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"A Question of Evolution? Imagining a History of Women in Computing"

by

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A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of *Master of Arts*

in

English and Film Studies

Humanities Computing

Edmonton, Alberta

Fall 2005

Dedicated to the women – known and unknown –
who have fought to contribute to the fields of science and technology.
Their passion and talents have become our collective legacy.

Abstract

A Question of Evolution?

Imagining a History of Women in Computing

In my Masters of Arts thesis project, I trace the origins of women in the history of computing, particularly in light Donna Haraway and Sadie Plant's contemporary feminist theories. In endeavoring to trace the "inherited obligations," as Haraway puts it, of women in the history of science and technology, I found no better place to begin than with Mary Shelley's monster in *Frankenstein*. Contemporary feminist images, such as the cyborg, have evolved out of other feminist stories and rhetoric that I see as encompassed in Debra Benita Shaw's term "the Frankenstein Inheritance." I (re)interpret the role of the Frankenstein Inheritance, and illustrate the importance of such (hi)stories as they involve contemporary gender politics. Such (hi)stories form a network, connecting each story to a larger whole comprised of many conflicting but intertwining notions of identity reflected in Baconian notions of science that continue throughout the twentieth-century.

Acknowledgements

Many people supported my journey through this project. First, I would like to thank Dr. Harvey Quamen for his direction and persistence throughout the research and writing of this work. His in-depth knowledge of the themes of this piece, and his suggestions about the resources I might examine, were hugely important to the completion of my thesis. Thank you also to my committee members, Drs. Sean Gouglas and Stephen Slemon.

My family has been extremely supportive throughout this process. I would like to thank my parents, Anne and Peter Smith, for their continued motivation and inspiration. My grandparents, Jack and Dorothy Reid, have also been extremely supportive in every way. Their character always pushes me forward. Thanks to all my friends and family for being supportive of my work through the years. Sonya and Mike and Karly – you are gems and kept me sane and balanced. Finally, I would like to thank Rich for all of his wisdom and laughter during the past year. Your intellect, heart, and perspective made me persevere.

Table of Contents

A Question of Evolution?

Imagining a History of Women in Computing

In writing this thesis, I was faced with two main problems. The first problem involved looking back to an origin of women in the history of computing, particularly in light of the contemporary feminist theories of Donna Haraway and Sadie Plant -- a hefty task for several reasons, many of which will be outlined in the following chapters. My second problem was much more evasive, though I sensed its presence from the beginning. It involved, in a general sense, the question of whether or not there was much merit in researching a history of women in the fields of computing and technology from the late nineteenth-century to present. Indeed, the very idea of constructing any type of historical timeline of women, especially one that involves the lofty concept of origins, might assume that there was *one* place to begin. It might assume that there was *one* correct way of viewing the events that occurred, or only *one* correct timeline to consider. This was a trap into which I was determined not to fall.

Yet, as I continued my research, I uncovered many important and interesting stories of women in early areas of computing. In particular, I found stories of women taking on the work of men during World War II. These stories began to form a network in my mind, a network that connected each story to a larger whole comprising many conflicting but intertwining binaries -- beauty and horror, or perhaps possibility and limitations -- caught up in the birth of modern computing during WWII. These stories become even more compelling when one considers how they directly intersect with many feminist stances of the late twentieth-century, particularly those of Haraway and Plant. But the

stories also stood out because I had not encountered them in *any* of my previous undergraduate or graduate level courses on the topic of the history and philosophy of computing. How could this be, I asked myself, when the history and philosophy of computing has been (and currently is) an integral part of the curriculum for undergraduate and graduate work in Humanities Computing? The absence of such material made the task of searching for more information on women in technological fields from the late nineteenth-century to present even more pressing, even if I faced the problem of looking at such women in a historical context that could venture into the dangerous territory of origins. Incorporating these women into the history and philosophy of computing became an important academic endeavor.

