage and her work. The private and the professional are conflicting here, not only because Charles is involved in both but also because Lord Lovelace represents a definite move away from Ada's involvement in science. Charles is intertwined with her private and her professional life and transcends the boundaries in these overlaying letters. Ada is supposed to find a suitable husband, someone other than Charles, and be a good wife, which would be negated by her continued interest in working in science with Charles, and the entanglement of both strands of her life are symbolised by this narrative intersection.

This conflict is further heightened by another scene of overlaying letters. Bryan Richardson has noted that "alternation between narration and enacted events is quite comparable in many ways to a homodiegetic narrator's shift between presenting scenes as they unfolded in his or her life and the retrospective commentary that takes place during the time of the writing" ("Voice" 683). In this case, this alternation and shift can be directly applied to the enacted letters, providing narration on stage. The scene is prefaced by the stage directions introducing "[*a*]*nother series of letters [which] pass back and forth… Ada's come as she preps for marriage*" while "*Babbage's letters come as he drafts, sketches, and tinkers with cogs and wheels in his study*" (Gunderson "Ada" 33). The conflict in Ada's life has progressed, yet has not been resolved. She is still planning to marry Lord Lovelace without ceasing the corresponding with Charles. The tension between Ada's two lives is even more pronounced in this scene, since Ada starts the scene by narrating a letter to her future husband. This letter is then interrupted by a letter from Charles, who pulls her attention away from her spouse towards himself and their work. The scene seems tranquil at first. The stage directions are rather vague, only indicating that she is prepping for marriage, which might entail taking measurements for a dress, sending out invitations, packing her belongings, or any other tasks that need to be fulfilled before she becomes Lady Lovelace. Her husband-to-be is on stage as well, reacting to her sweet words of affection before they are ultimately married, according to the stage directions, and professes his love for his "sweetest, rarest bird", a nickname he had given Ada earlier (Gunderson "Ada" 33).

Charles's letter, in turn, goes out to the newly-wed Lady Lovelace, lamenting that "it has been months since [they]'ve spoken" which may hint at the long time frame this scene covers (Gunderson "Ada" 33). Lord Lovelace now forgotten, Ada solely corresponds with Charles through the narrated letters throughout the rest of the scene while continuing to potter around while he is still occupied in his study. She assures Charles that she tries to engage with mathematics every day, yet that her children occupy

a lot of her time (Gunderson "Ada" 33). It is now not only the marriage and professional career that are in conflict with each other; motherhood adds another private responsibility to Ada's life that demands her attention. Ada's letters turn from one affectionate letter to her husband to lines filled with her concern for mathematics and an upcoming conference in Turin. Her wifely and motherly duties are a mere nuisance that takes away precious time from her work.

Both Ada and Charles are involved in the action on stage as well as in the narrative action of the performed letters. Although they have transcended the two different layers, Lord Lovelace remains in the scene without anyone to pay attention to him. One letter from Charles and he is forgotten in favour of his perceived rival for Ada's affection. One might even argue that this symbolises how Lord Lovelace is left behind in the action as his wife and her colleague ascend to their own level of correspondence, one which Lord Lovelace has no place in and has no access to. This underlines the hybridity of the letters which sit somewhere in between narrative instance and a messenger report. They both provide an integral part of narration on the dramatic stage that help the dramatic plot move further by signifying the passage of time, as well as offering an extradiegetic narrative function in terms of adding information to the plot that characters on stage may not be privy to (Pewny 151-152). Lord Lovelace might not be aware of the correspondence between his wife and her close friend, whom he perceives as a threat to their relationship. He is still involved in the action on stage while Charles and Ada have moved beyond the mere intradiegetic level.

This scene highlights the quick advancement of time with Ada's marriage and birth of two children, as well as the continuously growing chasm between her private and her professional life. She adheres to the societal standards of mother and wife, yet cannot help but remain involved in mathematics. She is a woman torn between two aspects of her life and her passion for science appears to win, judging by her decided detour of attention. Or maybe she does not even have to choose, as she told Babbage and Sommerville in an earlier scene, and will simply combine the two: "I shall be a bride of *science*" (Gunderson "Ada" 22, emphasis in original). Being married to science appears easier for Ada then being married *and* conducting science, so it seems.

4.6.4 ADA AS A WOMAN IN SCIENCE

The relationship of Babbage and Lovelace shows a striking similarity to the relationship of Emilie and Voltaire in Gunderson's *Emilie: La Marquise du Châtelet Defends Her Life Tonight*, which was discussed in an earlier chapter of this thesis. Emilie and Ada find themselves in similar situations as women in science. Both were a woman in science rising above her respective societies' plans for her working with a man firmly established in science. Both plays show Voltaire and Charles as teachers or mentors before becoming a closer personal figure in the life of the female scientist. The only difference is that Voltaire and Emilie were in fact a couple that worked together, but Charles and Ada always remained co-workers despite their evident feelings. We have seen how the relationship between Emilie and Voltaire has soured because of their professional differences, which has ultimately cost them their love.

With Ada and Charles, the risks were apparently deemed too high to pursue a more intimate relationship, both for societal reasons and because it might have jeopardised their work as well. They were already in conflict once because of Charles' stubbornness towards the British government; no-one can know how many more conflicts they have avoided because they kept their relationship as professional as possible. Charles' disdain for politics has been made clear from the very beginning when he acerbically complains to his friend Mary that "these crooked, idiotic ministers – these bastards – these – […] vampires of industry" (Gunderson "Ada" 21) are incapable of understanding his work. He had presented them with a sketch and a model of the engine, yet they were not satisfied and demanded a real engine. Charles had not been able to build one yet and the government had subsequently withheld further funding, which would make building the engine nigh impossible. In the beginning, Ada is completely on Charles' side, even offering him her dowry to help funding, a fact which would greatly displease her mother (Gunderson "Ada" 22). However, once she realises that Charles intends to attach a preface to their joint grand publication that would directly attack the government for their withdrawal of funds, Ada is incensed. The article is as much her work as it is his and Charles would undoubtedly draw her into this conflict of his with the government. His rash idea of criticizing the government would probably not harm his own reputation very much, as he is already an established scientist. Ada, however, as a young woman with a difficult family history in a profession typically associated with men is in a much more vulnerable position. She does not cower in the face of Charles' rage at

her lack of support. On the contrary, when he proves that he will not hear her more measured arguments of his "lunacy" and her "saving [him] heaps of embarrassment" (both Gunderson "Ada" 47-48), Ada launches into a full rant of how delusional he is:

> ADA. I will *retract this paper*? *From print*? Who are you? Who would have me efface months' worth of work and time and, if I do say so, *leaps of mental acuity* in translating not just the French but your knotted complexity into the vernacular of reality. […]
> CHARLES. You defy me then?
> ADA. Is it not you who defy me? My good sense?
> CHARLES. Oh yes, *sense* is your family's most rumored feature.
> ADA. Do not condescend to me when you are using my name to sell your lies and you know it. I am a prize for you. I am your protégé [sic]. And I am every bit the genius you are.
>
> (Gunderson "Ada" 48-49)

Similar to the fictional Emilie, Ada does not accept Charles' dismissal of her opinion. She takes the low blow he meant to deliver by alluding to her family's tarnished reputation and throws it right back at him. She is confident in her ability as a scientist and as a translator of his work, regardless of his approval. In this scene, their age difference is barely noticeable. Ada speaks with the confidence of a woman much older and much more experienced and puts Charles in his place. Charles' delusional conviction that one simple note will sway the public opinion in his favour is countered by Ada's trump card of her own influence. She is famous or infamous, depending on how one might interpret the rumours attached to her family. Either way, Charles profits from this infamy, as it would make a publication much more interesting because the daughter of the salacious Lord Byron is attached to it. Both of them seem aware of this and Ada is confident enough to remind her friend and colleague of her own authority. He cannot and will not decide this without her input and certainly will not endanger her budding career. Ada holds her ground against a much more experienced male scientist and smartly uses whatever means are at her disposal to ensure that she will not be dismissed so easily by her colleague's folly. Their discussion is eventually cut short by Ada's confession that she suffers from a fatal disease, which redirects the topic of the conversation without them having reached

any agreement. Yet it is clear that Ada had no intentions of giving in to Charles's idiocy and meant to stay in charge as his equal.

Narratively, this entire conversation is supported by the stage directions. Instead of simply providing descriptive commentary to the action, such as the blocking of the scene or the layout of the stage, they fulfil their postclassical purpose of adding an epic quality to the discussion. When Charles accuses Ada that she would not exist, therefore not be of importance in science, without him, the directions react to this almost like a bystander would: "*Oh damn*." (Gunderson "Ada" 49, emphasis in original). The short exclamation feels like a muttered utterance that somebody in the room would add, as it underlines the impudence of Charles' claim. It gives them a very human quality to speak, for lack of a better word, without a filter and to simply react to what is happening on stage. They potentially mirror what the reader might think or feel, which can add a humorous quality to the stage directions in case a potential readership recognises their own reaction in them. At other times, the stage directions provide information that might be irrelevant to the staging yet are important for those reading the play. When Charles tries to stop Ada from leaving during this fight, we learn that Ada is "[*h*]*olding her rage down to a low flame, but it is a hot one*" before telling Charles not to touch her (Gunderson "Ada" 51, emphasis in original). There is no doubt that she would be incensed after the entire conversation, yet this description gives a concrete image of how her words are uttered: Not just with anger, but presumably with icy cold rage that might be contained for a while but nevertheless is not quelled. These pieces of information are usually given in a prose narrative in which a narrative figure would detail the extent of the character's feelings. In the case of the dramatic text, this function is carried out by the stage directions which go beyond the mere description of what the character experiences, filling in the blanks and painting a much more vivid image (Pfister 72).

Ada rightly defends her career in science and her work accompanies her even after her death. After a long bout of sickness, she enters the afterlife on stage where she now meets her dead father, Lord Byron. After a short conversation and an emotional reconciliation, Ada tries to explain to him what she does as a scientist. Byron is sceptical in face of a thinking engine, as Ada introduces the Analytical Engine to him, and he considers this "all the more impossible" because machines simply cannot work like a human brain (Gunderson "Ada" 70). Ada, however, is not fazed, as she is too caught up in the possibility of the engine becoming reality. On a whim, she talks to the room in binary, hoping to confirm her suspicion, namely that they are in the presence of such a

machine. To her delight, the room answers with a single note which soon turns into a complex song, which Ada can turn on and off simply by saying "one", the binary equivalent of "on", and "zero", the binary correspondent of "off" (Gunderson "Ada" 70-71). She shows her father an actual proof of her work and soon, both start to join in the song that the machine is producing under Ada's programming. This marks a suffusion of poetry and science, creating a bridge between the two vocations and therefore between father and daughter, something Ada desperately wished for during her lifetime. In contrast to the historical Ada, who never had a chance to meet Lord Byron and connect to him, this gives the fictional Ada a closure to the tumultuous relationship with her estranged father. They are one, despite their different professions, caught in the beat of their respective work, dancing along and singing, Byron with his poetry, Ada in binary code. For a short time, Charles joins in the daughter-father duet, presumably because he has died and is now in the afterlife, too. Father, daughter and colleague fuse their work for a short time in a sort of chant, then Byron exits the stage to leave the scientists alone. Charles is the next to go, he "*doesn't want to*" but "*must leave her*" (Gunderson "Ada" 74, emphasis in original), leaving Ada alone on stage to continue the merger of her work and her father's poetry, singing the poem in the rhythm of a binary code. The final scene is dedicated to Ada alone, without the interference of the two men who have undoubtedly shaped her life, for better or for worse. It is a visualization of what she has achieved in her lifetime with the additional outlook on what her first computer programme has paved the way for:

> *Ada is alone… her ones and zeros now echoing around her, outside of her. She is not singing but sound is all around her. The song and the numbers funnel down into a spotlight on her. The spotlight and song gradually fade as a strange blue light and a strange new sound takes over… It's the blue light of modern computer screens – laptops, iPhones, iPads – all giving off their ghostly light on her. All play her song.*
>
> (Gunderson "Ada" 76, emphasis in original)

The blue light of screens surrounds Ada in her final moments on stage, enveloping her in the modern technology that she had the foresight to conceive of. What we associate with work and stress, the blue light of screens, is a novelty for Ada and the confirmation that her work will have a lasting impact. The focus is redirected away from Charles and Byron

in order to leave the stage to Ada to bask in the success of her ideas. Her legacy lives on, now on a much larger scope than either she or Charles could have ever imagined, and it leaves her infinitely happy.

Ada and the Engine imagines an afterlife for Ada Lovelace that serves her closure after her untimely death. Similar to the fictional and historical Ada Lovelace, the eponymous protagonist of the following drama, *The Half-Life of Marie Curie*, has had to face societal repercussions for her private life. In Marie Curie's case, she is hounded by the French press for an affair with a fellow scientist but, in fiction and in history, is supported by a fellow female scientist and suffragist, Hertha Ayrton. Both women are established as scientists and major characters in framing soliloquies with narrative stage directions providing introspection in between lines.

4.7 "I DON'T WANT TO BE WHERE I'M NOT WANTED": LAUREN GUNDERSON'S *THE HALF-LIFE OF MARIE CURIE* (2019)

It almost feels redundant to offer a short biography of Marie Curie. She is a two-time Nobel Prize winner, probably the most covered female scientist in the history of science and therefore the veritable exception to the general rule of women being written out of history. Yet, as earlier chapters have shown, the success of one woman comes at a price for other women. Marie Curie is the daunting shadow that looms over aspiring female scientists, who have this superhuman role model to look up to and to be compared to. The "Marie Curie effect" denotes the unrealistic standards that women in science have to surpass in order to be taken seriously as scientists (Kohlstedt 4). But, despite the earlier sentiment that Marie Curie is well-covered in the history of science, her inclusion in this thesis is warranted. Marie Curie may not be a forgotten woman in science, but she is nevertheless a peak example of how the worth of women in science is measured by societal standards that are often influenced by archaic gender concepts. Marie Curie has been judged in the court of public opinion during her lifetime and therefore represents so many female scientists who have suffered from the experience of sexism and twisted moral high grounds.

The play selected for this section was originally designed as an audio play for the audiobook provider Audible[21]. In this play called *The Half-Life of Marie Curie* (2019), the author Lauren Gunderson presents the downside of being a well-known scientist, namely the spotlight on Marie Curie's private life when Curie's affair with fellow scientists Paul Langevin becomes known to the public. The play starts shortly after the press has found out about the affair between the two and has been harassing Marie Curie for quite some time. Marie Curie is visited at her beleaguered home by her friend, fellow scientist and suffragist Hertha Ayrton, who convinces Marie to take herself and her daughters to Hertha's house by the British seaside to hide from the onslaught of press and to recuperate from the stress. During this visit, which makes up the majority of the play, Hertha and Marie discuss their work in science, the fate of women in their time and Marie's love for both her deceased husband Pierre and Paul. The play ends with their return to Paris and, in a voice-over narration, they both guide each other through the remainder of their lives to their death, where they meet again, ready for whatever comes

[21] The script is curtesy of Lauren Gunderson and her team at Gersh.

next. In narratological terms, the play offers various narrative means: Apart from framing opening soliloquies by the two main characters, Marie Curie and Hertha Ayrton, the stage directions of the play assume a narrative function by "preimpos[ing] an interpretative perspective on the dramatic presentation that follows" (Pfister 72) and providing introspection beyond mere description.

