Women and Science, 17th Century to Present

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Edited by

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TO OUR DAUGHTERS

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INTRODUCTION

DONNA SPALDING ANDRÉOLLE
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While women's interest and participation in the advancement of science has a long history, the academic study of their contributions is a far more recent phenomenon, to be placed in the wake of "second wave" feminism in the 1970s and the advent of women's studies.[1] Research on female figures in specific fields or, more generally speaking, on women's battles to gain access to knowledge, education and recognition in the scientific world thus really started in the late 1980s when some useful and comprehensive biographical accounts were published, such as those of historians Margaret Alic (1986), Marilyn Ogilvie (1986) Pnina Geraldine Abir-Am (1987) or Barbara Gates (1998), to name but a few.

These studies, while providing a useful insight into the contributions of well-known figures, have so far mostly focused on the obstacles that women have had to overcome in the fields of education and employment or in their quest for acknowledgement by their male peers, or again on the mutual impact of family life and scientific career. The aim of this volume is to try and approach the issue from a different and more comprehensive point of view, taking into account not only the position of women in science, but also the link between women *and* science through the analysis of various kinds of discourse and representation such as the press, poetry, fiction, biographies and autobiographies or professional journals… – including those of women themselves. The questions of the presentation or re(-)presentation of science by women will thus be at the core of this study, as well as that of the portrayal and self-portrayal of women in the sciences (whether in the educational, or the professional field). A final part examines how women are represented in science fiction which, like science itself, has traditionally been a field dominated by men. Following in the footsteps of the likes of Mary Shelley, women writers of science fiction, as well as the depiction of strong, scientifically knowledgeable female characters make their appearance in the mid-twentieth century, being connected as they are to the second-wave feminist movement, in

particular in the United States where a specific feminist science fiction genre emerged in the early 1970s. This does not, however, exclude men (as authors and/or as characters), nor does it limit such representation to one country or one culture as the study of female cyborg superheroes in Japanese *anime* so perfectly demonstrates. From the gendered dynamics of female creation in Keatsian poetry and Dan Simmons's novels to Alasdair Gray's *Poor Things* in which the female reincarnation of life-giving science suggests a possible alternative to the masculinist paradigm of scientific knowledge, new visions of women and science vehicled in the popular culture—whether created through the use of pastiche, role-reversal or post-Romantic and post-modern influences—constitute a clear political message regarding the shifting relationships of gender and gender(ed) roles in modern society.

A question that arises when putting into relation women and science—more particularly when focusing on the issue of representation—is whether such a thing as a gendered (re)presentation of science actually exists. In an attempt to provide some answers this question, the first part of this book will examine the contributions of women to scientific knowledge and their possibly gendered (re-)presentations of the fields they studied, covering four centuries and five countries, and beginning with 17th century England.

This period, sometimes referred to as the Scientific Revolution,[2] certainly offers a contrasted image in terms of women's contribution to the new sciences. While the natural world had so far been perceived as a living organism and its approach linked to theology, some natural philosophers began to favour investigation through supposedly "objective" experimentation, mathematics and correct reasoning, and felt they were proposing new and important changes in both its knowledge and the means and practices by which this knowledge was to be attained and communicated (Shapin, 5). This process, some historians have argued, marked the ostracization of women from science (LeMay Sheffield, 3; Merchant, 1980). "Including women, they felt, would undermine their new study," Suzanne LeMay Sheffield explains, "in part because women tended to be followers of old practices, but also because of the 'natural' character of women which they believed was irrational, emotional, spiritual, and lacking intellectual rigor" (3). The changing nature of science and the fact that it was taking place increasingly in societies and academies does not mean, however, that women stopped practicing science. As a matter of fact, larger numbers of women took an interest in science as the telescope and the microscope became the new "toys" of the

aristocracy; and it became fashionable, in aristocratic circles, for ladies to keep up to date on the latest scientific developments. Books and lectures which were published and delivered specifically for female audiences reflect the new craze for science of the time. One of the best-known examples is probably the French *Entretiens sur la Pluralité des Mondes* (*Conversations on the Plurality of Worlds*) published in 1686, in which Bernard de Fontenelle explained and popularized the mechanistic theories of Descartes in the form of a dialogue between de Fontenelle and Madame la Marquise de G*** who, for six nights, was introduced to the intricacies of astronomy. Many then took up Fontenelle's lead, including Francesco Algarotti's *Il Neutoniasnismo per le dame*, published in 1737, Britain Benjamin Martin's *The Young Gentleman and Lady's Philosophy* (1759) or again James Ferguson's *An Easy Introduction to Astronomy, for Young Gentlemen and Ladies* (1768), all of them often written in a dialogue form, or letter format.