Moreover, there was the problem of placing such individual stories of women in computing into a more general context of the field. It was difficult to determine how to read into this network of stories. Which of the individual women's stories of working with and literally *as* computers were anecdotes or anomalies, and which were more representative of most women's experiences? And how did such stories of women in particular fit into a greater narrative of the evolution of computing, which is admittedly very male-dominated? Such difficulties exist with most research that delves into the area of origins and philosophy.

But there are also some particular research difficulties that exist in the field of Humanities Computing to acknowledge since, though there is plenty of research on the history of computing, these accounts rarely (if ever) mention women outside of the few well-known figures like Ada Lovelace or Grace Murray Hopper. My research determined that there is nothing remotely close to a "definitive guide" on women in

computing. Janet Abbate, an academic and well-known author on the history of computer networks, agrees that there is a lack of information on the history of women in computing. She argues that "[w]omen's historical involvement with computers has not been widely publicized, in part because historians of computing until recently have focused mainly on hardware" (Abbate 4). She goes on to outline the reasons why women have historically played an important role in the development of software (a point which we will return to in Chapter Three). Abbate describes how women offer valuable skill sets to the field of computing. However, she agrees that this lack of information on women in the history of computing has effectively obscured the role of women (Abbate 4). Given the state of these grossly inadequate accounts of women in the history of computing, the task of delving into this history more thoroughly becomes an increasingly necessary (if difficult) one.

Indeed, historically women have been most important to the programming, the *language*, of computing. Adele Goldstine was one such woman. According to her husband Herman, himself an important pioneer in the field of computing and the head of the development team for the ENIAC during the early 1940s, most of the credit for ENIAC's success goes to Adele Goldstine (Greene 76). She created both a systematic method of programming, an extraordinary task that no one had ever accomplished before, and the program manual for the ENIAC (Greene 75-76). Like computing pioneer Ada Lovelace, lesser-known women like Adele Goldstine used their skills to not only gain a thorough understanding of the cutting edge technology of their time, but they also used their skills to communicate with others. They were involved in educating others about new technology, and played a large role in imagining the applications of computers.

Many women, like Adele Goldstein, played an important role in the history of computing. Their stories are an integral part of understanding the history of computing. Though I could not list all of their individual names and accomplishments in this thesis project, I have attempted to pay homage to their importance in the more general account of the history of computing. I have tried to capture the overarching essence of their work, their talents, and their courage in entering the male-dominated realm of science and technology.

The research difficulties in the field of Humanities Computing (indeed, in many interdisciplinary programs) are compounded because of the limited resources available. Often, these resources are not consolidated in one area or cross-listed in any way, but instead can appear in such diverse areas as Engineering, English Literature, History, Art and Design, and Computing Science. Of course, one might anticipate that such research problems will decrease as interdisciplinary fields like Humanities Computing expand and grow. My research highlighted the importance of creating a place for such interdisciplinary work on computing to be more consolidated and easily cross-referenced rather than being lost in the remote zones of so many different disciplines. Though I make no claim to solving such research problems, I do hope that efforts to bring together interdisciplinary work will highlight women in computing history and make it more apparent that there are still many stories to incorporate into a history of computing.

Yet, in spite of all these factors illustrating the significance of examining women in the history of computing, I was both intrigued by and worried about how a look back at women in the history of computing might confront aspects of current feminist theory. I wondered how one could examine the history of women while also realizing possibility

in moving away from binary definitions of origin, gender, and progress. In particular, I was concerned with how the history and stories of women in areas of technology might intersect with Donna Haraway's conception of the cyborg. Haraway's ever-so-postmodern dismissal of origins, or a linear understanding of history and historical contexts, still presents itself as a strong part of women's studies and feminist theory, particularly in relation to women and technology. In her influential essay "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth-century," she advocates forgoing romantic attempts to find origin(s) that affirm and define such binary constructs of male/female or nature/technology. She employs the image of the cyborg to represent a postmodern-feminist affirmation that embraces hybridity in lieu of searching for an authentic definition or actualization of these binaries or of the self. She sees "Liberation" as existing in an acceptance and exploration of technoscience which makes no claim of innocence and instead recognizes the potential in the hybridization, rather than the binarization, of nature/mechanical, organic/cybernetic, male/female. For Haraway, feminist and social possibilities are encoded only in the monstrous cyborg which resists categorization and thus subordination.