4.7.1 BIOGRAPHICAL BACKGROUND

The first years of Marie Curie's life read very different from what the public will later remember of her. Marie Curie, née Marie Sklodowska, was born in Poland in 1867. During this time, Poland was under the Russian tsar's control after a group of Polish rebels tried to overthrow the Russian rule in their country (Ogilvie "Curie" 311), leaving Poland under political oppression and its inhabitants at the mercy of a foreign crown. Marie's father was a science teacher himself with ties to the rebel underground, her mother a school principal (Ogilvie "Curie" 311). Her mother, a life-long sufferer of tuberculosis, was a "full-time director of a private school" (Bertsch-McGrayne 12) while taking care of her five children. Marie's talents manifested very early on in her life: Her secondary education was finished with a gold medal for her efforts, nevertheless she was forced to work as a tutor and governess to support her family's strained household after finishing school instead of being able to focus on pursuing a career (Ogilvie "Curie" 312). As a woman, she would be barred from attending universities in Russia or Poland, which was at that time still under Russian control (Bertsch-McGrayne 16).

It was her sister, Bronia, who was already studying in Paris at the Sorbonne, who convinced her youngest sister Marie to join her in her household and start studying in Paris as well, a call that Marie heeded in 1891 at the age of 25 (Ogilvie "Curie" 312, Ogilvie "Marie" xiii). Today, the public associates Marie Curie with glorious acknowledgement and the luxurious life as a well-known scientist, but these first years of studying must have been harrowing for her. The severity of her financial problems depends on the source material, yet it is clear that Marie Curie lived in poverty once she moved out of her sister's house, in close quarters with money for either food or heating, leaving her mal-nourished for several years (Ogilvie "Marie" 200). Nevertheless, she proved a capable and gifted student. She obtained two degrees, one in physics and, only

one year later, a degree in mathematics, in 1893 and 1894 respectively (Ogilvie "Marie" xiii).

In 1894, she met the laboratory chief of the School of Industrial Physics and Chemistry, who would become her husband by 1895, a man named Pierre Curie (Ogilvie "Women" 312). When talking about world-famous scientists, one cannot mention Marie without mentioning Pierre. Marie Curie and her husband Pierre can almost be seen as one of the veritable exceptions to the rule of women being relegated to the sides as assistant. Their collaboration on radioactivity propelled them both into the public eye of the scientific community; it was even her who coined the term radioactive in one of their first publications on the matter in 1898 (Hargittai *Women* 9). Inspired by the findings of her colleague Henri Becquerel, Marie Curie started to work on the new concept of radioactivity and published an article on her first findings concerning thorium. Pierre, now convinced of the potential of this new field, moved from his work on crystals to aid his wife in her research (Bertsch-McGrayne 20-22). In 1898, the discovery of two new radioactive elements polonium, named for Marie's home country, and radium, named for its radioactive qualities, cemented their legacy in the history of science (Ogilvie "Marie" 52, 54). Their joint work on radium consisted of long, tedious hours of manually digging through a material called pitchblende, a uranium ore, in order to successfully separate the ore from the radium that the Curies so desperately were trying to isolate (Ogilvie "Marie" 52). Marie as the chemist and more experimental part in their team was assigned to doing much of the manual labour in their work with the ore (Ogilvie "Marie" 53). Nevertheless, she would describe this time "in this miserable old shed" as "the best and happiest years of [their] life" (Curie as quoted in Bertsch-McGrayne 23).

Marie and Pierre Curie's strict adherence to scientific standards also presented a refreshing difference to the usual treatment of female scientists in collaboration with male scientists. Marie and her husband Pierre were extremely diligent in giving credit in their joint publication, in which they "continuously highlighted their joint and individual contributions" by means of "self-citation", clearly distinguishing between first person plural when talking about their joint work or using the third person singular when referring to work one of them had done on their own (Pycior 306). This inevitably led to both of them being recognised for their work on radioactivity, with contemporary French scientists always citing both of their names in publications instead of only Pierre's (Pycior 312). Not only did their proper scientific practice prevent Marie from being obscured in her husband's shadow, Pierre himself also advocated for her inclusion in a male-

dominated scientific world. When the Nobel committee planned on awarding the Nobel Prize in Physics to Henri Becquerel and Pierre Curie, Gustav Mittag-Leffler warned Pierre that Marie might not be included in the recognition. Pierre then made it abundantly clear in a note to the committee that if he was considered, then so would his wife need to be (Pycior 317).

Tragedy struck shortly after their joint awarding of the Nobel Prize when in 1906, Pierre was hit by a carriage while crossing the street, his skull shattered by the wagon's wheel, killing him almost instantly (Ogilvie "Curie" 313-314). With Pierre's premature death, a majority of the work on radioactivity was left to conduct for Marie, who was destitute at having lost her husband and most important collaborator. As the first woman ever in France, Marie had the bittersweet honour of succeeding Pierre as an assistant professor with the faculty of science, ascending to a full professorship in 1908 (Ogilvie "Marie" 77-79). In 1911 Marie Curie would make history as the first and, until this very day, only woman to receive two Nobel Prizes, in two different categories no less with her second Prize being awarded in chemistry (Bertsch-McGrayne 31). This tremendous achievement was overshadowed at that time by a smear campaign that started when her affair with the married scientist Paul Langevin became public. Even though extramarital affairs had been a standard in the turn of the century France, the unfaithfulness of Paul Langevin was ignored in favour of condemning Marie Curie, a widowed woman and "a Pole who had stolen A Frenchwoman's husband" who also supposedly besmirched the memory of her late husband Pierre (Bertsch-McGrayne 31). The xenophobic and at times anti-Semitic attacks against Curie did nothing to diminish her reputation in the long run. As hurtful as the immediate impact of the accusations against her must have been, her scientific triumphs prevail. Throughout the First World War, Marie Curie worked as a scientist, bringing portable x-ray machines to soldiers at the front and also trained countless women in the work with x-rays, providing a future generation of trained women technicians (Bertsch-McGrayne 32).

The late years of Marie Curie's life were accompanied by failing health, potentially a late effect of the long exposure to radioactive material, even though Curie herself spent her life-time denying the harmful effects of radiation despite the staggering numbers of reported incidents. In July 1934, Marie Curie died of pernicious anaemia in a sanatorium in the French mountains, leaving behind her two daughters, Ève and Irène (Ogilvie 315). The impactful legacy of the Curie family would continue with Marie's children. In what Hargittai refers to as a "dynasty", her eldest daughter Irène won a Nobel

Prize alongside her husband Frédéric Joliot in 1935, making them the first and, so far, only mother-daughter tandem to both win a Nobel Prize (*Women* 11-12). Ève, Pierre's and Marie's youngest daughter, grew up to be an international concert pianist. In an ironic twist of fate, the granddaughter of Marie Curie, Hélène Joliot-Curie, married the grandson of Paul Langevin, Michel Langevin; both worked as renowned scientists, her a physicist, him a biochemist (Hargittai *Women* 11-12).

4.7.2 THE SUFFRAGIST AND THE FEMALE SCIENTISTS

The Half-Life of Marie Curie offers an intersection eerily similar to the topic of this dissertation, namely that of women in science and their struggle for equality by combining the perspective of two women in science as well as that of a suffragist. By relaying an actual historical event, it adds the historical component as well: Hertha Ayrton and Marie Curie did, in fact, know each other and truly spent a summer together shortly after Marie Curie's affair became public. Biographer Barbara Goldsmith goes so far as to credit "Marie Curie's gradual recovery […] largely to Hertha Ayrton, who offered Marie and her daughters sanctuary in England" (Goldsmith 180).

Compared to Marie Curie, Hertha Ayrton might seem like an unimportant figure in the history of science but her contributions were significant. Hertha Ayrton, born Phoebe Sarah Marks in 1854, was a child of poor immigrants who only in later life changed her first name to Hertha after a poem by Algernon Swinburne (Hargittai *Meeting* 241). Her scientific career is that of a self-made woman who blazed a trail for women in engineering and physics in which only a few had already managed to set foot. Despite her low-income background, she was supported from an early age on by benefactresses all around her who saw her talent and were adamant at enabling her to pursue a career: At the age of 9, two years after the death of her father which left the family in dire straits, Ayrton was invited by her aunt, who ran a school in London, to join their household and be taught by them. This is where Ayrton acquired her first lessons on mathematics and on several other sciences alongside her male cousins (Mason 20). By the age of sixteen, she earned her own money as a governess and fully supported herself and her mother as well (Mason 20). In 1874, after many evenings spent coaching herself alongside her close friend Ottilie Blind, Ayrton passed the Cambridge University Examination for women and proceeded to study at Girton College, a female-only campus of Cambridge

University. Nevertheless, Cambridge University did not award any degrees or certificate to women until 1881, which meant that Ayrton, who finished her studies in 1880, did so without any degree (Mason 20). It was during her time of studies that Ayrton first started her career as an inventor when she designed a line-divider used by artists, architects and engineers, and later patented the invention in 1884. After having sustained her career with teaching and tutoring for many years, this line of work proved her true calling. In her life, Ayrton "was granted twenty-six patents: five on mathematical dividers, thirteen on arc lamps and electrodes, and eight relating to the propulsion of air" (Bruton). Ayrton is probably best known for her work on the electric arc and her influential publication *The Electric Arc* has remained a standard on the subject until after the 1920s when the field of electricity received newer standard text books (Mason 17).

Proto-feminist Barbara Bodichon was a mentor of Ayrton's, who financed a part of the yearly fee for Ayrton's university studies (Mason 20). Bodichon also introduced Ayrton to the influential London circle of suffragettes and proto-feminists of the time, among them Mary Anne Evans, better known under her pen name George Eliot (Mason 20). Rumour has it that Eliot designed one of her characters in *Daniel Deronda*, namely Mirah, after the image of Hertha Ayrton, who became a close friend of hers (Mason 20). Ottilie Blind, daughter of the Jewish-German immigrant Karl Blind, was another female friend and influential figure in Hertha's life as she was the one who encouraged Ayrton to apply for a place at Cambridge University and coached her for the entrance examination for women (Hargittai *Meeting* 242). This tight-knit circle of female friends and supporters must have made a lasting impact on Ayrton herself, who grew up to be an ardent defender of women's rights and an active or even founding member of many women's rights associations such as the International Federation of University Women or the National Union of Scientific Workers (Mason 21).

Curie and Ayrton met on a gala held in honour of the Curies who had just won their Nobel Prize in 1903 in the Royal Institution in London:

> Here, the two women became good friends and they had man shared commonalities: being part of a married collaborative couple; an independent dedication to scientific research, which both pursued against their social origins and gendered expectations of the time; and a strong sense of social justice especially for women.

(Bruton)

With Ayrton, Marie Curie and her daughters found refuge after the affair of Curie and Paul Langevin was made public in 1911. Ayrton invited the three over to England to stay at her cottage in order to escape the harrowing pursuit of the press (Mason 22).

Ayrton continued to work throughout the First World War as an inventor, too, providing the British troops with a specialised fan that would drive the poisonous gas used by the Germans out of the trenches. Her apparatus, called the Ayrton anti-gas fan, was one of her final successful inventions before her death in 1923. By 1917, after many hesitant reactions from the War Office and several improved versions of the fan, over one hundred thousand Ayrton anti-gas fans were ordered and were "quite capable of rolling [the poisonous gases] back into the open, even of clearing dugouts of gas" (Mason 19). Ayrton died in 1923 and only two years later, her friend Ottilie Blind established a fellowship in her name at Girton College to secure her legacy of women in science (Tattersall and McMurran 107).

Given this background information on Ayrton's life and the relationship of Ayrton and Curie, it is no wonder that the drama centres on the intersection of women in science and proto-feminist ideology by example of these two outstanding scientists. The historical Hertha Ayrton's experiences with the system are even part of the story. The failed membership with the Royal Society of Hertha Ayrton's is an especially curious incident and perfectly highlights the standing of women during her lifetime. After she published *The Electric Arc,* a member of the Royal Society nominated her for a membership after having read her paper and other members as well. The Royal Society long argued over whether a woman ought to be allowed as a full member with the then president William Huggins speaking out "against women 'trivialising' his elite scientific institution" (Bruton). Some of them may even have been intimidated by Ayrton's ardent political engagement for women's rights and ultimately, her application was denied. The reason for not allowing her entrance, however, was not because of her political activism or gender, but simply for a legal reason: According to the law, women were not seen as separate individuals once they were married and since Ayrton's husband was already a member of the society, her application was seen as redundant (Hargittai "Why" 7). When Ayrton later read her paper before the Royal Society, William Huggins was curiously absent and apparently still disapproved of a woman's presence in the Royal Society (Bruton). This little historical incident goes to show the fight female scientists in England

of the 19th century had to deal with and how their hands were legally tied in face of the injustice.

When the fictional Marie, her daughters and Hertha arrive in Britain in Hertha's cottage, the two women continue to vent about the injustice of the system. During this conversation Hertha lets Marie in on how she was almost elected to the Royal Society, a society that Marie "tried half a dozen times" to enter and was never accepted into (Gunderson "Half" 23). The fictional Hertha adds another layer to the incident, claiming that the society first was convinced that a man had written her paper on the electrical arc, confusing her with her husband William, who always had "insisted that [they] not work together to avoid this exact confusion" (Gunderson "Half" 24). But once they realised that it was William Ayrton's wife who had written the article, they turned to the aforementioned law that named women the legal property of their husband and therefore rejected Hertha on the basis of "an existential contradiction […] even though, because [they] are physicist, [they] have no problem with the contradiction that light is both a wave and a particle" (Gunderson "Half" 24). Hertha calls out the hypocrisy of her rejection to the society: If physicists have no trouble accepting the contradicting wave-particle duality of light, then they should not be averse to accepting a woman's independent legal status as a member, despite what the law says. It all comes down to the question of exclusivity and gatekeeping, as Hertha says: "I think they created their little Societies just to keep us out of them" (Gunderson "Half" 23). If the societies are meant for networking and enabling joint scientific work, then one has to ask why a person should be excluded from them on arbitrary factors such as their gender which has nothing to do with their capabilities as scientists. These career opportunities are the founding reason for many of these societies and those in power, in this case male scientists, have long denied women the access to these institutions and societies based on misinformed prejudices against the other sex. It is gatekeeping at its best, those in power denying those outside of an elite ring access to power and to the resources needed to succeed in a specific career field.