It was in this context that Margaret Cavendish (1661-1717) and Anne Conway (1631-1679), who, like most women of the 17th century, were denied a formal education, wrote treatises of natural philosophy revealing clear knowledge of the scientific theories of their time. In order to access such knowledge, both Cavendish and Conway made the most of the practices of erudite sociability in the Republic of Letters and, as Sandrine Parageau shows, their respective scientific discourses show signs of these indirect modes of access to knowledge. As autodidacts, both women could only glean fragments of knowledge, which they then tried to reassemble in dialogic and eclectic works; in this regard, Cavendish's and Conway's scientific discourses are thus characterised by Claude Levi-Strauss's notion of "bricolage," that is both women strove to reconcile all the doctrines in the history of natural philosophy without discriminating between personal and traditional knowledge. Cavendish, however, because she published her works, also had to use "tactics" (M. de Certeau[3]), Parageau explains, in order to encroach on men's territory without being condemned for her transgression.

An examination of Marie-Geneviève-Charlotte Thiroux d'Arconville (1720-1805)'s translation work in the realm of practical chemistry also provides a new evaluation of women's role in the making of early modern science. Some of the works just cited were translated by women. That was the case of Algarotti's *Il Neutoniasnismo per le dame*, translated by Elizabeth Carter under the title *Sir Isaac Newton's philosophy explain'd for the use of the ladies: In six dialogues on light and colours*; interestingly, the preface specified that the translation was done by "Elizabeth Carter, *the friend of Dr. Johnson*" (my italics). *Entretiens sur la Pluralité des*

Mondes was also translated a second time into English in 1688 by Aphra Behn under the title *A Discovery of New Worlds*. Both translators, in this case, were writers and poetesses. Yet, there were other prominent women scientific translators in the Enlightenment period and scientific translation sometimes required more than a grasp of multiple languages. One famous example is that of Émilie du Châtelet who, besides translating Newton's *Principia* into French, expanded Newton's work to include up-dated progress made in mathematical physics after his death. Her superior grasp of mathematics, as William E. Burns points out in his *Encyclopaedia of Science in the Enlightenment*, made her contribution to Voltaire's *Elements of the Philosophy of Newton* (1738) a vital one. Though by no means the only female scientific translator of the mid-eighteenth century, d'Arconville was one of few French women who undertook translation work while leading experimentations herself, Margaret Carlyle points out. Centring discussion on a treatise by the English chemist, Peter Shaw (which d'Arconville translated into French and published in 1759 as *Leçons de chymie*) Carlyle argues that d'Arconville's role as a female "scientist" problematises our understanding of the translator's role both in the construction and transmission of scientific knowledge and forces us to consider the challenges faced by all Enlightenment era translators of the natural sciences, and more specifically by female interpreters.

Rousseau was not favourable to the scientific education of women. In *Emile*, the French philosopher dedicated a chapter to Sophie's education in which he explained that the "art of thinking is not foreign to women, but they ought only to skim the sciences of reasoning. Sophie gets a conception of everything and does not remember very much. Her greatest progress is in ethics and in matters of taste. As for physics, she remembers only some idea of its general laws and of the cosmic system."[4] Women, for Rousseau, had to be excluded from the sciences on the grounds that they were incapable of grasping general principles or generalizing ideas. In his discussion of Sophie, he wrote again: "The quest for abstract and speculative truths, principles, and axioms in the sciences, for everything that tends to generalize ideas, is not within the competence of women. Their studies should concern practical things. It is their task to apply the principles discovered by man and it is up to them to make the observations that lead man to discover these principles" (386). Some objects of scientific study were, however, deemed more acceptable—or respectable—than others by Rousseau and other opponents to women's scientific education. In the French philosopher's opinion, botany for example, (which did not involve dissecting), abated "the taste for frivolous amusements, prevents the tumult of the passions, and provides the mind with a nourishment that