While there is immense possibility in this image of the cyborg -- indeed, it has become synonymous with a large body of feminist work since the 1980s -- it is the concept of *origins* that must act as a crucial axis of engagement when exploring women's role in the history of computing. In discussing the politics of domination that exist in science and scientific discourse, Haraway specifically sees the liberating functions of social relations as dependent upon the rejection of an idealistic quest for authenticity and objectivity. She calls for the rejection of all ideological claims for "pure objectivity" that

justify the human domination of nature *(Simians and Cyborgs* 19). She continues this dismissal of the quest for true origins and pure objectivity throughout her discussion of situated knowledges and the feminist conception of the cyborg. Haraway especially attempts to rearticulate the feminist investment in redefining notions of objectivity and origin. Instead of relying on Baconian views of science that reinforce the definition of subjectivity and objectivity as mutually exclusive terms, Haraway advocates scientific and social exploration that requires multiple points of inquiry. She challenges binary, exclusive ideals and ideological boundaries that promise transcendence. Rather, she is in favour of earth-wide connections because "partial perspective can be held accountable for both its promising and destructive monsters" *(Simians and Cyborgs* 190-191).

While Haraway takes issue with origins, it is by looking at stories of women in early areas of computing in conjunction with modern feminist conceptions of technology that we can reimagine the human/scientific/nature relationship in new terms. This redefinition of complex relationships and histories attempts to circumvent a quest for one truth, origin, or objectivity, particularly those that rely on the dynamics of domination and submission. With this focus on origins and putting issues of gender and technology into a broader historical frame, I began to see the importance of preserving, not erasing, these (hi)stories. By considering *both* the early twentieth-century roots of women working as computers and post-modern feminist theory, one can conceptualize a fuller, more balanced and rich way of recognizing our past while still imagining the future. Indeed, it is this preservation and exploration of women in technology that I will explore in more detail during the coming chapters.

This mitigation of past, present, and future stories is what I found to be the most

interesting about Haraway's introduction to the recently released collection of her essays, *The Haraway Reader* (2004). Here, she emphasizes (if briefly) the importance of reconciling the impossibility of authentic origins with the importance of stories. In fact, Haraway chooses this issue to frame her collection of works:

> Figures collect up hopes and fears and show possibilities and dangers. Both imaginary and material, figures root peoples in stories and link them to histories. Stories are always more generous, more capacious, than ideologies; in that fact is one of my strongest hopes. I want to know how to inhabit histories and stories rather than deny them. I want to know how critically to live both inherited and novel kinships, in a spirit neither of condemnation nor celebration. I want to know how to help build ongoing stories rather than histories that end. In that sense, my kinships are about keeping the lineages going, even while defamiliarizing their members and turning lines into webs, trees into esplanades, and pedigrees into affinity groups. (*The Haraway Reader* 1)

Here, Haraway attempts to redefine history not in terms of truth, transcendence, or origin, but by embracing our inherited stories of and relationships with the past, rather than leaving this complex array of perspectives by the wayside of political and literary theory. Her approach shows great promise as a tool for discovery and analysis. My thesis project echoes the hope that Donna Haraway so aptly articulates. I too hope to build (and advocate) "ongoing stories" of women in technology. But in order to ensure that such stories of women in computing do go on, we must first explore the many points from which they came.