At the heart of the drama lies the relationship of Hertha and Marie, surrounded by the scandal that Marie has to go through. Hertha swoops in and saves her friend from the harassment of the press. She particularly loathes the action of the members of the press, claiming that "journalists are pigeons, you can't get rid of them before they shit on everything" (Gunderson "Half" 6). Hertha is particularly vexed by the discrepancy

between the treatment of Marie and of Paul, in which the French press shows their explicit bias:

> MARIE: I might've finally *stopped* feeling, actually. I can't decide if I'm shattered or slowly evaporating. I can hardly fathom that when they say "homewrecking harlot", they mean me.
> HERTHA: Goddamn the press for doing this to you. They wouldn't do this to a man, you know. They aren't! I hear all manner of vileness about you, but Paul is called only an "unfaithful" husband," and even that is said with a bit of congratulations.
> MARIE: Even I look at what they write and think, "what a terrible woman that Madam Curie must be."
>
> (Gunderson "Half" 6, emphasis in original)

Marie is still too caught up in the hurt and the shock of the violent reaction of the press to her affair but Hertha is ready to fight. She is appalled by the hypocrisy of the treatment of both parties involved in the affair. Marie comments with a grim sense of humour that, compared to the witch hunt of the press, shovelling "Uranium was nicer" (Gunderson "Half" 13). Marie, a widowed woman with no affiliation, is treated as the supposedly "homewrecking harlot", even though she is technically speaking not the one to betray her husband, as he has already died. Nevertheless, she is referred to as "Madam Curie" by the press as if she was still married, an emphasis on her marital status before the law, even as a widow. Paul, on the other hand, is almost congratulated for having two women to choose from, one his wife, one his affair. Hertha is only right in condemning this social injustice: The societal expectations placed on women are a lot higher than the ones placed on men, especially in terms of virtue and fidelity, as this particular example shows. Men in the profession of Marie and Hertha are not nearly as much under close inspection when it comes to their private lives as the women are, as Hertha remarks: "They don't mind what Einstein does with his evenings, Einstein gets to keep his lab!" (Gunderson "Half" 13). The insults hurled at Marie are not only confined to her gender. Marie lists to Hertha all the names that she has been called so far, "a foreign mistress, a conniving tramp […] [a]n immigrant whore, a dirty Jew, a disgrace to her country […] a disgrace to her husband's memory". (Gunderson "Half" 9). A latent bias against Marie's Jewish heritage is reinstated upon her supposed misbehaviour in face of French moral

values. Not only is she a woman choosing to freely live her sexuality, she is also an immigrant and a Jew. As much as the French country claimed her when she won her first Nobel Prize and thereby claim her success and fame for nationalistic reasons (cf. Gunderson "Half" 11), they are now ready to distance themselves from her upon her simply because she did not adhere to a volatile moral code. Hertha, with her suffragist background, very succinctly summarises what Marie is being harassed for: "I think it's what every woman is punished for: being alive and enjoying it" (Gunderson "Half" 10).

Marie's scandal almost comically comes to a peak when Marie announces that she has won her second Nobel Prize to Hertha and, in the following sentence, refuses to go to the ceremony. Upon Hertha's violent reaction, Marie explains: "I don't want to be where I'm not wanted" (Gunderson "Half" 19). Marie refers to the hostile reaction to her private life, of course, and this shows her fear of being rejected at such an important point in her career. This statement bears another innuendo when taking out of its situational context and applied to the general situation of women in science. If Marie had heeded this advice at a very young age, if she had not gone where she had not been wanted, then she would probably have never ventured into science anyway. As the earlier historical overview of women in science has shown, women were for many centuries nigh unrepresented in the canon of science and were above all not accepted nor wanted by the majority of the science community. There is defeat in Marie's statement, an acknowledgement of a truth much larger than her current private and professional situation: the rejection she as a woman has faced in her chosen profession goes much beyond her supposedly immoral behaviour. After facing several dismissals just because of her gender, Marie must feel like this is the final straw. But it is, once again, Hertha who serves Marie an answer to her issue with pragmatism and a note of her suffragist background: "Who cares if you're wanted. Here you are" (Gunderson "Half" 19).

As simple as Hertha's solution sounds, her answer can also be transposed onto the larger context of women in science. An influential majority may reject the participation of women in science and even them living their private life according to their own moral codex, such as Marie has. But that does not mean that women need to adhere to this. Hertha advises her friend to try and stop caring what the public may want from her and she also advises women in general to disregard the arbitrary boundaries that have been put upon them and that keep them from choosing their own paths. Hertha's message is an enduring one that has relevance in any particular historical context: Whether women are wanted in science or not, they still belong.

4.7.3 THE ODES OF MARIE AND HERTHA

In terms of narration, the drama is full of the usual devices used by narrative media, this time applied in a dramatic setting. From the very beginning, the text employs framing devices in the form of two opening soliloquies by both Hertha and Marie respectively. Framing devices such as these were originally meant to capture the attention of the audience (Richardson "Drama" 146). In this particular case, however, the soliloquies are more than mere prologues to the action, they establish the two main characters and their respective professions as women in science.

The play immediately starts with Marie's soliloquy, her "ode to the radium in her pocket" (Gunderson "Half" 3). She is alone on stage, which differentiates the soliloquy from a monologue, in her hand a vial of radium that she, according to her own words, always carries in her own pocket because it "reminds [her] of Pierre" (Gunderson "Half" 3). Radium might be the titular element of this soliloquy, but it stands in as a metaphor for all that Marie has gained and lost in the time that occurred before this play starts. Radium is the key of her work, the element she and Pierre spent such a long time refining and then discovering. It therefore stands not only for her own work as a scientist but for the cooperation that she and her husband had had for many years before his untimely death. Keeping a vial of radium in her pocket serves as a physical token of Marie's affection for her deceased husband. The element is connoted positively as well as negatively. It might serve as a reminder of Pierre but thereby also reminds Marie of his death. It catapulted her career and meant her breakthrough as a scientist but also signifies the then unknown dangerous potential of radioactive material.

Her fascination with the ambiguous element that she herself discovered is evident in her speech. She likens it to "a cold heat, a dark light, a force of nature" that seems like a "gaze […] [that] can't take its eyes off you […] [l]ike the love of your life" (all Gunderson "Half" 3). Her description of this dangerous radioactive substance makes it sound much more mesmerising than it would usually be for any person outside of physics or chemistry. There is something about the element that fixes the gaze of its beholder, such as Marie's, and according to her, it even gazes back. This personification of Radium serves the above-mentioned metaphor well. If Radium reminds Marie of her deceased husband, then it is only natural that she would keep a vial of it with herself to keep the memory of Pierre close. If Radium supposedly gazes at her with the intensity of the love of one's life, we as the reader might wonder about its significance to Marie. It does not

only symbolise her success as a scientist, it also stands in as a connection to Pierre, with whom she spent years and years researching and working hard to extract the precious element. In the context of her work as a scientist, Marie's personification of Radium might hint to the element's dangerous qualities and its consequences: If the radioactive element actively gazes back at her, then the gaze substitutes the rays of radioactivity that will take hold of Marie's body and of those bodies of many others who would continue to work with the element in an unprotected fashion.

What is also covered in Marie's opening soliloquy is the titular quality of Radium, namely the transformation an element goes through by reaching its half-life: "The moment an element transforms so fully that it is more other than self. That's what we call it. Half…life." (Gunderson "Half" 3). In chemistry, "(radioactive) half-life is defined, for a simple radioactive decay process, as the time required for the activity to decrease to half its value by that process" (Rittner and Bailey 122-123). In a lay person's terms, the half-life of a chemical substance is the time it takes for the material to decay to half of its value, meaning that after that amount of time has passed, only half of it remains. This eponymous half-life does not only adhere to the radioactive element but also to Marie as one of the main characters of this drama. Marie has, by the time the action starts, come to a decisive moment in her life. As this drama plays out when her affair with Paul Langevin is discovered in 1911, the fictional Marie Curie is in a deep crisis. She has lost her husband and main support, Pierre, almost five years ago and has struggled first as a woman in science regaining her footing in academia and now additionally as a Polish Jew in France who is defamed by a smear campaign. She has won the first of the two Nobel Prizes that she will win in her lifetime and has come very far in her career. Yet this career seems almost over, at least in Marie's mind, as the course of the drama will tell. She is deadly afraid that because of her affair and the pressure from the press, "they'll take [her] funding, they'll take [her] students, the Radium Institute will vanish" (Gunderson "Half" 11).

Marie muses in her opening soliloquy about the transformation that the element will go through, as "Radium decays to Radon which decays to Polonium which decays to Lead, all of these metals shedding themselves to the point of abandonment. I empathize" (Gunderson "Half" 3). It is this last sentence that gives the metaphor of the half-life its meaning: Marie sees herself in this rapid decay of the element she has discovered. She finds herself at a crossroad in her life, both personally and professionally, in which she has to ask herself what is left of herself after all these years. She has shed her Polish roots,

her religious upbringing, has lost her husband and therefore a key figure in her life, has now lost her right to a private life, so it seems, and she is on her own in all of it. If she continues on her path, and at the beginning of the drama she is still unsure whether she will find the strength to do so, she will need to craft a new identity for herself and decide which path she will continue upon. If so much of what gave her meaning in life has come to an end or needs re-evaluation, then she is at her own half-time, just as the element in her pocket. More than half of her life may have passed but it is at this moment that the fictional Marie Curie will have to ask herself whether she wants to give in to this abandonment and shed her old self in order to welcome the new, other one. As Marie herself says only a few lines later, she "can't decide whether [she is] shattered or slowly evaporating" implying her impending character change (Gunderson "Half" 6). Her journey through this drama, as this soliloquy suggests, is one of self-discovery, of taking inventory of one's own life and deciding whether the shedding has reformed oneself in the right ways.

Hertha's soliloquy, an "ode to the electric arc" (Gunderson "Half" 4) plays out very differently from Marie's. Whereas Marie's opening soliloquy is gloomy and longing, Hertha spends her introduction to the play as an assertive and smart woman. Her speech centres around her greatest invention, namely how she fixed the hissing of the typical arc lamps. When electric lamps were invented in the late 19th century, they were designed as arc lamps, meaning that "the electricity arced across a small divide between two carbon rods", as Hertha explains to the audience (Gunderson "Half" 4). The glow of the lamp comes from this bridging, which is the entire purpose of the lamps, but it also means that the lamps are making "this hissing, scratching, popping noise" (Gunderson "Half" 4). It was the historical Hertha Ayrton who fixed this problem and established herself as an expert on the field of electric arcs (Mason 16).

The fictional Hertha now stands on stage as a proud scientist who has solved an everyday problem for the people. Marie's work on chemistry is hard to grasp for any layperson and is not explained in any more detail nor does it need to because of her fame. But Hertha specifically uses her opening soliloquy to highlight her achievement to those who listen, explaining how she facilitated the life of many people. The audience needs no introduction to Marie's work but Hertha has to explain who she is and why she is allowed to stand on stage, so it seems. In contrast to Marie's introduction to the play, Hertha gives no direct insight into her feelings and thoughts other than her immense pride at having fixed this problem. She recognises that "[t]here was a technical problem in the world and

[she] fixed it and you're welcome" (Gunderson "Half" 4). Her confidence is evident in her entire speech and her ode guides the reader from the original problem to the solution, provided by her, similar to how a teacher would plan a lesson and guide their students through problem, experiment and ultimately solution. Hertha's tone is both playful and almost cocky. She curses, uses direct audience addresses by asking rhetorical questions and even injects a certain sense of humour in her tale. When the horrible noises made by lamps can be heard by the audience, she counters: "Isn't that the most dreadful thing you have ever heard! Good god. I'd rather go back to candles and shouting '*where are you?!*' after dinner." (Gunderson "Half" 4). For audience and readers, her short introduction is fun, entertaining and especially convincing of her work as a capable scientist who sees problems and then promptly fixes them.

These two soliloquies serve not only as introductions to the drama itself. They also add a vital part to the characterisation of both Marie and Hertha. The reader will have no trouble knowing who Marie Curie is but Hertha Ayrton is not a name that is known to the general public. By giving both of them an opening speech, the drama levels them in a way that history has not yet done. Both Marie Curie and Hertha Ayrton are opening the action, both get to talk about their work, with the addition of Marie giving more of a personal insight while Hertha establishes herself as a headstrong and confident woman. Even though Marie's prologue is titled an "ode to the radium in her pocket", it is truly a swan song for her deceased husband Pierre and the impact of their work together. Science is only a small part of her soliloquy; her feelings regarding her work and her deceased husband are more in focus, establishing Marie as a sensitive and more introverted character with a lot of introspection.

Hertha, on the other hand, shows nigh to no direct feelings. Her character shines through in the way she presents herself and her work. Hertha is funny, assertive, sure of herself and shows no hesitancy in praising her own work. Her opening soliloquy "ode to the electric arc" is exactly what the title promises: It is Hertha explaining her great invention, from the start of electric lamps to the issue that she saw needed fixing. In a sense, these two soliloquies foreshadow the drama in its core. Two women, one a thinker, one a doer, meet through science and where Marie brings the problem, namely her self-doubt and smear campaign, Hertha is the one to ultimately help her fix it by holding up a mirror to her friend and reminding her of the great she has done and will also continue to do. Or, as the fictional Hertha herself later explains: "I'm an engineer, darling, we fix things any way we can." (Gunderson "Half" 7).

These contrasting opening soliloquies also serve as excellent examples for the different kinds of characterization that prologues and specifically narration by characters can provide. The two soliloquies in particular function similarly to a stream of consciousness in epic narration, comparable to homodiegetic narration or internal focalization in classical epic literature (Nünning and Sommer 117-118). Marie is giving the audience her direct thoughts and feelings, stating them explicitly and therefore provides readers and audiences alike with an explicit characterization of her at the beginning of the drama: She is heartbroken, unsure, at loss in her own life with little to no direction.

Hertha, on the other hand, offers no such personal insights. All that Hertha does is introduce her work and stand proudly before the audience, ready to collect the recognition she is due. In contrast to Marie, finding out where Hertha as a character stands at the beginning of the drama requires a reading between the lines. It is implicit in Hertha's demeanour, her choice of words, her actions, that she is a focussed, proud and headstrong woman without her ever stating this as directly as Marie does. The opening soliloquies are therefore prime examples of the implicit and explicit characterization that is often used to introduce characters in opening soliloquy (Nünning and Sommer 117-118). This contrast works extremely well because the public already has a certain image of Marie Curie from the archives of history: The strong scientist, the one defying the odds, the pioneer in science. Yet this fictional version of Marie adds the vulnerable side to the public imagination of her, the one who cries and mourns her husband and is devastatingly unsure of her own career. Hertha, by contrast, is significantly less known to the general public than Marie. Her opening needs therefore to establish her as a capable scientist in order to avoid the effect named after the aforementioned two-time Nobel Prize winner. Hertha has to take up space and establish her as worthy of being side by side on stage with Marie in order to later occupy the important role of a mentor and supporter.

Whereas Hertha remains in her role as a character outside of her opening ode, Marie will continue to serve as a narrator figure throughout several other odes that she delivers in the course of the drama. Judging by Richardson's types of dramatic narrator figures, Marie can be classified as an internal narrator, a character who tells other characters or, in this case, the reader what has happened off-stage (Richardson "Point" 209-211). In several of these additional odes, Marie offers a teichoscopy of what is happening in between scenes (cf. Pewny 152). When Marie and her daughters take the boat from Calais to Dover to stay at Hertha's cottage, Marie informs the reader that "[she

is] on a boat from Calais to Dover" and that "[she has] told them [her] name is Sklodowska", indicating how she has used her maiden name to secure safe passage. When "the boat is docking", as Marie narrates, the scene smoothly transitions from this report given by Marie to the actual scene of Hertha and Marie talking, in which Marie seamlessly reverts back to her role as a character only. This additional function clearly denotes Marie as the main character with more narrative privilege compared to Hertha.