is salutary" (*Essais élementaires sur la botanique*—which became in English *Elements of Botany Addressed to a Lady*, Letter I, 19). In fact, the opening of the New World and the Far East had provided European scientists with thousands of new species to examine and classify, while in the 17th century the newly-invented microscope had made it possible to study insects more closely. As drawing and water-colour were part of a young lady's education, their subjects now included landscapes as well as floral arrangements; and women were taught the Linnaean system of ordering, categorizing and naming plants. However, while most of them stayed at home to study and classify plants in their own herbarium collections, gathered on the occasion of walks, grown in their own conservatories, or sent from abroad, some did not hesitate to travel to far-off continents at a time when ocean travel was rarely undertaken. That was the case of Maria Sibylla Merian (1647-1717), one of the earliest entomologists and finest botanical artists of the period, founder of biological classification. While Cavendish and Conway may be said to have remained outside of the new science in different ways, Maria Sibylla Merian, in Germany, moved closer to the increasingly masculine world of science, breaking new ground in the areas of insect reproduction and insect behaviour. As underlined by Kay Etheridge, the images in her books changed the conventions of depicting nature, and influenced how plants and animals were regarded. Yet, as Etheridge points out, in spite of a recent resurgence of interest in her work, Merian continues to be excluded from the pantheon of natural scientists that form the line connecting Gesner to Darwin and beyond. Her books have been reprinted in various forms for three centuries and her work was highly valued by several prominent natural historians of the 18th century but, by the 19th century, most naturalists praised her art but were dismissive of her scientific contributions. Even today most analyses of Merian focus on her personal history or on her artistry while neglecting her seminal contributions to science.

Woman herself could sometimes be an object of scientific discourse. Ever since Antiquity, theories had presented women as less developed than males and had underlined their physical weakness as well as intellectual and moral inferiority. Such attitudes were promoted throughout the ensuing centuries by religious and legal institutions and, more generally speaking, by the entire social hierarchy. In the 19th century, however, scientific and pseudo-scientific discourse was increasingly used *specifically* to emphasize women's physical and intellectual inferiority as a response to the demands for equal education and political rights by the women's movement that emerged in the late 1840s in the United States

and a little more than a decade later in Great Britain. Drawing on fields as diverse as phrenology, medicine or evolutionism, the arguments used ranged from the handicap induced by their capricious wombs to their smaller skulls and their limited energy.[5] While the use of such arguments to counter the emerging feminist movement has been the object of study by historians of science and of the women's movement (Mosedale, 1978; Russett 1989; Harrison, 2003), not so well-known are cases of women's "re-appropriation" and "re-presentation" of these arguments in the same period. As early as 1688, Marguerite Buffet had claimed in her *Nouvelles Observations sur la Langue françoise* that "women's minds, beauty, and virtue are superior to that of men" and argued that "female babies take longer to come to term than male babies, indicating that female babies are more complex organisms than male babies" (LeMay, 45). Two centuries later, in 1864, in the United States, Eliza Farnham published a voluminous book entitled *Woman and Her Era* in which, focusing on the "organic argument," she argued that the female body was biologically superior to the male system; and by examining the physiological and nervous characteristics of the female body, Farnham tried to convince her readers that women were at the top of the evolutionary ladder and that their more sophisticated and more complex corporal organizations accounted for their higher morality and spirituality. Speaking as an enlightened prophet mastering the scientific knowledge of her day, she adopted, rejected or adapted the theories on female biology. As Claire Sorin shows, Farnham did not reject the notion of physical fragility, nor did she urge women to step out of their domestic sphere; however, she redefined the theory of separate spheres, presenting an ideal world in which woman was a divine creature endowed with a moral mission and man but a material provider equipped with a robust but rudimentary body.