It is not my aim to emphasize women in the history of early computing in order to pin-point once and for all the "true" history of computing, or to create, as Haraway says, "histories that end." While researching my thesis project, I began to see how the contemporary fascination with gender and science is very much a part of a larger scientific narrative of the twentieth-century. This larger narrative of gender-science dynamics is rooted in such diverse aspects of culture as science fiction, war-time identity changes, and emerging economic and scientific relationships that fostered many of the technological developments of the previous century. Much of my research led me to discover the importance of the *language* of technology. In her influential feminist work, Sadie Plant engages the language of science as it has been related to the conception of binary definitions of male/female, objective/subjective, nature/science. In particular, she raises questions about these binaries as they are involved in feminist discourse of the past, present, and future. She discusses binaries and boundaries in order to challenge notions of gender that place women outside of scientific and technological discourse.

Both Donna Haraway and Sadie Plant make inquiries about technology and metaphors of code in order to reimagine and rearticulate historical and contemporary feminist agency. However, Plant's particular strength is her emphasis of the material aspect of the codes, boundaries, and hierarchies involved in the gender-science debate. She uses powerful, nitty-gritty language not typical of academic theory to highlight the hands-on labour required to move in, around, and between these boundaries. In detailing the raw material aspects of technological evolution and human interaction, she brings together the technical and the organic components of the history of women in computing. Like Haraway, Plant takes up the gender politics of domination and notions of the human

that involve an ideal of uncovering historical truth or what is "natural." Yet, Plant's focus on the organic and the material aspects, especially her work highlighting the work of women in the history of science and technology, underscores the literal and physical human connections involved with these (hi)stories. Her efforts to paint a complex picture of this history by looking at the particular historical, social, and scientific circumstances involved in the gender-science debate have certainly influenced and inspired my attempt to rearticulate the history of women in computing.

Historically, scientific language and the metaphors therein have been an important part of articulating early notions of innate or "natural" male and female relationships to nature and science. This was especially true throughout the Victorian era, when writers and scientific thinkers alike contemplated the importance of science. Throughout the twentieth-century, language continued to play an important role in enabling women to demonstrate their strong technical abilities. In many ways, women used their linguistic capabilities to teach others about science and technology, to record and preserve important historical data, and to articulate new ideas about the applications and usage of developing technologies. In the following chapters, I hope to demonstrate the importance of considering the work of women in early technological realms in order to (re)interpret women in computing, especially in reference to the work of women involved with Allied war efforts during WWII.

I find it impossible to avoid the issue of war when looking at the history of women in computing, and thus have intentionally highlighted the WWII era. In looking at the 1930s and 1940s, one can see both the birth of many complex conceptions of modern technology, as well as the confusion of gender roles and definitions after the introduction

of new tools like the computer. Technology after WWII became ambiguously loaded tools because of the amount of change. New technologies (including new domestic tools for housekeeping) were intentionally marketed as a part of the new American dream and the democratic way of life. For instance, one of the ways in which a certain amount of limited agency erupted during WWII was through U.S. propaganda, which was at once telling women to join the workforce but also to imagine their future in secure, postwar domestic roles. In most of these propaganda pieces, women in the Allied countries like the United States were told like never before to embrace technology, whether it be through filling the jobs of men away at war or through their moral-boosting dreams of post-war "kitchens of the future" (Wosk 188).

Haraway's discussion of stories also reinforces the importance of such (hi)stories to war. To her, the wars of the twentieth and twenty-first century have given her "inherited obligations" and make her who she is (*The Haraway Reader* 1). In her words, "[t]hese worlds at war are the belly of the monster from which I have tried to write into a more vivid reality a kin group of feminist figures" (*The Haraway Reader* 1). There is great potential in redefining the history of women in computing while also taking on our inherited obligations. I share her conviction that stories, even defamiliarized or chaotic ones, fuelled the wars of the twentieth-century, especially WWII. In a very real way, it is where history and technology and issues of agency intersect that one can see both the most abhorrent and the most inspiring of human action. It is no coincidence that so many stories of women working with machines during the war efforts of the 1930s and 1940s should become an integral part of the history of computing, and of many political narratives still present today.