4.7.4 HEALING IN THE STAGE DIRECTIONS

The main narrative function, however, is not carried out by either of the two characters but rather by the stage directions of the play. The character of Marie may add to the narration as a part-time mediator but it is the stage directions that give the drama its true narrative quality. There are, of course, directions that are solely descriptive and only give basic information on staging or on the action on stage, yet many of them carry an additional meaning and add to the experience of the drama. The expressiveness of the stage directions might largely be credited to the original format of this drama as an audio play, since it was written for an auditory experience only. My hope remains that these extremely narrative annotations will survive in an eventual publication of the play, as they are a prime example of narrativity in drama.

The largest part of the stage directions serve as means of focalization into the characters' inner feelings. As was the case with the opening odes, the focalization of the stage directions is largely attuned to Marie and her emotions. They provide the kind of insight that homodiegetic narration or internal focalization would usually give in epic narration (Nünning and Sommer 117-118). These insights into her troubled feelings allow for a closer understanding of the struggle she is going through especially in the very beginning of the drama. Upon Hertha's visit to Paris and her promise to defend Marie against the press, the directions announce that "*Marie doesn't know what do to with this kindness*" (Gunderson "Half" 6, emphasis in original). When Marie enumerates the different insults that have been thrown at her, it is said that "a disgrace to her *husband's memory* […] *was the biggest insult she weathered of course. Marie cracks again, trying to hold it together, not succeeding*" (Gunderson "Half" 9, emphasis in original). Both statements go far beyond any description of a stage setting. They offer the kind of understandings one would expect from a mediated kind of literature, not a supposedly

unmediated one. Similar to her ode, Marie's feelings are the focal point here: What cannot be transposed through her direct speech is added as an addendum in the stage directions to give larger context to her troubled inner psyche. It becomes clear that she has experienced too much hate in the past few weeks to accept her friend's loyalty to her and that the idea of disgracing her beloved deceased husband might be the final straw for her countenance and the worst insult possible. All this might have been inferred from the direct speech of her, yet the added narrated introspection through the stage directions provide the bigger picture of her situation.

The same can be applied to Hertha. A fight breaks out between the two during their stay in their cottage in which they argue about the danger of Marie carrying around a vial of Radium at all times. This quickly spirals into a vicious spat between friends. Marie delivers a low blow when she accuses Hertha: "You never wanted to save me, you just wanted to *matter*." (Gunderson "Half" 50, emphasis in original) and thereby blames Hertha for only latching on to Marie for fame. Understandably, in face of this cruelty, Hertha "*is gobsmacked* […] *furious and heartbroken and stews, slams something, breaks something*" (Gunderson "Half" 50, emphasis in original). Mirroring the earlier stage directions, these ones outline the silent rage of Hertha who is rightly infuriated at this unfair treatment after all that she has done for Marie. The directions merge from a narrative transcription of her feelings to a description of her actions in her rage, blurring the line between standard stage directions and narrative mediation. The directions shape what happens in diegesis and therefore provide a narrative quality to the dramatic text (Muny 69).

Similarly, Hertha's forgiveness for Marie is also mediated in later stage directions, when Marie has returned and acknowledges Hertha's support: "I think you saved my life" (Gunderson "Half" 62). It is then that "*Hertha fully hears this[, t]akes it in*" and, as the directions describe, "*[t]hat meant so much*" to her (all Gunderson "Half" 62, emphasis in original). From Hertha's almost flippant next line in which she acknowledges how she is of course the one to save Marie as no one else could do it the way she did (Gunderson "Half" 62), one might think that she just took the apology in stride and that she was never really hurt. But the stage directions give her own feelings away, insinuating that Hertha was hurt badly by Marie's dismissal and is all the happier to hear that Marie can accept her friendship and help. The stage directions offer the additional layer that go beyond the spoken word and reveal Hertha's own self-doubts and insecurities.

Another significant part of the stage directions deliver prolepsis into the future of the characters outside of the drama. The directions offer a glance into the future when mentioning Marie's younger daughter, Eve[22], who continues to play piano in the background. As the play progresses, "*Little Eve's playing gets better and better until is quite masterful as anyone's would with the passage of time*" (Gunderson "Half 65, emphasis in original). As the directions state themselves, in this case by the end of the drama, the fictional Eve is mirrored after her historical counterpart, the successful concert pianist Eve Curie. They foreshadow a future outside of the dramatic action.

Part of this prolepsis may also include a deliberate withholding of information or rhetoric questions to taunt the reader or audience. Such is the case when Marie goes into the water by the beach near Hertha's house, fully clothed:

> *Underwater she thinks this, whispered rapidly, rhythmically, tideally. If we can… We hear the roar and the shush of going above and below the surface of the water, she's drowning… or she's free. […] Will she stay under? Is this the end?* ***Massive breath as she surfaces****. Ocean lapping and pouring around her. Seagulls. Life*.
>
> (Gunderson "Half" 42, emphasis in original)

We as readers are simultaneously receiving knowledge of what Marie might try to accomplish with her little stunt, namely an attempt at suicide. Her dress is too heavy and, soaked with water, it could potentially drag her down to the bottom with no hope for help. It is left open, deliberately, I would wager, whether almost drowning was her initial intent, an afterthought or a mere coincidence and it is even implied that a death could set her free. The directions are synaesthetically describing and focalizing while also posing questions that may run through the reader's head. Perceptions such as the sounds of the ocean and its fauna as well as the feeling of water all around are mingled with detailed descriptions of what is happening. One can almost imagine Marie resurfacing with a massive breath she needs after staying underwater for too long. These kinds of stage descriptions are not only similar to a stream of consciousness; they also tease the reader with the prospective of an alternate ending in which the famous scientist's life came to a tragic end in the aftermath of a moral scandal. The rhetorical question of whether she

[22] The historical Ève Curie is spelled with an accent over the e, the fictional one without.

lives or becomes free through death practically taunts the reader with what could have been despite the common knowledge that the fictional Marie Curie died at the age of 66, which is much later. But this is fiction and the drama may take this liberty to imagine an alternate ending and provide a narrative stream of consciousness into this other reality. These directions almost seem like an "authorial secondary text", information that transcend the knowledge of the characters and purposefully allude to the knowledge of the audience (Pfister 72). This begs the question whether the fictional Marie will be able to take care of her mental health. It is in another proleptic stage direction later in the drama that this thread is picked up again and finally closed: When Hertha and Marie have reconciled after their fight, Marie is alone for a short moment and "***locks the radium away again***" (Gunderson "Half" 63, emphasis in original), on the one hand because the radium was the cause of the fight with Hertha. On the other hand, it appears that she is no longer in need of the reminder of Pierre, her husband, as she had originally stated in her introductory ode. The radium was her connection to Pierre through her work. Judging by the stage directions, she "*[d]oesn't need it anymore. Stretches and rubs her aching hands. But she's going to be okay. She knows that now. It's true now*." (Gunderson "Half" 63, emphasis in original). The suspense that was created earlier with the questioning of her mental health can now be resolved. The directions give an outlook that is historically already known: Marie Curie will not commit suicide, neither the historical nor the fictional one. They will be fine. They can continue their life despite the death of their husbands and despite the slander of the press.

As small as the insight into the life of Marie Curie might have been, *The Half-Life of Marie Curie* nevertheless manages to capture the difficult conflict the historical figure found herself in by means of framing soliloquies and stage directions. The final drama in the analysis, *Uniform Convergence*, draws a parallel between the life of a contemporary female mathematics professor and the life of the Russian mathematician Sofya Kovalevskaya, as both experienced sexism and racism in their scientific careers.

4.8 "IT'S NOT ABOUT SEX, IT'S NOT ABOUT RACE": CORRINE YAP'S *UNIFORM CONVERGENCE* (2019)

The next section follows a dramatic text inspired by the life of the Russian mathematician Sofya Kovalevskaya, the first woman to ever hold a chair of mathematics at a European university in the 19th century (Tamboukou 341). Finding contemporary sources on Kovalevskaya has been quite difficult as there are few works published on her achievements in the English-speaking world. The scarcity of sources on Kovalevskaya's life that were published in English already hint at the omission of hers from the international historical archive outside of the countries where she worked[23]. A notable exception is the article "Traces in the Archive: Re-imagining Sofia Kovalevskaya" by Maria Tamboukou from 2022, which I will use as my primary source of biographical information in this chapter. Kovalevskaya was born in Russia and had an impressive international career, working as a professor of mathematics in Sweden and also living in Germany and France. Nevertheless, her work appears relatively unknown in the English-speaking community.

Uniform Convergence draws a parallel between Kovalevskaya's situation almost 150 years ago and the situation of women in science today. The dramatic text takes place in two different times for women in science, one of them being the time of Sofya Kovalevskaya's life. The other timeline follows an unnamed female professor at an American university teaching an introduction to analysis for students. The timelines are linked in the very beginning, when the professor names Kovalevskaya as one of the "people who were very important to the subject [they]'ll be studying" and who will therefore be mentioned in the textbook students will use in her class (Yap 2). The course of the drama follows the professor and Sofya respectively throughout several instances in their lives. Sofya's timeline almost exclusively happens in the stage directions, a fact which will be of importance in the upcoming analysis. In these stage directions or etudes as they are called in the dramaturgical notes, Sofya grows from an inquisitive child fascinated with mathematics to a young woman facing the limits her sex and therefore

[23] As I am unable to read or speak Russian, I can only account for the Anglophone publications, of which there are scandalously few. The many spelling variations of Kovalevskaya's name and the different translations of the Cyrillic alphabet to the Roman alphabet make a comprehensive search of sources on her life even harder. For consistency's sake, I am sticking to the anglicised version, namely Sofya Kovalevskaya. The works cited list will honour the publication's individual spelling.

marital status present her with on her quest to study at a university. She ultimately receives a chance to pursue a degree and, in her final scene where she steps out of the stage directions and onto the stage as a proper character, gives a lecture on mathematics. The professor's timeline accompanies an unnamed female mathematician teaching a class of students on real analysis throughout an entire semester, told almost exclusively in monologues by said professor where she appears to be talking to her students while at the blackboard. In these monologues, the professor hints at the situation outside of her classroom on campus such as protests by students fuelled by racist incidents. She is introduced by the paratextual notes as an "Asian-American math professor in her late 20's" (Yap) and it becomes apparent throughout the text that she has also suffered from racial stereotyping as well as sexism throughout her career. Mathematical teaching mixes with her personal experiences as a Woman of Colour in academia, highlighting the intersectional discrimination she has faced, while she repeatedly draws parallels to the life of Sofya Kovalevskaya.

The drama is split into eleven scenes, six of which follow the unnamed female professor teaching her class with the other five consisting of scenes depicting Sofya's life in stage directions and in a final monologue. Each of these scenes is presented in a similar fashion, consisting entirely of a monologue of the professor at the front of her class, addressing an unseen and unheard group of students. At times, she appears to react to her imagined audience, answering questions or handing out papers that have not been collected for correction or even commenting on the dwindling size of her class as the semester progresses (Yap 3, 8). Her apparent acknowledgement of other people in the diegesis, even if these people are the unheard and unseen students, marks every one of her scenes as extended monologues. This provides a fascinating structure of the play and allows for a thorough character study through these monologues.

4.8.1 Biographical Background

Sofya Kovalevskaya was born in 1851 to Russian aristocratic parents as the middle child of three (Tamboukou 343). Her career in mathematics was hampered by the limitations for her sex at that time: young women did have more freedom of choice in Russia than they did in Europe, yet these liberties did not extend to living alone, let alone abroad without male supervision, e.g. either a male relative or their husband. Additionally,

Russian universities did not officially allow women to study (Tamboukou 343). Sofya, however, was bent on pursuing a career in mathematics, including receiving her PhD under the supervision of then well-known mathematics professor Karl Weierstrass (Tamboukou 345). Her ticket to autonomy, as it was for many of her female Russian peers, was a marriage of convenience with a man, which would in turn allow her to move to a city – and a university – of her choice. Her husband, Vladimir Kovalevskii, was a Russian radical more than willing to support Sofya's ambition for education and the two married in 1867. After a short period in St Petersburg, the couple went their separate ways while keeping their marriage officially intact, with Sofya finally moving to Heidelberg in 1869, where she studied physics and mathematics, and Vladimir leaving for Vienna to study palaeontology (Tamboukou 344). Together with a friend, Sofya moved to Berlin to start her PhD with Prof Weierstrass, her life "totally devoted to the hard work of doctoral studies" (Tamboukou 345). Her eventual PhD was a cumulative thesis, covering the topics of differential equations, Abelian and elliptic integrals and the application of Laplace's work in astronomy (Jaeger 88). After finishing her PhD, Sofya returned to Russia but had immense difficulties finding a position in her field of choice as a woman. She found work instead as an author, publishing a semi-biographical novel on her own experiences (Tamboukou 346). Returning to Europe, she was hired as a teacher at a university in Stockholm with the help of her former PhD supervisor Weierstrass and his former PhD student Gösta Mittag-Leffler (Tamboukou 346). Mittag-Leffler would continue to support Sofya with funds and offered her positions at the universities he was teaching at. Sofya finally received a permanent position as a professor of mathematics in Stockholm in 1890, only one year before she would die of pneumonia (Tamboukou 347-9).

Sofya struggled with her role at university, as Maria Tamboukou gathers from her letters, diaries and autobiographical novel. Tamboukou reports that, when her three papers for her PhD were finished, Sofya was hesitant to present her work to the men of her faculty, fearing that she as "[o]ne of the greatest mathematical minds of her time had to excuse herself for daring submitting a PhD thesis […] and to do so *in absentia* because she felt nervous in the presence of men and not mastering the German language", which "casts [a shameful light] on the male academic culture which Sofia felt obliged to propriate" (345-6, emphasis in original). According to Jaeger, Sofya Kovalevskaya "was perceived more as a kind of freak than as a champion of women's rights" when she started her position in mathematics in Sweden, "with massive resistance" from the other

professors in her department at her recruitment (91). Thus, she is a peak example of women feeling inept and unwelcome in the male-dominated field of science. Yet Sofya Kovalevskaya achieved several milestones that her fellow female scientists could only dream of: She became a member of the Paris mathematical society in 1882 at a time when women were usually not accepted as members of these elite clubs of scientists. She received prizes from the French Academy of Sciences for her publication, which where even deemed good enough to warrant a higher prize money than usually allotted (both Tamboukou 349), not to mention her tenured position that she sadly only had for one year before her early death.

4.8.2 Intersections of Racism and Sexism

One of the prevailing topics of *Uniform Convergence* is the topic of racism in science. As stated in my introduction to this thesis, there are too few texts, be they literary or non-fictional, dealing with the intersection of gender and race in science. *Uniform Convergence*, however, has made it its main topic by portraying the struggles of two female scientists, one in the 19th century Europe and one in present-day North America, who both experience discrimination based on their sex and based on their nationalities or race. It is difficult comparing these two experiences as Sofya Kovalevskaya is portrayed as having to deal with rejection because she is Russian while the unnamed professor is discriminated against because of her race. The following analysis does not mean to conflate these two topics nor to weigh one against the other. Both characters are united by their experience of discrimination on the basis of their sex with the added dimension of nationality and race, respectively, and the analysis strives to do both of these situations justice without treating them as if they were one and the same experience. This kind of multifaceted discrimination has been covered by the term intersectionality, coined by law professor Kimberlé Crenshaw in her ground-breaking article in 1991[24]. Crenshaw highlighted in her article that the experiences Women of Colour make are not just denoted by their race or sex alone but that the intersection of these discrimination needs to be considered. She argued for a "need to account for multiple grounds of identity when

[24] I am aware of the discussion around the current use of the term by Crenshaw, who has voiced her dissatisfaction with the way her concepts have been diluted by mainstream media. For more information, see her interview with Katy Steinmetz in *Time Magazine* from February 2020.

considering how the social world is constructed" (Crenshaw 1245). The professor's identity encompasses more than just being a woman or being Asian-American; it sits at the intersection of these two sides, uniting both the individual identities as well as their connectedness.