Another instance of re-appropriation of the dominant scientific discourse could be witnessed in a very different context, that of Weimar Germany (1919-1933). Despite the systematic victimization of women through state-supported reproductive policies and exclusion from the medical profession on the grounds that professional work could interfere with domestic duties, medicine then became the fastest growing profession for women in the inter-war period. Not only had the number of women doctors doubled by the early 1940s, but female physicians also introduced new approaches to sexual and reproductive concerns by bringing "women's issues"—namely, discussions about the necessity of access to birth control and legalized abortion in order to allow women to make responsible reproductive choices—into the mainstream discourse. While men used the language of eugenics to push women out of the profession,

women doctors appropriated this language to justify their work in Weimar marriage counselling centres. Supporting these mainstream views was thus a way for female physicians, whom male doctors continuously shunned throughout the 1920s and 1930s, to gain new opportunities in the medical profession.

Regardless of the nature of their contribution, the way women of science have been portrayed (both by their contemporaries and historians) as well as how they have portrayed themselves has undoubtedly involved a gendered dimension. Particularly interesting is to question to what extent integration or separatism (a consequence of this gendered representation) was instrumental in allowing women to achieve the recognition they sought.

Publications on the history of Irish science and Irish scientists in the 19th century are sparse in their mention of women who played any part in the development of science or scientific institutions in Ireland. Where women are included, the names of the same half dozen 19th century ladies involved in Irish science and technology recur. In her article, Clara Cullen focuses not on these women *per se*, but on the activities and interests of numbers of other Irish women who pursued scientific knowledge in Dublin and whose activities have been barely noted or recognised. Indeed, between 1854 and 1867, an almost forgotten Dublin institution, the Government School of Science at the Museum of Irish Industry, offered courses composed of lectures on scientific topics and in applied sciences available to men and women alike. A significant number of women participated in these courses and competed equally (and successfully) with men there.

More difficult, on the other hand, was women's access to medical studies, largely because of the professional and financial interests at stake. While in Italy women had been allowed to practice medicine from the Middle Ages (Alic, 50-57) and the medical schools of Europe admitted women by the mid-19th century, in Britain the struggle for the medical education of women reached its peak in the late 19th century. Even in obstetrics, which when first developed as a science in 16th century France had partly been led by women,[6] in Britain of the mid-18th century, obstetricians and male midwives began ousting women from the birth process by constructing gynaecology and obstetrics as a male profession. Veronique Molinari looks into the strategies that were used by women in the second part of the 19th century to regain that place while clarifying the foundation and development of the first two medical schools for women (the Ladies' Medical College and the London School of Medicine for Women); at the same time particular attention is paid to the reasons that

led to their creation and to the choice of a separatist strategy as well as to how these schools were respectively perceived by the medical profession and campaigners. Along the same line of thought, Elizabeth Blackwell—who in 1849 became the first American female certified physician—is an illustration of the ambivalence of such pioneering women on both sides of the Atlantic. In her article, Hélène Quanquin not only insists on Blackwell's crusade to make a place for women doctors in 19th century America by founding and operating an independent dispensary *for* women, *by* women, but also exposes the contradictory discourses surrounding representations of her, be they autobiographical or historical in nature. While some popular (feminist) depictions published during Blackwell's lifetime used her example to call for the empowerment of women in medicine, Elisabeth Blackwell herself denounced the more radical dimensions of the feminist movement—embodied, notably, by certain of her high-profile relatives such as her sister-in-law Lucy Stone; her position on feminist activism has led some more recent historians to label her a "conservative." Thus, as Quanquin rightly points out, Blackwell's existence as a "singular woman doctor" (Blackwell's own expression) demonstrates such women's uneasy struggle against both male prejudice in the professional realm and against the hostility of female contemporaries in the social sphere, while calling into question interpretations of what it meant, or still means, to be a feminist.