In endeavouring to trace back the "inherited obligations" of which Haraway speaks, I have found no better place to begin a discussion of this inheritance than with Mary Shelley's monster in *Frankenstein*. As a young author, Shelley created her own dialogue within a popular, public frame while using her texts to explore and gain access to a private, male-dominated scientific sphere. Recently, contemporary feminist Debra Benita Shaw coined the phrase "the Frankenstein Inheritance" because of Shelley's attempt to create "a world structured by the possibilities of scientific theory but informed, necessarily, by the politics of gender" (Shaw 178). I have taken this concept of the Frankenstein Inheritance to signify feminist attempts to repossess that which is outside of and discarded by traditional, male-controlled scientific and philosophical topography. The Frankenstein Inheritance has continued to hold importance for feminists since the nineteenth-century because the symbol of the monster is so rich, so diverse, and so popular. The monster is both a foreign, unnatural Other (an outcast because of his hideous form and unique because of his scientific birth), but also a familiar reflection of self (he goes through developments stages, such as acquiring language and expressing emotion, that every human experiences). Frankenstein's monster also represents ambiguity since Shelley often gives the monster both female and male gender characteristics throughout the novel. The monster, at once liberated by his birth and confined by his scientific abnormalities, is the quintessential metaphor of conflated and confused notions of justice, human nature, science, and gender that exploded in WWII and which became so recurrent throughout the twentieth-century.

I see the Frankenstein Inheritance as also signifying a lineage involving the author and the technology of popular writing in general. Just as Mary Shelley employed

metaphor to gain access to scientific discourse and participate in a scientific dialogue, so too have feminist critics claimed the outcast Shelley as their own, affirming *Frankenstein* and the image of its hybridized monster as a symbol of power. Her popularity and the widespread attention to her novel indicate Shelley's ability to use the novel and the technology of writing to overcome boundaries of gender. Through this new form of scientific discourse, science fiction, she enabled the accessible exploration of elite nineteenth-century scientific discourse for the masses. This lineage involves not only the metaphor of the monster that signifies so many complex and contradictory issues involving technology, science, and human nature during the twentieth-century, but it also involves the means by which this metaphor was represented and distributed. As the mother of popular science fiction, Shelly has provided us with the Frankenstein Inheritance so that we too can delve into conceptions of identity and life that are at once ambiguous but also full of insights into philosophical complexities.

The History of Women in Science and Technology:

(Re)Producing Mother Nature

During the late seventeenth-century and early eighteenth-century, Sir Francis Bacon developed influential writings that advocated for man's domination and control of nature, particularly through scientific methods that would exploit the natural environment. Bacon's scientific philosophies were the basis of scientific theory and practice throughout the Renaissance and the Victorian era, and Baconian theories continue to resonate with feminists and scientists alike. An English philosopher, politician, and scientific methodologist, Bacon advocated a new scientific empiricism that championed experimental control and rejected biased and supposed knowledge based on appeals to authority. One of his most influential theories of modern science was his theory of induction. Induction attempts to demonstrate that certain laws are general and can be universally accepted. Thus, according to Bacon, certain responses which result in measurable change can be anticipated based on these laws. For instance, with heat one can observe a measurable change in the motion of particles that make up the moving body. One reason why Baconian theories have been a central and controversial part of the development of modern science is not only because his works articulated new, measurable scientific methodology, but also because he *imagined* and *articulated* this new science in a way that fascinated others. As Paolo Rossi notes,

> Bacon is one of the constructors – perhaps the greatest – of that which can be called the modern image of science. His discourse on this theme is ample, articulated, full of intellectual force, literarily efficacious, rich in

> inimitable metaphors. His discourse does not concern only the method of science (everyone knows he made an important contribution to the discussion on induction). It concerns above all the function of science in human life...the ways in which this form of knowledge must present itself in comparison to the other forms of cultural life: poetry, history, religion, ethics, politics. (Rossi 26)

What is compelling about Bacon's philosophies, then, is not only what he articulated but also how he imagined modern science. His works were able to traverse literary, philosophical, political, and scientific spheres. He remains a central figure in popular discussions of the social history of science because his employment of language and metaphor bridge the gap between science and society. Indeed, this use of *language* to engage public interest and discussions on a number of diverse scientific issues will remain an important part of our exploration of the feminist aspect of recent social histories of science.