One of the first incidents in which the professor is faced with micro-aggressions in the form of everyday racism is in her opening lecture with her students. As the session draws to a close, she invites any remaining questions on her own person, specifically referencing her career or "any personal questions […] just not too personal" (Yap 2). A student appears to raise their hand and the professor turns to them:

> PROFESSOR
> Ah, I see one hand in the back. Yes?... I'm sorry, I didn't quite catch that.
> (beat)
> I'm originally from Saint Louis in Missouri, although I grew up in a few different rural towns in Missouri...Where am I really from? Well, I think being born and raised in Missouri makes me really from Missouri, don't you?
> (awkward silence)
> No more questions? Good. Now, on to Real Analysis.
>
> (Yap 2-3)

Right after she has asked for the questions to not be too personal, a student apparently asks about her background and where she comes from. This first questions can almost appear innocent, simply an inquiry from a curious student of whether their lecturer is a local. Yet the student does not seem satisfied by the professor's answer and asks once more, namely to inquire where she was really from, insinuating that the answer they just received – Missouri – can hardly be correct. As stated earlier, the professor is described as an Asian-American woman and while we do not learn her name, she might even have a first or last name that suggests a migratory background. Both information, her name and her appearance, hardly justify questioning her answer. Nevertheless, the repeated question of the student entails clearly that someone who looks like the professor or is supposedly named like the professor is unlikely to "really" (Yap 2) be American. The implication is clear: The professor does not present as White; therefore, she cannot possibly be an American woman. The professor reacts with fervour to this: Not only does

this line of questioning undermine her authority as a lecturer, who will know best where she is from; it also perpetuates the common stereotype that people who do not look like the majority of a country's population must immediately be foreigners. There is nothing wrong with being foreign in a country but incidents like these do question the legitimacy of non-White people in Western or predominantly White countries: They look different and are therefore not part of the community of people born and raised in the country. The question of the students might stem from true curiosity, yet it shows a harmful prejudice against racial diversity. It is difficult enough as it is to work as a female math professor in a male-dominated field. Having one's own identity questioned repeatedly does not help. What this question also does is traverse the thin borders between the private and the public life of the female professor. As discussed earlier, women in science are usually associated with the private sphere. The professor here appears in a public function as a figure of authority who has specifically asked not to be questioned about any issues that are too personal. Her background or rather where she was born and raised has nothing to do with her capability as a lecturer, yet the questioning of her legitimacy as a professor at an American university denies her all the authority that usually comes with holding such a public position of teaching.

It all comes down to the normativity of Whiteness that she has experienced in her everyday life, such as when her friend tells her a story and has to specify that one person in this story was an Asian man "because if she had said, 'I saw this man' I would have imagined a white-skinned man – the 'default' human who can exist without labels, without qualifiers" (Yap 12). A description, she claims, is necessary for accurate representation, yet White is seen as the norm when telling a story with all other races, Asian in this case, needing a signifier because they are not the default. It is the end of the semester when the professor vents about this story to her students in one of her monologues, long after this question in her first session. During this last session she picks up the thread again, detailing her own fragmented identity. When she tells people that she is American, it "is met with surprise and confusion", she does not feel spoken to when she talks about Asian women herself:

> When I write about characters who are Asian, when I write people who are supposed to be me and I describe them as 'an Asian woman', I don't imagine me, I imagine 'an Asian woman', long straight black hair, slanted brown

> eyes, angular face, striking features, Chiaki Kuriyama, the perfect Asian women who doesn't look like me.
>
> (Yap 12)

What the professor describes is the experience of many Black and Indigenous People of Colour in majorly White countries. One is at home in the country of birth, in this case the United States, yet is made to feel like a foreigner every day because only a certain skin colour or certain face shape is accepted. Yet when describing a foreigner, most people do not immediately think of themselves, even though they are perceived by others as such. The professor must have felt foreign everywhere she goes: She is not accepted in her own home country, but if she went to an Asian country, her American accent and upbringing would single her out there as well. It is a lose-lose situation for all Black and Indigenous People of Colour in which they can never find a true way to be themselves.

A similar situation of everyday racism, this time however more overt, happens in another scene. After a short introduction, the professor proceeds to explain the concept of uniform convergence, a topic that she has repeatedly discussed in her lectures and that also features as the title of the play. The metaphorical importance of this concept will be covered at a later point in this analysis. In the midst of her mathematical explanations, she flips the blackboard in order to use the second side for more notes, only to discover that someone has written "CHINK" (Yap 8) on this other side. Shocked, she flips the board back around and faces her students, incensed and demanding to know who has done this. "Chink" is a derogatory racial slur commonly used for people from Asia or the Pacific Islands, referring to the slanted eye shape that is fairly common among people from these specific regions. The professor appears to be startled for a moment, yet quickly regains her footing and faces the classroom with determination in the face of such obvious disrespect: Whether it be directed at her or at another person in the class, she wants to "make it abundantly clear the [she does] not tolerate discrimination and prejudice in [her] classroom" (Yap 9). Bullies will not be tolerated in her class and she asks anyone who disagrees to leave immediately. Given the boundary-crossing nature of such an incident, the professor proves very capable of defending herself and even to offer solidarity with other people in her surrounding who suffer from the same discrimination. In an earlier scene, she had even offered Students of Colour that they were always welcome to come and see her in her office for private conversations. Maybe through all of her own

experiences with racism and discrimination throughout her younger years, she is now aiming to provide the support she would have needed herself to younger students.

However, the professor's strength is only one side of the coin. What is also revealed in these longer monologues of hers is that the professor has had to endure these kinds of racist comments throughout her entire life and how they have gnawed on her. She likens her situation to mathematical concepts very often, claiming that her "trajectories are always interrupted, never as simple as they initially seem" (Yap 6), similar to functions never being uniformly convergent. In a harrowing scene, she describes her life's trajectory and how it has been intercepted and diverted by the racism she is facing:

> When I was 16, I wanted to be an actress. The next year, I was cast in the school musical as a Chinese man named Chang. […] I fell in love with a blonde boy with green-blue eyes whose laugh made me drunk on California sunshine; we stood side by side and the mirror told me that his skin was darker, but according to everyone else, I was the colored one.
>
> (Yap 6)

These tales from her past are told with an almost melancholy quality as she recounts the many ways in which her race was a deciding factor for her life when it had no business being one. Both her school life as well as her romantic relationships have been affected by racism. Her being cast as a Chinese man with the most stereotypical name is an indicator of a school system and teaching staff that is not sensitive enough to understand that her occupying the role of an Asian man is not diversity or representation but rather a racist casting. The stereotypical name of the character she portrayed, Chang, does not help in the matter. What is also affected by racism is her private life, more precisely her personal and romantic relationships. The boy she describes sounds like the typical American sweetheart: A blonde, green-blue eyed boy from the West coast of the United States. The allusion to the sunny state in the West conjures up images of a tanned youth with an easy smile who spends most of his days outside. The mirror that she and her love are facing in this anecdote is a simile for rational thought: By all accounts, his tanned White skin is factually darker than her pale complexion yet "everyone else" (Yap 6), meaning society, will always refer to her as the Coloured Person simply because she is not White.

She blames “the melanin”, “the extra molecules of melanin in [her] skin that manifest themselves into societal barriers” and “the straight black hair and the dark brown eyes that create these extremal points, these suprema and infima” (all Yap 6). Her phenotypes, her physical appearance ingrained in her chromosomes, which are entirely out of her control, dictate the borders of her life and signify what is possible for her to achieve. The professor helps herself to mathematical metaphors one more time by calling the limitations that her race has set upon her the supremum and infimum of her life. Infimum and supremum are terms from higher mathematics. The supremum denotes the lowest possible maximum in a function while the infimum designates the highest possible minimum (Hildebrandt 12-13). More simply put, they signify the absolute limits that her appearance has created for her. Her life consists of all that her phenotype allows her to be, with the limits set by arbitrary rules that society imposes on her because of these phenotypes. The unknown identity of the female professors adds to this impression. She has no name, no distinguishing features to the reader. Her fate is both anonymous yet universal as she could stand in for any Asian-American women who has experienced this kind of racial discrimination.

Outside of the limited space of the classroom, the entire campus seems to be occupied with discussions of race as well. As stated before, the professor has opened several of her lectures alluding to protests on other campus of the university, which have caused her to be late for class or which have prompted her, as stated before, to invite Students of Colour to confide in her, if need be (Yap 5). Based on her own personal experiences, it is no wonder that the professor tells her students that she is “distrustful” of change happening, as “[n]o matter how much progress we make, we never seem to reach the final destination, whatever it may be” (Yap 10). She uses another mathematical simile to describe the endless strife for equality and equity: Every function of a certain type converges towards a limit yet never actually reaches it. A graph may come infinitesimally close to this limit of the function, yet will never truly reach it (Yap 9). Where words fail her to accurately describe, she turns to what she knows best, namely mathematics, to convey her hesitance in expecting change. As many efforts as she sees in her everyday life, such as growing respect for the different gender identities or the student body organizing protests for the rights of Students of Colour, there are still many aspects of her private life that leave her hesitant: Her cousin using the word gay as a derogatory adjective, yellow-facing on a local theatre stage or some of her relatives feeling offended when being referred to as “White” (all Yap 10). She likens these efforts to uniformly

convergent sequences which "[approach] a limit, a limit function" but will never really reach this designated limit (Yap 9). If the function f is the society she lives in and this supposed limit is true equality and equity between people, then the strive for this seems endless: "[W]e see f getting closer and closer, we see it coming, we anticipate it. but as long as we're in the sequence f_k we only ever see it coming; we never actually reach it" (Yap 9). In real life, one assumes that things will eventually converge, as the word may suggest. But sometimes, life is more akin to mathematics, where "we spend an infinity knowing that it's there, getting closer, but never experiencing it" (Yap 10). This outlook is bleak yet on the basis of her experiences maybe more realistic. Not expecting too much will always guard her from being disappointed.

This rather negative attitude towards the possibility of change in reflected in an advice she doles out in one of her monologues in front of the class. She warns her students that, in contrast to graphs, "[p]eople are not nicely behaved. You will learn that as you grow up" (Yap 10). In an attempt to spare them the disappointment she has faced, she gives them a pre-emptive life lesson in how to deal with these kinds of stereotypes. After she has given examples on where she still sees no change at all in people (Yap 10) she doles out an almost cynical advice: "What you can do is overcompensate. Be even more nicely behaved to make up for those who aren't. When people hand you stereotypes, instead of correcting them, play to those stereotypes so as not to cause trouble" (Yap 10). The sad reality that she is describing here is that people may not change or abandon their stereotypical expectations of other people who do not look or behave like them. Even though these distinctions might be arbitrary, even though the stereotypes might be founded on lies, the professor is hesitant to question them, probably knowing from experience that this will not bring her any further in the quest for acceptance and equality. So, instead of bothering to educate others or to fight what is unstoppable, she has conceded to playing along and advises her students to do the same. It is a sad outlook and indicative of the experiences she has made so far that have apparently shattered her resistance and her hope for change. She leaves it up to her students to make choices for how they want to go through life: "One has to make a choice: when do we surge forward, trying to reach that golden function, and when do we sit back, content to know that it's merely epsilon away?" (Yap 10). There is always the option of continuing to fight for what is right and to meet racism or sexism head-on. Yet these final moments in one of the professor's monologues show that she will not and cannot fault anyone who is tired of

fighting and instead content to approach and converge towards an ideal state, knowing that it is almost there but can never be reached.

4.8.3 THE PROFESSOR AS A MONOLOGUING NARRATOR

After having read these first pages of analysis, one might wonder why a professor would divulge such private information to her students. She is, according to the stage directions, standing in front of her class, at her workplace, in the company of students who she will need to assess and who are not her friends or confidantes. Yet she is telling them about the shaping incidents of her youth such as her early career dreams – actress –, her disappointment in the social system in terms of racial equality; she even tells them about her first love, the boy with the green-blue eyes. On the pure level of content, this might seem like a transgression of a teacher who overshares. But if we turn to the narratological side outside of the diegesis, this is rather an ingenious way of providing background information on the character of the professor. It is a character insight enabled by means of extended monologues, a narrative means of focalizing a character in a medium where focalization is usually scarce. If we apply Richardson's typology of dramatic narrators, then the unnamed professor embodies a monodramatic narrator: she is only one of two characters and occupies most of the dramatic text with her speech, thereby providing this kind of intimate insight (Richardson "Point" 209-211).

As stated earlier, because women have been omitted from the archives of science and because many of their private correspondences have been destroyed because they were considered unimportant, we have little to no knowledge of these women's biographies. And even today, in a more hostile and competitive atmosphere of science, women are hesitant to share their worries about their careers or about the challenges they have faced out of fear to be ridiculed or not taken seriously. The professor's monologues present her thoughts and feelings on being an Asian-American woman in science, an insight that is rarely granted to the general public. It can be used as a safe space to investigate the current-day situation of women in science with the added bonus of shedding light on issues of race and its intersection with gender. In Nünning and Sommer's terms, these extended monologues surpass the boundaries of individual consciousness similar to internal focalization and open up a world that many of us are

privy to, namely those who are not Asian-American women working in science (117-118).

What aides setting the stage for these monologues is the character constellation or rather configuration on stage. There are only two acting roles available for the entire drama, one of those is that of the professor, the other Sofya. The students are neither heard nor see, they only exist as her imaginary counterpart. Any questions the students pose are never voiced directly, only indirectly repeated by the professor (cf. for example Yap 2-3) in order to make up for the missing acting partner. Presumably, this could involve the actual audience in a staging of the play: The actress playing the professor could hand out fake papers to members of the audience or address them directly while speaking. This could simultaneously break the fourth wall and thereby the illusion of the theatrical experience while also implementing the atmosphere of an actual classroom sitting together. It would wholly depend on the actual staging, which is sadly not part of this dissertation. As a single character on stage, the professor has no counterpart to work with, no fellow character to involve in the action or to confide in. This necessitates her speaking in monologues, as she is alone on stage with only her imagined audience of students to speak to. The stage directions are aiding in the transitions from a perceived dialogue with her students to a monologue that the professor holds on her experiences as a woman and as an Asian-American. Between the topical shifts from mathematics to personal, stage directions such as “a shift” or “beat” (Yap 4, 6) mark the sudden change. The stage directions also enable a return for the professor from her personal experiences back to mathematics, as at times a “pause. A realization; return” (Yap 4) paint the picture of the professor suddenly realizing that she is in the presence of an audience in the diegesis, in this case her class, which prompts her to abandon her monologues.