At least, one might say here, women like Elisabeth Blackwell possessed a certain social and professional status in spite of the dominant male-oriented attitudes of the time and have managed to be the focus of historical interpretation albeit in the last twenty to thirty years. Lindsay Wilson's article, however, exposes the more troubling cases of women contributors to science who remain in the shadows of "great" men of science such as Charles Darwin and Sigmund Freud. Departing from a recent *Le Monde* article which relegates a few female Freudian disciples to the sidelines of the history of psychoanalysis, Wilson first studies the contributions of Clémence Royer and Marie Bonaparte, both translators of famous scientific productions: Royer translated Darwin's *Origin of Species*, while Bonaparte translated nine of Freud's works. Unlike Margaret Cavendish and Anne Conway (studied in Sandrine Parageau's text) who resorted to "briolage" and "tactics" to promote their scientific discourse within the social mores of their time, Royer and Bonaparte were fervent proponents of the theory behind the texts they translated. Royer published many works on the origins of man and society, in reality pushing Darwin's own theories well beyond what he dared to do himself; Royer's translator preface to the *Origin of Species* actually discussed human evolution,

which Darwin referred to as "blasphemous" in a letter to a friend. Bonaparte, originally one of Freud's patients, later wrote scores of articles on psychoanalysis, founded the Paris Psychoanalytic Society in 1926 and finally wrote articles on Freud's life and work. Why then, asks, Wilson, can such achievements go unnoticed in French scientific scholarship, at least until recently? The answer seems to be that these women led unorthodox private lives, pioneers not only in science but in the realm of liberating behaviour as well—a point repeatedly developed in other articles of the present volume; Royer and Bonaparte defied social norms which unfortunately led to the discrediting of their reputations in the professional sphere, a fate avoided by their male counterparts. As a final example of this idea, Wilson discusses the tribulations of Marie Curie, two-time winner of the Nobel Prize (first in physics, then in chemistry) who was asked to not attend the second prize ceremony because she was involved in a much-publicised sex scandal at the time.

Another example of women's negative portrayal is Amy Bix's study of the unsung heroines of Georgia Tech, which brings to the light the (extremely shocking, to the modern reader) treatment of women who dared dream of obtaining an engineering degree in post-World War II America. Studied through the "filter" of campus newspapers and personal correspondence, Bix shows us the male gaze cast upon the first young women to set foot on the all-male campus of Georgia Tech, while at the same time shedding light on this experience through the testimony of those same female students. Focusing first on the articles, editorials and cartoons of *The Yellow Jacket*, *The Technique* and *The Georgia Tech Alumni Magazine*, Bix exposes the sexist discourse and the theme of invasion used to report on the arrival of coeducation in one of the American bastions of engineering, mocking women's desire to succeed in the sciences and accusing the rare applicants of only wanting to find a husband. One of the critical advances in women's admission to Georgia Tech was the arrival of President Blake Van Leer in 1944, whose progressive ideas about women's capacity to study engineering put an end to single-sex education there. In the second half of the study, Bix then proceeds to tell the story of the pioneering women students who braved catcalls, stares, ostracism and condescending press coverage to become engineers. Much like their ancestors who had gone against the grain of socially acceptable behaviour to excel in different fields of science, these women compensated for their gender by graduating in the top ranks of their classes. Thus the case of Georgia Tech is yet another example of how, by breaching the traditions of all-male culture, women not only succeed but help open the doors to

ensuing generations of women desiring to pursue scientific and technological careers.

No study of women and science can be complete without exploring literary and cinematographic representations of the female as both scientific creation and as scientist. Part III tackles this issue through the examination of specific works of fiction. Caroline Bertonèche returns to the Romantic era to uncover the Keatsian origins of Dan Simmons's science fiction, notably its influence on the depiction of female emancipation. First, Bertonèche points out the "singular precedence of women authors and fictional characters—playing mad scientists, acting as investigative spirits or modern Prometheans—when the eminent discoverers in Romantic science were [...] men only." Mary Shelley was at the roots of 'science fiction,' then coined 'science romance,' followed to a lesser degree by Jane Austen whose "views on science were to be as discreet as woman's own sexuality." Keats's feminisation of the sciences—as a means of mythologizing them—can be found in Dan Simmons's version of *Hyperion* in which "mothers and keepers of creativity [are] restored," and in which it is through female leadership and sacrifice that "scientific and spiritual rebellion" are salvaged. Surprisingly, then, Caroline Bertonèche's observations of Romantic influences on modern science fiction banish the representations of the genteel wife/daughter passively assisting the all-knowing scientist husband/father and replace them with a dynamic vision of woman as masculine and meta-poetic force illustrating the influence of science within the literary world since the 19th century.