Because Bacon's imagination of modern science relies on the characterization of nature in relation to gender, Baconian theories have been taken up by many women writing about science, including Mary Shelley and Evelyn Fox Keller. Such a gendered characterization of nature both *affects* and *crystallizes* the power dynamics involved in many scientific preconceptions and practices. One of Bacon's most famous and influential works, *Novum Organum*, depicts nature as a female object controlled by the male sphere of scientific reasoning. In the author's preface to *Novum Organum* and *The Dignity and Advancement of Learning*, Bacon explains the state of eighteenth-century knowledge, reasoning, and natural history in the following way:

> Our natural history is not designed so much to please by its variety, or benefit by gainful experiments, as to afford light to the discovery of causes, and hold out the breasts to philosophy...With regard to its collection; we propose to show nature not only in a free state...but more particularly as she is bound, and tortured, pressed, formed, and turned out of her course by art and human industry. Hence we would set down all opposite experiments of the mechanic and liberal arts, with many other not yet formed into arts; for the nature of things is better discovered in the torturing of art, than when they are left to themselves...For man being the minister and interpreter of nature, acts and understands so far as he has observed of the order, the works and the mind of nature, and can proceed no further; for no power is able to loose or break the chain of causes, nor is nature to be conquered but by submission. (Bacon 17-20)

Here, Bacon clearly portrays nature as the female object to be controlled and forced into submission by the rational, subjective male scientist. His gendered metaphors place man as a powerful "minister and interpreter" who must control and observe Nature by conquering her, even if her submission requires means of torture. Such strong and problematic metaphors that idealize man's control of nature and conceptualize women as the object of submission have remained in the fore of many feminist discussions of scientific theory and practice, particularly during the twentieth-century. The relevance of Bacon's metaphor of man versus nature exists not only in its influential popularity, but also in its ability to give a telling historical glimpse into the early conceptions of women's role in (and exclusion from) science. Bacon's metaphors helped create the

many "natural" analogies and assumptions of his time, especially because his philosophies also create a new way of imagining modern scientific purpose and practices.

Evelyn Fox Keller agrees that social critics of modern science hold a general acceptance of Bacon's theories that articulate a need for science to control and dominate nature. In her influential text, *Reflections on Gender and Science*, Fox Keller notes how the acceptance of Bacon's gendered depictions of science and nature has important implications that are often overlooked or misunderstood:

> the aggressive male stance of Bacon's scientist could, and perhaps now should, be seen as driven by the need to deny what all scientists, including Bacon, privately have known, namely, that the scientific mind must be, on some level, a hermaphroditic mind...[the contemporary scientist's] kinship with Bacon survives in his simultaneous appropriation and denial of the feminine. (Fox Keller 42)

By looking at the evolution of Bacon's metaphors of gender in relation to science and nature, she contends that one cannot read Bacon's theories themselves as simply equating nature with the feminine and the scientific mind with the masculine. Rather, it is the recognition and subsequent suppression of the fluid relationships between science and nature, male and female, that indicates important and problematic trends in the larger social acceptance of Baconian theories. The pervasiveness of Baconian theories and their continued application in twentieth-century science point to the greater, complex gender dynamics within the scientific community. These complex gender dynamics, as Fox Keller notes, are based on problematic philosophies of domination that frequently involve the "appropriation and denial" of the female. The scientific community's confused and

historically problematic application of Baconian theories is indicative of the widespread gender politic throughout scientific fields which privilege the male and deny the female.