The content of these monologues is varied and shifts in the scenes themselves from mathematical topics to allegories of how the matter she has just discussed scholarly might stand in for the situation in her life. In her earlier discussed first meeting with the class, she assertively stands her ground against the racism she is immediately faced with. This first monologue is rather topical on the surface, detailing how the course is going to work and what students are supposed to expect from her class (Yap 2-3). She also introduces, almost casually as a side note, the work of Sofya Kovalevskaya, whose work on analysis will be central to the topics discussed in the class. Kovalevskaya is also featured in the textbook they will be using. Even though “this is not a math history class” as the professor notes, she deems it “important for [the students] to learn a bit about where

things began" (both Yap 2). This gives Kovalevskaya's work an amount of significance that she might have scarcely known during her lifetime and since her death, given how few female mathematicians are discussed in modern mathematics classes. According to the professor, there are several names on the schedule and the work of other mathematicians will be discussed, yet she singles out Kovalevskaya for her unique status as "one of the most important female mathematicians to date, […] the first female professor in Northern Europe, the first female Russian mathematician" whose "important contributions to analysis, as well as differential equations and mathematics in general" have greatly impacted modern-day mathematics (all Yap 2).

In her second monologue, the professor returns to her class for the next session, noting that some students have opted to leave the class because of a lack of discipline (Yap 3). The mathematical topic of her lecture for this day comes from a question from a student who was puzzled by the idea of one concept having two definitions. The professor argues that this is a common thing in mathematics, that the same thing can be defined in several ways. The key, according to her, is in "prov[ing] the definitions are equivalent" (Yap 4). One could argue that this can be read as another allegory on the debate of racism and its underlying implication of worthiness based on people's skin colour. Some people may have fairer skin, some darker, yet they both ought to be counted as equivalent human beings despite their differences. The professor continues with another mathematical issue, namely that of incomplete spaces which can easily be completed by rationales. It is at this point where the content of her monologue shifts, as discussed above, by aid of a stage direction. If mathematics worked for the real life, too, then "all the gaps, all the missing pieces" (Yap 4) in one's life might easily be filled with a simple mathematical function that produces all these things that are supposedly missing:

> [E]ven those parts can be constructed, created, made to appear where one wants them to. Those parts of one's self that come from culture, from upbringing, when someone asks why you don't have them, you can whip out a formula for bringing them into existence […] if only I could use that to build myself-
>
> (Yap 4)

The implication is clear: Anything that she presumably lacks in the eyes of society, maybe as an Asian-American, maybe as a woman in science, could simply be magically

conceived of, even though it might simply be due to her upbringing or her culture, something that is both completely out of her control. What society deems that she is missing could be filled in if the real world worked like mathematics. She returns to this point in a later monologue, where she uses the metaphor of tests in mathematics, which can either be passed or failed with no in-between. According to her, it would make labelling and fitting people into categories or "boxes" (Yap 12) so much easier. Plus, it would give her simple explanations for any kind of discrimination or harassment she faces:

> Everything would be so much easier to understand. "I was randomly chosen for security screening because I failed the race test." "I was harassed on the street because I passed the gender test." "I didn't get a job because I failed the physical appearance test." Whenever someone asks the question "Why?", there should always be an answer because we can fit everything into categories, into boxes, because that is what we do as human beings. We label things.
>
> (Yap 12)

As these two examples in the quote above show, for those who are affected by racism or sexism being the victim of such discrimination can be unexplainable. The tone turns cynical once again as the professor suggests that it would make understanding the world much easier if there were these supposedly simple explanations for being a victim. One's skin colour or gender can hardly account for being mistreated, yet tests have no in-between, only right or wrong according to society's standards: If you fail or pass a test, you are selected and will be treated accordingly. Fail the race test and you are deemed unsafe at the airport and need to be scanned, presumably as a threat for violence, drug abuse or terrorism. Pass the gender test and you are deemed and appropriate victim of sexual harassment because as a woman, you are expected to enjoy any attention bestowed upon you, whether wanted or not. What the professor leaves unsaid is the implication behind these tests, namely that they remain unquestioned and taken as the encompassing measure of correctness. These unquestioned tests that society places upon individuals serve as markers for sorting people into categories, regardless of whether the tests are right or wrong. Her cynical allegory highlights how fed up the professor is with the entire system and its underlying inequalities. The tests really do not serve to explain

discrimination; they facilitate it. They provide easy explanations and superficial excuses for people's behaviour when there are actually no explanations or excuses to give.

As bleak as these outlooks sound, the drama ends with a final monologue on a hopeful note. Presumably, the class has reached its final session and the professor leaves her students with final parting words. Despite her earlier resignation at facing everyday racism, she now seems much more optimistic about the continued fight for equality. After having conceded that her opinions might not mirror those of the students, she encourages her students to remain vigilant and never become too satisfied with the current state of society: "I hope you will continue to explore all that is beautiful and difficult and challenging about the subjects I have presented in this room […] It is not acceptable to become complacent with what you already know, because there is always more, more to learn, more to teach, more that may not exist yet." (Yap 15). Notice how she does not specify that she wants her students to continue learning about the mathematical subjects she has discussed. It is either purposefully vague and carries another meaning. The professor has discussed much more than mathematics; she has imparted her own life's learnings to her class as an Asian-American woman in science. But now, according to the stage directions, her lecture is finished: "She is not going to lecture them anymore." (Yap 15). This is narrative tools in drama at their best. The direction transcends any descriptions of staging or of the character's exterior and directly gives an outlook for what would happen in the diegesis after the end of the play. The professor's lecture is done; she has given the students whatever input she may have been able to give on so much more than on mathematics. Now it is time for them to find their own way and to learn their own coping mechanisms for all that life may throw at them. The stage direction projects into the future, gives a reason for her final words and also provides the explanation for her behaviour. It surpasses its original function of a mere description and has turned into an expressive means of providing narration where there usually cannot be found any narration. By adding a call back to one of the first stage directions of the play, namely by signalling that the same music is played at the end as it has at the beginning, the stage directions expertly link the beginning with the end as well as the two time strands featured in the play. The Russian instrumental piece of music has served as a signifier for Sofya's story and now bleeds into the story of the professor as well, highlighting the interconnectedness of both their experiences. The final goodbye of the professor aids in this connection. She informs her students that "[t]hat will be all for today" and then wishes them goodbye in Russian (Yap 15), Sofya's mother tongue, which

is even written in the Cyrillic alphabet in the dramatic text, fully supporting the immersion.

What these monologues have provided is a kaleidoscope of the experiences of the professor in her life, both as a woman as well as a Person of Colour. They serve as a character study and accompany the struggles of a contemporary Asian woman in science. In juxtaposition to this, the stage directions focus on a more historical perspective, namely on that of Sofya Kovalevskaya's life.

4.8.4 Etudes: Sofya's Life in Stage Directions

It is a recurring misconception that stage directions are only intended for the staging of a play. They do provide important background information on the setting and blocking but I would argue, as I have done in an earlier chapter, that they have moved far beyond this function. This becomes apparent in this play in particular. I have mentioned before that the play consists of two interwoven time strands, one of them being the aforementioned and discussed life of the professor in front of her analysis class, the other being the life of Russian mathematician Sofya Kovalevskaya. While the professor's tale happens entirely on stage, Sofya's experiences are relegated to the stage directions only, with the exception of one single appearance of her on stage where she gives her own monologue.

The paratextual reading notes already establish this hybrid quality of the stage directions right from the beginning. The scenes that exclusively feature Sofya's life are referred to as etudes, which is French for studies. She is, just as the professor in the other scenes, alone on stage each time for these etudes. Any other characters that are referred to in the stage directions are not physically on stage und are apparently to be imagined out of sight, with Sofya only turning towards them as she is alone on stage. The notes state that "[t]hey are written as stage directions, describing a setting and emotional quality, purposely left up to interpretation" (Yap "Reading Notes"). This description renders the stage directions a hybrid: Stage directions are supposed to only help in the staging of a play, according to popular opinion, yet the description of emotions is not one of the usual uses of them. As Elke Muny described, these directions provide more than description, they provide commentary and dimension (69). The author already gives away that these stage directions mean much more for the reader than simple descriptions. Sofya's life takes place in these stage directions, with its entirety of thoughts, important

events and introspection into what Sofya must have been feeling at that point. Contrary to this narrative quality of the etudes, the author claims that "[t]hey are intentionally with little to no dialogue and fall in the spectrum between mime and dance" (Yap "Reading Notes). The etudes combine the strength of traditional narrative mediums and classical drama, bringing together both the mimetic quality of unmediated theatre while also providing the narrative of a life of a forgotten woman in science. They "preimpose[…] an interpretative perspective on the dramatic presentation that follows" (Pfister 72), extending mere descriptions to a narrative of their own.

The readers first meet Sofya in the second scene, after the professor has introduced her class for the first time. In this etude, two points of her life are portrayed. In the first part of the etude, Sofya is reading a math textbook by candlelight and calls for her off-stage father each time she stumbles across something she does not understand. Her father is able to help her two times before having to concede by the third time. His reactions are not conveyed or described through his physical movements but rather stated plainly. When he cannot help his daughter anymore, it is said that "[t]his time, he doesn't know." (Yap 3). As he is not a physical presence on stage, these directions are rather puzzling. In a more mimetic fashion, the stage directions could have told the reader that he shrugged or scratched his head or did any other physical movement that implies overwhelm or helplessness, yet the interpretation of these movements is what is given as a direction: He does not know how to help his daughter. Simultaneously, this trifecta of Sofya asking for help serves as an example of how early as a young child she was already outgrowing the knowledge that the education provided by her parents. If her father, who has probably finished his school education, is unable to help her as a grown man, then Sofya's capabilities as a child are already very advanced. In the second part of the etude, Sofya is "sneaking out of the house to a train station", suitcase in hand, presumably ready to leave (Yap 3). When she tries to purchase a ticket, she is denied the ticket and instead is asked something, to which she replies: "What? Married?! Nyet!" (Yap 3). We as the readers are now witnessing the first obstacle placed in her way to becoming a mathematician or at least a scholar: As an unmarried woman in Russia in the 19th century, her opportunities were limited without male supervision. A single word denotes her rude awakening: "Realization." (Yap 3), upon which she returns home. Once again, her reaction is not mimetically described in the stage directions but rather plainly narrated. Like a spotlight, the realization hits her and it is implied that this is an obstacle that she cannot overcome without aid.

This aid comes in the form of Vladimir, her husband whom she married to obtain the permission to study at university, as history has shown. In the second etude, she and Vladimir, who, like her father, is not a physical presence on stage, are apparently married and have moved into a new home. In a moment of foreshadowing, Sofya "writes a letter to Weierstrass asking to be his student while having to deal with Vladimir" (Yap 4-5). The reader gleans two things from this short sentence: First, Weierstrass is introduced as an important figure in Sofya's life. Historically, he is the one to supervise her thesis and, in the drama, he functions as the extension of Sofya's father from the previous etude, namely the person Sofya turns to with all her mathematical inquiries. On the polar opposite sits Vladimir, with whom she has to deal with. As stated in the reading notes, it is purposely left vague what this might mean, but it stands in stark contrast to the first part of the sentence. Weierstrass is her object of intellectual professionalism, the person she is reaching out for in order to obtain her degree. Vladimir, in contrast to his historical role, is a nuisance that she has to deal with on the side, potentially a source of distraction from her pursuit for a scholarly career.

The following etude is the longest one of all and again portrays more than one incident in Sofya's life. The first part takes place at her desk at home, at which she is studying one of Weierstrass' papers at his request. She stumbles upon a mistake in his proof and sets out immediately to write to inform him. Yet the writing of this note is not as easy as it might sound: Sofya crafts a letter three times and sends them away to her supervisor. The development of the tone of her letters to Weierstrass mirrors her growing as a scholar and gaining confidence in her ability. In the first version, she is still hesitant to point out the mistake he has made, referring to it as "a minor error" that only requires an "annotated copy" (Yap 7) of the proof for her to send. Shortly after she has returned to studying at her desk, she crafts a second note. In this, she is still considering what she has found "trivial" (Yap 7) but has already "gone to the trouble of writing down a proof sketch" (Yap 7), thus going one step further and offering her own input on the matter in form of her own proof instead of just annotations to the paper of Weierstrass. This note is also sent away. Only a moment later, Sofya writes her third and most assertive letter, after having realised, as she writes, that "the small error is indeed not so trivial as it initially seemed" (Yap 7). She now encloses an entire proof sketch of herself in this letter for Weierstrass to consider. In her postscript, she is bold enough to remind him that she has, with this proof, now written her "third dissertation-length paper" which means that

"it is enough for [her] to graduate" (Yap 7). Finally, she asks him to help her find a job as a teacher at a university.

Throughout this first part of the etude, Sofya undergoes a strong character development mirrored in the tone of her letters. She develops from a hesitant, submissive student to a researcher and scholar of her own, even feeling capable enough to submit her own correction of her supervisor's work as a fully fleshed-out proof. Additionally, she reaches the milestone of having finished her third paper and can now move from the position of a student to that of a teacher. All three versions are folded into paper airplanes and are sent away by letting them fly. Because the third letter includes some 40 pages of proof, the airplane is harder to fold and "presumably […] doesn't fly very far" (Yap 7) when Sofya sends it off. The airplane is not just weighed down because of the paper weight. It is a stand in for Sofya's trouble finishing her degree as a woman in a male-dominated field which is usually closed to people of her sex. Despite her stating that she is done with her third paper and therefore ready to obtain a degree, her efforts are in vain if she is trying to compete in a world where woman are usually not taken seriously or are even invited to. Her career, the metaphorical paper airplane, cannot fly very far.

As the second part of this etude shows, her efforts will indeed be thwarted by circumstances outside of her control. Weierstrass does not answer her request for help in finding a position as "[n]othing comes" (Yap 8), so Sofya takes matters into her own hand. As the stage directions take over a narrative function again, it is said that "she resolves to try by herself" (Yap 8) by asking for positions into the void on stage. In a voiceover, several universities seem to answer her, all of them shouting the same answer at her in Hungarian, German, Swedish and English, implying that she applied for a position as a teacher in four different countries. The message of the answers is clear:

> Three times, she asks:
> Are there any openings? In the mathematics department?
> VOICEOVER of her own voice yelling at her:
> *Nem azért, mert egy nő vagy. Nem azért, mert egy orosz vagy.*
> *Es ist nicht, weil Sie eine Frau sind. Es ist nicht, weil Sie Russisch sind.*
> *Det är inte för att du är en kvinna. Det är inte för att du är ryska.*
> *It's not because you're a woman! It's not because you're a Russian!*

Her voice changes into VLADIMIR's voice:

It's not about sex, it's not about race, do you understand that?

(Loud train whistle as lights fade.)

(Yap 8, emphasis in original)

The ensuing replies from the different universities in different countries are variations of the same assurance: Neither her sex nor her nationality are to blame, a variation on the typical excuse of the fault lying with the company not with the employee when someone is let go, or in relationships when one partner breaks up and wants to reassure the other party that they are not the problem. The repetition of the same content in different languages renders the entire message hollow. One excuse might have reassured Sofya, but four universities, who stand for their respective nations, that deny her access not on the basis of either her sex or national background are more than suspicious. The explanations begin to sound more like self-defence and Sofya is at the receiving end of sexism and xenophobia. To undermine this, the final moments of the stage direction are spent with a voice-over by Vladimir, her husband, who apparently has tried to ingrain in her his socialist values and belief-systems, claiming that "[i]t's not about sex, it's not about race, do you understand that?" (Yap 8). It is easy for Vladimir to discourage any feelings of discrimination in Sofya when he, according to the common societal standards at that time, is free to move across countries, pursue his career and choose his own path without being hindered by his sex. As much as race might factor into the discrimination Sofya encounters, the prejudices against women in science are so deeply ingrained in the culture of the Global North that Vladimir's dismissal of sexism highlights his naivety and unaffectedness.