The Romantic origins of modern science fiction are also the focus of David Leishman's analysis of *Poor Things* and other works by Scottish author Alasdair Gray. Borrowing heavily from Mary Shelley's *Frankenstein* (among other classics), Gray's work uses "competing levels of texts, intertexts, paratexts [...] to compose complex, sometimes contradictory works of a near-endless postmodernist playfulness." The comparison to Shelley's work sheds light on the ways in which the author is "concerned with the notions of scientific and social progress and how this view has strong gendered associations in his fiction." More particularly, the postmodernist mode of writing a text which simultaneously asserts and subverts claims of scientific objectivity provides the author with the means to comment on the cultural representations of science, especially in its masculinist forms. This is true not only in *Poor Things*, but in other writings by Alasdair Gray as well, such as his science fiction short story "The End of the Axeltree" (1983) and the novel *1982 Janine* (1984) both of which criticize male scientific ambition in a metaphorical

style close to that of Frankenstein. As David Leishman points out, science is denounced in Gray's work "through use of metaphors and symbols which perpetrate a gendered opposition of a male science substituting itself for, and ultimately compromising, female fertility." In *Poor Things* it is through the character of Victoria that the themes of the connections between women, fertility and science are represented; yet despite Gray's postmodern, humoristic style, questions such as the "scientification" of childbirth are treated in a nuanced manner and invite, even force, the reader to reassess scientific progress in this field and others relating to the female body since the 19th century.

In a similar fashion and in an earlier timeframe, Donna Andréolle proposes an overview of science fiction written by women in the historical context of the second-wave feminist movement in the United States. This particular brand of science fiction is grounded in radical feminist reactions to the "gospel" of scientific progress, reactions which were simultaneously technophobic and 'techno-friendly' in nature: technophobic because the predominant images of the period, within the counter-culture, were those of the destructive uses of science linked to its military applications in Vietnam (napalm and the defoliant Agent Orange); 'techno-friendly' in that radical feminist Shulamith Firestone called for the use of "cybernetics," i.e. the development of artificial reproduction and incubation of human foetuses to free women from the "barbarism" of pregnancy and child-rearing. As Andréolle explains, feminist science fiction in its original form (written in the 1970's and 1980's) sought to promote the representation of strong female characters in control of scientific knowledge, especially the knowledge that liberates the female body from masculinist power structures. Two of the most uncompromisingly violent works on this theme are Suzy McKee Charnas's *Walk to the End of the World* (1974) and the sequel *Motherlines* (1976) in which an all-male society is depicted as depraved and cannibalistic while a mirrored, all-female culture has mutated itself to be able to mate with horses. Radical feminist scholar Marleen Barr, in an article on Charnas's novels, actually went so far as to propose that the tribal society of horse-women in *Motherlines* was superior to women's living conditions in 20th century America!

And yet such a stance rapidly produced a contradictory effect: in novels such as *Woman on the Edge of Time* (Marge Piercy, 1976) or *The Shore of Women* (Pamela Sargent, 1986) and *The Gate to Women's Country* (Sheri Tepper, 1988), female societies of the far-off future control science, and men, with a sometimes iron fist, leading the authors to question the superior nature of women in such cases. Connie Ramos, protagonist of *Woman on the Edge* of Time watches, with disgust and

hatred, a genetically transformed male breast-feeding a baby and denounces how science has actually stolen woman's unique bond with her offspring; the rising generation of young women in both Sargent's and Tepper's stories wonder if their mothers have not reproduced the gender-biased oppression from which they had liberated themselves. Thus, Andréolle concludes, today we must consider these works as a means used by women writers in the 1970's and 1980's "to bridge the gap between ideological representations of radical feminism's most controversial planks and the 'uneducated' female readership the authors were hoping to reach."