This distracting quality of Vladimir's becomes clearer in a following etude, which finds Sofya once again "tiredly writing letters asking for jobs and sending them out via airplane" (Yap 11). Her letters go out to Göttingen, Helsinki and Vienna, inquiring with different professors for jobs at their faculties. Presumably, the letters remain unanswered as the next line moves from her professional to her private life. After a proposition from Vladimir who probably asked her to join him in his return to Moscow, the stage directions next find her "in high society Moscow, dancing, chatting, forgetting all about mathematics" (Yap 11). The shift from a mere description of her actions in Moscow to the introspective tone of her "forgetting all about mathematics" indicates a shift in Sofya's priorities for a while. Discouraged and repeatedly rejected, she heeds her husband's ideas

and returns with him to her home country, supposedly supporting him in his work for the socialist party and they even have a child together. She abandons her calling because of the rejection she has faced and is easily swayed by Vladimir who appears to have been a distraction all along (cf. Yap 5 "while having to deal with Vladimir"). As understated as these descriptions start, they reveal a major shift in the life of Sofya. She is rejected by the established universities based on her sex while she also does not experience any support from her husband, resulting in her feelings out of touch with her calling. However, it does not let her go: A letter from Weierstrass, her former mentor, arrives at her place in Moscow in which he is "begging her to return" (Yap 11). Sofya appears hesitant at first, yet "[s]lowly but surely she is drawn towards her mathematics again until she forgot about both Vladimir and the child […] puts on her hat, pucks up her suitcase, and leaves" (Yap 11), returning to where she belonged from the very beginning.

Her thematic return to mathematics is also employed in a shift in the dramatic text: For the first and only time, Sofya steps out of the paratextual stage directions and enters the stage and the podium that the professor has used beforehand, now as a character in the actual diegesis. In this short monologue, she addresses the French Academy of Sciences, thanking them for "this beautiful award" (Yap 13), hinting at the *Prix Bordin* the historical Sofya Kovalevskaya received in 1888 with an extra 2000 francs of prize money because her paper that she was awarded for was thus outstanding (Tamboukou 349). The fictional Sofya is allowed to metaphorically celebrate one of her greatest achievements not on the side as a mute character in the stage directions but is given a spot as a character of her own on stage by the dramatic text itself. While Sofya is addressing an imaginary audience, her monologue also includes perspectives of herself on her own life. Her speech speaks of the indebtedness she feels to her fellow mathematician but also of the crippling self-doubt that she still holds. She thanks several people, among them her "first advisor and mentor and now colleague and friend, Herr Karl Weierstrass, without whom [she] would have been nothing but a Russian housewife" (Yap 13). It becomes clear that she attributes her success entirely to the mentoring of Weierstrass who saved her from a life that she would not have enjoyed, namely as a housewife. She paints herself as a damsel in need of help instead of as a capable scientist, which belies her own crooked self-understanding. If Sofya in this speech is to be believed, little to no credit would go out to herself for persevering and working hard or for simply being a gifted mathematician. She lists several other male mathematicians with whom she has worked throughout her career so far and thanks them for "having faith in [her]… as a woman, for

having the radical belief that [she] could do something" (Yap 13). It speaks for itself that she has to highlight the supposed braveness of her fellow male colleagues to deem her worthy of achievements not because of her sex but despite. She ends her speech by saying that all the men she has just mentioned will be remembered in the annals of history as great mathematicians "[b]ut only time will tell of [her]" (Yap 13). After having come so far in her career, after the character development that earlier etudes have shown of Sofya growing into a confident researcher, this last appearance of hers ends on a bittersweet note. She still doubts her abilities to be remembered for her contributions to the field in a world after her death, yet has no trouble believing in other male colleagues to be significant.

What Sofya does not and of course cannot know is that she will indeed be remembered, namely by the professor of mathematics in the other timeline in this dramatic text. This is where the two time strands finally connect, and where the final scenes of the dramatic text almost cyclically connect to the very beginning of the drama. Sofya, in these final scenes, doubts her worth as a mathematician and wonders whether history will remember her. As the first scene revealed, she will be. The historical Sofya Kovalevskaya is now part of a mathematical textbook that is used in higher mathematical education. Her birthday is listed next to other "people who were very important to the subjects [the class]'ll be studying" as she is "historically one of the most important female mathematicians to date, and in fact, only the second woman to make herself known in the field of mathematics" (both Yap 2). From today's point of view, Sofya's work can be appreciated for what it was and for the struggle she must have gone through. Not only is she now recognised, it is also a female professor of mathematics who introduces her to a new generation of students. Yet in these etudes, Sofya is still a female pioneer in a field where few women had made a name for themselves so far and her insecurities are only too understandable. Still, the ending of the drama gives a hopeful outlook when one considers its general message, namely that women, and in the case of the female professor, especially Women of Colour, have a place in mathematics and in teaching and can serve as a shining beacon for new aspiring female mathematicians to come.

4.9 SUMMARY

My analysis has unified the three key aspects of this dissertation: The history and historiography of women in science and its omissions, the narrative reappraisal of women in science in contemporary science plays and the postclassical narratological analysis of dramatic texts. This section gives a brief summary of the generated thematic and narratological findings of the analyses.

As *Silent Sky* and *Ada and the Engine* have shown, narrative means such as the messenger report, which is usually not associated with contemporary plays, can be successfully adapted to meet the needs of the present-day stage. In *Silent Sky*, these narrated letters signify how the fictional Henrietta Swan Leavitt is torn between her obligations to her budding career as an astronomer and her ties to home with her sister and father who also demand her attention. A similar conflict is mediated by narrated letters in *Ada and the Engine*, in which the fictional Ada Lovelace has to navigate the life of a wife to a husband who is doubtful of her scientific career and her almost inappropriately close relationship with her colleague, Charles Babbage. In both cases, these letters mirror the pluri-spatiality of the original messenger report while adding a pluri-temporality to both plays (cf. Pewny 152). A messenger report would usually denote a single incidence that had happened off-stage, but in these two cases, they represent a longer span of time (Pewny 151-152). The letters in these two dramas report not only what is happening in two places but also narratively convey a passage of time, thereby adding to the original narrative means and enhancing its potential to assume more than just an immediate temporal quality. The letters thereby ingeniously combine original historical content, such as direct quotes from the historical scientists' letters used in these plays, with a fictional addendum to what history may not have covered. The additional narrative layer that both *Silent Sky* and *Ada and the Engine* use comes in the form of having these letters overlay an action on stage, such as Henrietta's work or Ada's preparation for marriage, further highlighting the pluri-temporality and pluri-spatiality. What is more, these modern messenger reports have filled the gaps that have been left behind by the meagre historical material on both of these scientists: They imagine the personal struggles and conflicted emotions of these two scientists that would have otherwise been documented in their personal material, such as letters or diaries, had they been saved so many decades and centuries ago.

The analysis of stage directions in *The Half-Life of Marie Curie* and *Uniform Convergence*, among others, have also yielded new results on their narrative quality. Patricia Suchy has already ascribed to them the "characteristics of the fictive discourse of other genres" (80) and Manfred Pfister speaks of this paratextual aspect of the drama as "authorial secondary text" (72), yet the dramatic texts from the analysis show an entirely new quality of narrativity in stage directions. In *Uniform Convergence*, the life of Sofya Kovalevskaya has been entirely portrayed in the stage directions to act as a foil to the life of the unnamed mathematics professor. In this, the stage directions have provided more than mere commentary; they have worked as small narrated stories of their own. An entirely new access to focalization has been granted through the stage directions in *The Half-Life of Marie Curie*. They provide an additional dimension to the lines of dialogue, offering the sentiments behind the written words and the insight into the characters' motivation and feelings, similar to what focalization in classical narrative media would deliver. This goes far beyond any purely descriptive job they might originally have been meant to fulfil. I would argue that the stage directions have developed from mere paratextual additions to veritable narrative means of their own. The analyses of *Silent Sky* and *Emilie: La Marquise du Châtelet Defends Her Life Tonight* provide additional proof for this. In the case of *Uniform Convergence*, the double temporality of the past, signified inside the stage directions, and the present, signified outside of them, come together as the fictional Sofya has actual lines as a character in the final scene. The present time line of the professor gives proleptic credit to the struggling scientist Sofya in the stage directions, who can then finally reap the benefits of her hard work, not knowing that her work will still matter many years after her death.

As stage managers or narrator figures, the fictional versions of historical scientists have contested the historical canon and righted the wrongs of historiography. The fictional Emilie du Châtelet has not only taken back control over the narrative of her own life which has so often centred around her relationship with the philosopher Voltaire. In *Emilie: La Marquise du Châtelet Defend Her Life Tonight*, she has managed to provide her own life with meaning and directs a version of it that is entirely her own and focusses on her achievements instead of on those of others. Thematically, the drama has opened up the possibility for Emilie to reflect on her own work and to find the answers to her research that has been so cruelly cut short by her early death. *Remembering Miss Meitner* presents a posthumous meeting of a fictional Lise Meitner and the two men who have dictated her career and estimation for many years during her lifetime, namely Manne

Siegbahn and Otto Hahn. This version of Lise Meitner is tired of the perpetrated false narrative of her as Otto Hahn's assistant and as Manne Siegbahn's inferior and reclaims the story of her life, providing the reader with her version of her own life. The drama therefore provides the fictional Lise Meitner with an opportunity to confront her former colleagues with their behaviour, be it their mistreatment of hers or their blatant dismissal of her work. As narrator figures and stage managers, the characters have taken active control in the course of the drama, influencing the plot and, by default as narrators, also the discourse. Brian Richardson's typology of dramatic narrators has found its application even 40 years after publication and the analysis has proven that the perceived unmediated genre of drama can use overt narrator figures (cf. "Point" 209-211).

Both *Photograph 51* and *Comet Hunter* have supplied examples for narrator figures that are not the female scientist protagonist, both with varying results. The male narrators in *Photograph 51* are the fictional versions of the male colleagues and competitors of Rosalind Franklin who are now reconvening to retell the story of their work and their betrayal, so to speak, of her during their time of collaboration. In addition to their narrator roles, they also embody a modern version of the chorus, providing critical commentary on the action and thereby distancing themselves and the readers from the action in a switch from narrator to character depending on their involvement in the scenes (cf. Palleau-Papin 146-147). In *Comet Hunter*, the character of Time not only represents the actual metaphysical concept of time but serves as a companion only visible to the fictional Caroline Herschel. Time is ephemeral and therefore knows about the fictional Caroline's fate before she herself does and at times assures, at times confuses her as to what her work might signify in coming centuries. These examples are both metahistoric narrators who exist both outside of the diegesis and as actual characters with an intimate connection to the female protagonist, either as their guardian in the form of Time or as their former colleagues and competitors who are revisiting a part of their own life, now with the reflective potential of hindsight. This retrospection reflects today's standard of historiography and provides a proleptic quality to their narration, allowing for reflection on the part of the male narrators in *Photograph 51* and foreshadowing by Time in *Comet Hunter*.

5 CONCLUSION

5.1 SUMMARY

In the very beginning, this dissertation started with the example of Jennifer Doudna and Emmanuelle Charpentier, highlighting their singularity as Nobel Prize-awarded women in science. As random as this fact might have sounded at first, this thesis has ultimately proven how far women have come in their participation in science while also still having a very long way to go. My thesis has set out to show what we conceivably know of women's participation in science as of today's historiographical standard, to explain how this rather fragmented knowledge has been accumulated and, first and foremost, to examine how contemporary science plays have used narratological devices to reassess the work of female scientists and to write them back into the history of science in order to supplant what history and historiography have omitted. Analysing the dramatic texts, I have proven that many narrative means that have always existed in dramatic texts have now been modernised to represent a contemporary approach to postclassical drama and have also re-included women in a comprehensive narrative of history.

One of my goals was to catalogue what we already know of women's participation in science. The first part of chapter two has undoubtedly shown the rocky path that women had to cross in order to arrive where they are now in the 21st century. Their earliest start in prehistoric proto-sciences was beside men, as equality was necessary for survival; no member of a group could have been excluded or treated as inferior in their support of the group. In Antiquity, the first ideas of inequality between the sexes can be traced back to influential philosophers such as Aristotle, who conceived of women as defected men and therefore as unsuited to education. No access to education meant that women would not be part of the public life of Ancient Greece and the Roman Empire, which signals the first separation of women and men into the private and the public sphere, a topic that would continue throughout history. The Middle Ages presented a dichotomous phase for women, who, on the one hand, were able to find safe spaces of learning in female-led convents, but on the other hand were farther pushed into the private sphere and were defamed as witches to keep them from partitioning medical sciences. The Early Modern Age encompassed the Renaissance, the Scientific Revolution and the Enlightenment, all three periods signifying different social situations for women in science. The Renaissance saw the eradication of female knowledge from the Middle Ages and the restructuring of female-led convents as well as a deterioration in the education of women. Even though

the Scientific Revolution marks a major improvement in the studying and conducting of science, it also meant a masculinization of the field, with women being the ones controlled and studied by it. A potential meeting place for women interested in science came in the form of scientific salons where amateur scientists such as wealthy women were able to pursue their interests. During the Enlightenment, women served as unpaid assistants to male scientists and found their way into the scientific discourse by publishing popularized scientific works, which would continue throughout the 19th century. An improvement in education for all genders as well as the budding feminist movement of the late nineteenth century signalled a change in women's struggle for participation. Two additional waves of feminism in the 20th century meant further advancement for women in general. Between the two World Wars, women oscillated between the public and the private sphere, filling vacant jobs left behind by men at the front and then returning to their homestead once the wars were over. At the beginning of the 21st century, statistical data proves that women have finally made headway in their positions in science, which leaves me hopeful for a definite change.

An additional question posed in the introduction was why we as the public know what we know and how history and historiography have contributed to this skewered image of women in science. The second part of chapter two was concerned with the supposed factuality of history and historiography. It traced the origin of the field back to its literary roots as a rhetorical art, highlighting how the rise of scientific empiricism created a separation of history from literature in the 19th century. The narrative turn in the 20th century introduced narrative studies to disciplines outside of literature and with the work of Hayden White, among others, the appreciation of history as a narrative came back into focus. It became clear that history and thereby historiography craft narratives from the available source material and therefore can only present a certain version of the past, yet have by no means a definitive claim to the truth. Feminist historians and historiographers have risen to the task of uncovering the lost history of women in general, highlighting the exclusively male focus of historiography. Women historians and historiographers of science in particular have uncovered previously lost knowledge on women's participation in science which has greatly advanced the visibility of historical female scientists.