Last but not least, Yukihide Endo presents the case of Japanese *anime* and how this culturally-specific genre challenges the traditional construction of female identity. Endo, like Andréolle, points to the impact of second-wave feminism which challenged the gender-equality agenda of 19th century feminism and "adopted an essentialist view of gender issues in order to bring to the fore the female body of unparalleled potential and capability." More recent developments in feminist theory, in particular Donna Haraway's "A Cyborg Manifesto" (1991), have shifted away from essentialist vs. anti-essentialist paradigms to "posthumanism discourse that embraces human-machine hybrids." This new discourse, according to Endo, finds its representation in the cyborg characters of Japanese science-fiction *manga* and *anime* films. Endo demonstrates, through the example of Mamoru Oshii's *Ghost in the Shell*, that the use of the woman cyborg allows for the emergence of a "new female identity and agency." Descending—while diverging fundamentally in nature—from other liberated female protagonists of the Western world such as Barbarella and Wonder Woman, the protagonist Motoko Kasangi is able to embody the feminine and masculine, both physically and spiritually. Such "cross-gendering" not only disturbs traditional male/female representations but also questions the spectator's stance, by 'demasculating' the male gaze while 'masculating' the female one. This observation leads Endo to the conclusion that Oshii's depiction of women rejects humanist rhetoric and espouses "Haraway's provocative identification of future feminist women as cyborgs." By disrupting the social structure that allows men to subjugate women in the name of irreconcilable biological differences, *anime* depictions of female cyborgs open the door to "a posthumanist age [where] this stereotyped definition of sex and gender will inevitably collapse."

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Notes

[1] "Throughout history women scientists have been ignored, robbed of credit and forgotten" Margaret Alic wrote in 1986. "Their scientific work has been suppressed or expropriated in a variety of ways. Often women were recognised and respected as scientists in their own day, but were ignored or discredited by later historians who refused to acknowledge that women had been important scientists" (10).

[2] Philosopher and historian Alexandre Koyré coined the term *scientific revolution* in 1939 to describe this epoch. Historians have since then become increasingly uneasy with the idea that in the 17th century "a single coherent cultural entity

called 'science'" existed and that "a singular and discrete event, localized in time and space, that can be pointed to as 'the' Scientific Revolution" (Shapin, 3).

[3] Cf de Certeau's distinction between the concepts of *strategy* and *tactics*. Certeau links "strategies" with institutions and structures of power which are the "producers," while individuals are "consumers" acting in environments defined by strategies by using "tactics." Strategy refers to the top-down exercise of power to coerce compliance. Tactics refer to the opportunistic manipulations offered by circumstance.

[4] « *L'art de penser n'est pas étranger aux femmes, mais elles ne doivent faire qu'effleurer les sciences de raisonnement. Sophie conçoit tout & ne retient pas grand chose. Ses plus grands progrès sont dans la morale & les choses du goût ; pour la physique, elle n'en retient que quelque idée des lois générales & du système du monde […]« La recherche des vérités abstraites et spéculatives, des principes, des axiomes dans les sciences, tout ce qui tend à généraliser les idées n'est point du ressort des femmes, leurs études doivent se rapporter toutes à la pratique ; c'est à elles à faire l'application des principes que l'homme a trouvés, et c'est à elles de faire les observations qui mènent l'homme à l'établissement des principes.* » (Rousseau, Emile, Paris : Armand Aubrée, 1831 (first edition 1762), 170)

[5] In the United States and in England, some doctors defended the "scientific" principle that female physiology was governed by fixed and limited energy resources for all physical, mental and social actions and that too much brain activity would be detrimental to a woman's health and to her reproductive faculties (Hargreaves, 45).

[6] In 1608, Louyse Bourgeois published a major and comprehensive treatise on obstetrics. In it, she stressed the importance of anatomical studies for midwives. Other French women followed in her steps, such as Marguerite du Tertre de la Marche, head midwife of the Hôtel Dieu from 1670 to 1686; Marie-Louise Lachapelle (1769-1821) who introduced several innovations to the management of childbirth, especially in the cases of difficult labour; and Marie-Anne Victorine Boivin who invented a vaginal speculum and was one of the first medical practitioners to use a stethoscope to listen to the foetal heartbeat.