As this evaluation of history and historiography has already introduced narrative studies, the next chapter proceeded to further develop my methodological approach, namely that of narratology. Narratology and narrative studies in general have served as

the guiding thought throughout this entire dissertation, from history as a narrative to postclassical narratology in dramatic texts. The third chapter exemplified how the study of narratology had always been conceived of as a transmedial one, despite its temporary focus on epic literature after the classical phase. Narration has always existed in dramatic texts and on stage, from early Antiquity to Brechtian theatre of alienation. I have given an extensive list of narrative means that can be employed in a dramatic text, such as monologues or soliloquies, prologues and epilogues, distinctive narrator figures on stage, messenger reports or the chorus as well as paratextual narration through the stage directions. Scholars such as Brian Richardson, Patricia A. Suchy, Katharina Pewny or Manfred Pfister have published extensively on the narrativity of dramatic texts and I have used their publications to demonstrate the narrative means of postclassical drama. In order to apply the intersection of gender and narratology in my corpus, I have also focussed on feminist narratology in its work to abolish an androcentric idea of narrative figures. This branch of narratology coined by Susan Lanser calls for a new approach to the analysis of narrative media. Whether women are heard or receive the right to speak and which narrative situations are coded as male or female has been the main focus of feminist narratology.

The final topical chapter, my analysis, has then presented the intersection of all chapters beforehand by applying narratology to dramatic texts that feature historical women in science. Key questions that guided my analysis were how the dramatic texts employ narrative means to evaluate the history of women in science and to fill in the gaps that have been left behind by the fragmented history presented in earlier chapters. The analysis has shown that many narrative means that have existed for centuries are now adapted to meet the demands of the contemporary stage. Narrated letters, as employed in *Silent Sky* and *Ada and the Engine*, fulfil the role of a pluri-spatial and pluri-temporal messenger report, covering a longer span of time than the original messenger report. These narrated letters are also meant to fill the gaps left by the fragmented material on both these historical scientists, providing an insight into personal conflicts that would have normally been documented in any personal material from the scientists. Contemporary stage directions have proved to be small narratives of their own, which was exemplified in *Uniform Convergence* and *The Half-Life of Marie Curie*. The historical mathematician Sofya Kovaleskaya exists entirely in her own narrated stage directions save for the final scene of the drama, whereas the fictional Marie Curie and Hertha Ayrton are focalised through the stage directions similar to internal narration. The

stage directions are no longer solely meant for the descriptive purpose they originally served, they produce their own narratives and allow for focalization similar to that in epic media. This focalization serves to intimately describe the struggles of historical scientists in face of the discriminatory practice they have to overcome. Some dramatic texts have also given the fictional counterparts of historical scientists the chance to retell their own life's story. In *Emilie: La Marquise Du Châtelet Defends Her Life Tonight* and *Remembering Miss Meitner*, the titular characters return to the stage post-mortem and assume the roles of narrators and stage managers, commenting on the historiography of their life and on the role that their male colleagues have occupied in it. These fictional versions of the scientists move from passive objects of historiography to active directors of their own retellings, a chance that was not granted to their historical counterparts. Narrator figures exist also outside of the pool of historical female scientists, as *Comet Hunter* and *Photograph 51* have shown. The metahistoric character of Time accompanies the fictional Caroline Herschel through her life and offers her proleptic perspective into how her work will ultimately be of value, despite Caroline's own feelings of inadequacy in face of her brother's success. The choral narrators of *Photograph 51* are embodied by Rosalind Franklin's male competitors and colleagues, who return to the stage as narrators accompanying the race for the DNA with the capacity for hindsight. They give critical commentary on the action and distance themselves in their role as narrators from the action, a privilege that is not granted to Rosalind Franklin. Both of these narrator figures exemplify metahistoric commentary that is aware of today's knowledge and historiographical standard. Time and the male narrators lend reflection and introspection to the narration and highlight the characters' significance in history, even if the female scientists were not appreciated for their work during their lifetime.

In summary, the dramatic texts have succeeded in two ways: Firstly, they have provided examples for contemporary narrative means in drama, justifying the postclassical approach to narratology that includes all kinds of media outside of the classical epic. Secondly, these texts have questioned, extended and personalised the historiographical canon of science in favour of the long-omitted women. The canon has been questioned by metahistorical commentary on popular history uttered either by the historical female scientists or their contemporaries themselves, as exemplified in *Remembering Miss Meitner*, *Photograph 51* or *Emilie: La Marquise Du Châtelet Defends Her Life Tonight*. *Silent Sky* and *Uniform Convergence* have added to the already existing history by filling in the blanks that the fragmented source material on the scientists has

created. *Ada and the Engine*, *Comet Hunter* and *The Half-Life of Marie Curie* have pencilled in the missing personal experience of the respective female scientists and have illustrated their private struggles as women in science.

These findings present a possible continuation of my thesis in future scholarly works. Similar to what I have stated in my introduction, a more comprehensive analysis of the individual stagings may prove fruitful, in case that reliable recordings of these stagings exist. A more thorough metadiegetic analysis might also be advisable. As the dramatic narratives leave less to the imagination and present a specific picture of history, one may turn to the production side of these texts and include the playwrights' approach to their text in an analysis. I conducted many email correspondences and video chats with the authors of the plays that I have featured in addition to many other authors whose plays were ultimately not chosen for my corpus. It became clear to me that their motivations and definite images of the historical scientists have greatly inspired their writing. A potential further investigation might examine whether certain preconceptions on the side of the authors have guided the writing of the dramatic texts and whether these historical re-tellings have been written with a specific goal in mind. Additionally, one may ask whether the playwrights had trouble crafting their plays based on the meagre source material some of these historical scientists have left behind.

5.2 OUTLOOK: WHAT CAN BE DONE?

The initial problem that has sparked this dissertation sadly remains: We know too little about the women in the history of science that have not made it into the annals of the historical canon. Hope remains that the more the topic comes to the forefront, the more historiographers will try and re-evaluate their source material, thereby adding hitherto forgotten names to the list of famous scientists. A new approach to the archivisation of materials might be advisable. Not only need the materials from women scientists be treated with more care after their passing, the public must also allow for female scientists to let their own voices be heard during their lifetime so that they may be remembered. The advancements made in the past century in terms of digitisation will prove majorly helpful in preserving material for future generation. As much as the idea of our eternal footprint in the digital age may scare us, it also ensures that we will always have means to access the personal records left behind by scientists. In 2022, Virginia

Trimble and David A. Weintraub published their anthology *The Sky is for Everyone: Women Astronomers in Their Own Words*, allowing 37 living female astronomers to share their life's stories. The contributions range from Anne Pyne Cowley, who completed her PhD in 1963, to Yilen Gómez Maqueo Chew, with a PhD no older than 15 years, spanning an impressive time frame to catalogue the experiences of different women in the same scientific field. Publications such as these enable those important women contributing to the advancement of science to leave their own words for posterity, to shape how they want to be remembered and what they deem important for the generations to come.

Sometimes, female scientists have taken it upon themselves to change the narrative and venture into science communication and public outreach. Astronomer Jocelyn Bell Burnell is known to many as the discoverer of pulsars, which are rapidly spinning neutron stars emitting radiation (Hargittai *Women* 25). As her PhD project, Bell Burnell had conceived of a radio telescope originally meant for the research of quasars that was then built at Cambridge University. It took her and her peers two years of hauling cables and material to complete it. She was also in charge of evaluating the material produced by the telescope (Jaeger 178-179). During this evaluation, she discovered several anomalies that indicated a pulsing radio source. Together with her supervisor, Antony Hewish, they published a paper on this new discovery in 1967, which caused a huge uproar in the scientific community and was seen as a major advancement (Jaeger 180). This was awarded with a Nobel Prize for Physics in 1974 and controversially, Bell Burnell was not included in the pool of laureates. Only Antony Hewish and the head of the project, Martin Ryle, were awarded and neither of the two gave credit to Bell Burnell. Hewish is even quoted as being "totally sick of it, this stupid thing that Jocelyn would have done all the work", denying that his student would have contributed enough to warrant an inclusion as a laureate (Hewish as quoted in Jaeger 184).

Bell Burnell has been more than gracious in her acceptance of the hierarchies that have prevented her from receiving due credit. In an interview with Ben Proudfoot from *The New York Times*, Bell Burnell claims she was "pleased […] that pulsars were considered important enough to rate a Nobel Prize" (12:09-12:16). She wagers that her status as a "graduate student and a woman together demoted [her] standing in terms of receiving a Nobel Prize" (11:56-12:06). Jocelyn Bell Burnell continued to have a majorly successful career in physics and astronomy and has received the *Special Breakthrough Prize* in 2018. As a support for upcoming generations, she dedicated its prize money of three million dollars to establish a scholarship for minority students to achieve a doctorate

in physics (Jaeger 187). Instead of the Nobel Prize, she has been awarded the Copley Medal, has been made Dame Commander of the Order of the British Empire and "was elected Fellow of the Royal Society", which Magdolna Hargittai highlights as "especially gratifying because it signals peers recognition" from the scientific community (*Women* 26). As of 2023, Bell Burnell serves as the chancellor of the University of Dundee (cf. her profile on *University of Dundee Website*). In contrast to many of the women discussed in the analysis, Bell Burnell had the chance to be publicly recognized for the slight against her and has received honours during her lifetime that have ensured that her legacy will never be forgotten.

Universities and research organizations as places of learning have attempted to highlight women's contributions as well. The Max Planck Society hosts a recurring interview series on "Female Scientists and Historical Trailblazers", in which contemporary female scientists are paired up, so to speak, with historical women from their own profession and interviewed about the impact that the latter had on the respective field. Many of the women named in my analysis are featured in this series, such as Caroline Herschel being praised by astronomer Sherry Suyu or Annette Vogt, mathematician and historian of science, who talks about the impact Sofya Kovaleskaya has had on her own work (cf. "Female Scientists and Historical Trailblazers" on the website of the Max Planck Society). Projects such as these not only place emphasis on the forgotten contributions of women and their struggles but also lend visibility to contemporary female scientists who can emulate the problems of these past women. The University of Erlangen has established a symposium on women in science in 2018, which was conceived of by women in science in Erlangen themselves, who "are convinced that a solid network of women must exist in order to tackle gender inequalities and gaps" ("About" *Women in Science – Erlangen Symposium*). Their goal is to offer a space for women to present, discuss and share their research among like-minded peers while also providing early-career scientists with chances to network. After two successful symposia in 2018 and 2023, the third symposium is planned for July 2024 ("Symposium – 2024" *Women in Science – Erlangen Symposium*). Such efforts can only be lauded and hopefully serve as examples for other institutions to follow suit.

There are also many non-academic projects that have made it their goal to heighten the visibility of female scientists in and out of fiction. A recent German project called "Die Kanon" has specifically questioned the male dominance in canons of nearly all aspects of life. Several German authors, scholars and journalists, among them Sybille

Berg, Margarete Stokowski and Theresia Reinhold, have come together to create an alternative canon that includes women, claiming that the canon is female, even though the noun is gendered male in the German language. The title of their project, "Die Kanon" is a re-gendered version of the noun. While the project originates in Germany, it covers women from all over the world in its database. It includes not only of female scientists and engineers but also of women in art, politics, economy, music, literature and sports. As of September 2022, the project sadly no longer has any funding to continue updating their database (Die Kanon "Kontakt"). The Austrian theatre group "Portrait Theater" has made it their goal to re-introduce the public to forgotten, extraordinary women and are touring with a program specifically dedicated to female scientists such as Hedy Lamarr, Caroline Herschel, Marie Curie, Lise Meitner, or Emmy Noether ("Produktionen" *Portraittheater*). Since 2019, they have extended their performances from Vienna to Tunisia, Germany, Denmark, Spain and the USA, allowing for a more international audience to be simultaneously educated and entertained ("Termine" *portraittheater.net*).

Other approaches to spreading the visibility of women in science can be detected in contemporary literature, both in fiction and non-fiction, as this thesis has proven. This may start from a very early age on. As mentioned in my analysis of *Ada and the Engine*, Ada Lovelace is a recurring character in children's literature, serving as an inspiration for younger generations interested in science. Other notable publications to feature nuanced women in science are, for example, *Shark Lady: The True Story of How Eugenie Clark Became the Ocean's Most Fearless Scientist* (2017) by Jess Keating about American ichthyologist Eugenie Clark or *Mae Among the Stars* (2018) by Roda Ahmed about Mae Jemison, the first African American women in space. The Spanish author María Isabel Sánchez Vegara has published over 90 editions of her *Little People, Big Dreams* series, which introduces "a diverse range of creatives, scientists, politicians and more" to children ages four and older ("About" *littlepeoplebigdreams.com*). The series was originally published in Spain and grew out of a personalised birthday present to the author's nieces and includes numerous female scientists in its editions, such as Hedy Lamarr, Jane Goodall or Mary Anning ("Shop" *littlepeoplebigdreams.com*). These will provide younger generations with an updated, gender-balanced image of science and hopefully change the literary landscape for the better. In the best case, this can be supported by education as well. As much as the educational system was criticised in the introduction to this thesis, there are also positive examples from contemporary school material. German schoolbook publisher Westermann has provided examples for including

the history of women in science in children's education. In two consecutive editions of their workbook *Elemente der Mathematik*, female scientists are used as examples in exercises for calculating with natural numbers. In their workbooks from 2012 and 2019, children are asked to calculate the exact age of a historical scientist and the selection of scientists is exclusively female in both editions. The scientists featured are, among others, Lise Meitner, Maria Sibylla Merian, Sophie German and Ada Lovelace (cf. *Elemente der Mathematik* 2012 and 2019). This playful approach to inclusion introduces children very early on to a more diverse image of the scientist and might even spark their interest in researching the stories of these women.

However, other types of non-fiction and fiction must also follow suit. A prominent current example of the repeated narrative of male dominance in science is Christopher Nolan's immensely successful *Oppenheimer* (2023), detailing the Los Alamos nuclear project and the following security hearings. The movie continues to feature almost exclusively male scientists, eradicating the participation of female scientists in the project. Only one female scientist involved in the Manhattan Project is actually named in the movie, and that is Lilli Hornig, a chemist working in the Los Alamos community (cf. "Full Cast & Crew: Oppenheimer (2023)" on *imdb.com*). She, controversially, is never shown in any of the scientific discussions of the movie; these appear to be exclusively held by men. Other important women involved in the project, such as Frances Dunne, Leona Woods Marshall (cf. Hargittai *Meeting* 76-79) or Elda Anderson, are not even mentioned[25]. One could argue that the movie is focusing on the titular character, Robert Oppenheimer, and his involvement in the making of the atomic bomb and the ensuing political fallout, therefore the representation of women was not a major concern in the production. However, the movie is teeming with supporting roles, all of them male, and therefore represents the stereotypical male environment of science. We as a contemporary public know about these women involved in the Los Alamos project and may wonder why the production did not pay attention to a more accurate representation of women in science on screen. This is especially troublesome since the two main female roles of the movie are that of Oppenheimer's wife, Kitty, and his lifelong mistress, Jean Tatlock, which are hardly nuanced roles for women to occupy in a movie made in 2023.

[25] The movie is also missing the point of view of the indigenous people suffering the short- and long-term consequences of the atomic testing in their territories, see the article "Native Americans and the Manhattan Project" published by the Atomic Heritage foundation.

Contemporary and future media have to do better. Historiography is not the only outlet to elevate the participance of women in science, medial representations reach more people than any scientifically specialized area could. Popular culture should honour the contributions of all members of society, no matter their gender, race or any other arbitrary denominator. Science is a constant companion in our everyday life and has changed so many lives for the better by providing advancements and knowledge. Everyone can benefit from a diverse approach to science and it seems only reasonable that science therefore needs to include every person, regardless of gender.

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