PART I:

WOMEN (RE-)PRESENTING SCIENCE

CHAPTER ONE

AUTO DIDACTICISM AND THE CONSTRUCTION OF SCIENTIFIC DISCOURSE IN EARLY MODERN ENGLAND: MARGARET CAVENDISH'S AND ANNE CONWAY'S "INTELLECTUAL BRICOLAGE"

SANDRINE PARAGEAU

Although they were denied a formal education like most women of their time, Margaret Cavendish, Duchess of Newcastle (1623-1673) and Anne, Viscountess Conway (1631-1679) both wrote treatises of natural philosophy. Cavendish published twelve books (and several revised editions of these works) between 1653 and 1668, while Conway wrote only one short treatise at the end of the 1670s, which she probably did not intend for publication. It was nonetheless posthumously and anonymously published in Amsterdam by Francis van Helmont and Henry More in 1690.[1] In their texts, Cavendish and Conway expounded their conceptions of nature and substance, presenting very similar views on the composition of matter. In answer to mechanistic theories, they both defended vitalistic doctrines, according to which nature is animated by a vital principle which secures order and harmony.[2]

Like the other "learned ladies" or "philosopheresses" of the seventeenth century, Cavendish and Conway may be considered as autodidacts in natural philosophy. It might be argued though that the expression "self-taught" natural philosophers seems as accurate (and maybe less pedantic) but "autodidact," a word which was coined in England in the sixteenth century,[3] may usefully refer to a variety of situations; what is more, as Joan Solomon wrote in defence of the use of "autodidacticism": "none of us could possibly be anywhere near to being completely self-taught" (3). Autodidacts may indeed be only partially self-taught; they sometimes receive the help of guides or mentors in their access to knowledge: they need "mediators" to succeed, be they places, practices, instruments or

persons (Frijhoff, 16). But they are considered as autodidacts as long as their knowledge is acquired outside the traditional educational system, whatever their social origin may be.

Margaret Cavendish and Anne Conway had to figure out different ways to access scientific knowledge in a patriarchal society that deterred women from dealing with intellectual subjects, and especially with science, which was still largely considered as a male prerogative.[4] Women who were interested in this field of knowledge, therefore, resorted to "tactics" in order to "infiltrate" the scientific world without being censured. Michel de Certeau's definition of "tactics" as "the art of the weak" is particularly relevant when it comes to studying how some women managed to access scientific knowledge in the seventeenth century. In *The Practice of Everyday Life*, Certeau explains that "tactics" are "*ways of using* the constraining order" (30). He adds:

> [The tactic] must play on and with a terrain imposed on it and organised by the law of a foreign power. It does not have the means to *keep to itself*, at a distance, in a position of withdrawal, foresight, and self-collection: it is a maneuver "within the enemy's field of vision," as von Bülow put it, and within enemy territory […]. It takes advantage of "opportunities" and depends on them […]. It must vigilantly make use of the cracks that particular conjunctions open in the surveillance of the proprietary powers. It poaches in them. It is a guileful ruse. (37)

Not only did Margaret Cavendish and Anne Conway use such "transverse tactics" in order to encroach on men's turf, but these very ways of "making do" led to unexpected results and creativity in their own scientific discourse (29-30).[5] Without any method or sustained pedagogical guidance, they had to invent their own conception and practice of science. But their books also reflect the scientific traditions of their time since, as autodidacts, Cavendish and Conway could not but imitate at first. Their scientific discourse is thus characterised by a surprising combination of tradition and audacity.

Considering that Margaret Cavendish and Anne Conway both wrote treatises of natural philosophy evincing clear mastering of the scientific vocabulary and theories of their time, one may wonder first, how they managed to acquire the knowledge revealed in their texts and what "tactics" they used to bypass patriarchal strictures. Then, what impact did these "tactics" have on their own scientific discourse? Is there any sign of the autodidacticism of their authors to be found in these texts?