The "Nearly Silent Listener":

Mary Shelley and the (Gender) Politics of Science

In light of this attempt to "appropriate and deny the feminine," feminist readings of scientific theories (particularly Baconian theories) become extremely important. Writers like Mary Shelley, Evelyn Fox Keller, and Donna Haraway, among others, have learned from Bacon's popular articulation of a scientific vision. These feminists have used the technology of language to articulate a more inclusive vision of science and nature, to take on metaphors that rely on binary conceptions of male/female, science/nature. In fact, Mary Shelley's popular text *Frankenstein* directly challenges such Baconian characterizations of nature as a female object for investigation, views that have become increasingly prominent in contemporary sciences. Feminist critics like Anne Mellor, Debra Benita Shaw, and Gillian Beer agree that Mary Shelley takes on precisely these Baconian views which place the woman (nature) as an object for investigation, inquiry, penetration, and reproduction, rather than the investigators of science (Shaw 6). These feminist literary critics argue that such Baconian constructs are the venue through which Shelley presents an alternative to and critique of female exclusion from science.

Indeed, anyone considering the history of women in relation to science and technology must recognize the importance of Shelley's work. *Frankenstein* has been so influential in scientific and social circles since its first publication in 1818 that much of

the literary and scientific discourse surrounding human nature, particularly that of feminists, has been dubbed "the Frankenstein Inheritance" (Shaw 178). Donna Haraway would likely include Mary Shelley's efforts as a part of what she calls "inherited obligations" and as a part of those "ongoing stories" and lineages important to contemporary feminism (*The Haraway Reader* 1). Situated within Romantic intellectual circles, Mary Shelley was privy to, but largely excluded from, much of the scientific and philosophical dialogue of her time, mainly through conversations between Lord Byron and her husband Percy Bysshe Shelley. During such dialogue Shelley was the " 'nearly silent listener,' excluded from, but affected by, scientific discourse" (Shaw 10-11).

In response to this exclusive masculine realm of scientific discussion, Shelley used her imagination and powers of metaphor to find feminist agency. She created her own dialogue within a popular, public frame, using her texts to explore and gain access to a male-dominated scientific sphere. The Frankenstein Inheritance, then, signifies the instantiation of feminist attempts to repossess that which is outside of and discarded by traditional, male-controlled scientific and philosophical topography. Just as Mary Shelley employed metaphor to gain access to scientific discourse and participate in a scientific dialogue, so too have feminist critics claimed the outcast Shelley as their own, affirming *Frankenstein* and the image of its hybridized monster as a symbol of power.

In focusing on the role of feminist criticism in preserving the valuable scientific and social importance of *Frankenstein*, one begins to witness the strength of Shelley's image of the monster as representative of the continued struggles of women in the sciences. The point at which science (the monster) and Romantic notions of "man" (the human) intersect in Shelley's novel is, appropriately, through nature and the natural.

Frankenstein contains many references to "nature" and the natural order of life, as well as what is "unnatural," and such terms describe Victor's intentions as a scientist as well as the his scientific creation, the monster itself.[1] Through Victor's desire to create his monster, he takes on three "unnatural" roles: he plays the role of Creator (he becomes God-like in his ability to create a living thing), the role of a successful but misguided, solitary, and obsessive male scientist, and the role of a maternal figure who spends time in "painful labour" while trying to animate his "lifeless matter" (Shelley 80-82). In his efforts to (re)produce a living being, Victor becomes the "author of unalterable evils," and through Victor's consequences Shelley seems to critique the role of a solitary, elite, and limited sphere of scientific discovery that does not involve balance and that relies on inflexible binary distinctions of gender, nature, and the human (Shelley 119). For instance, while he "pursued nature to her hiding places" during his scientific endeavors, Victor realizes that his human nature turns "with loathing" from his occupation (Shelley 82). However, the ultimate denial of his human impulses in favour of his scientific ones makes Victor more a slave than an artist enjoying his trade (Shelley 82). Despite his attempts to be rid of the monster, he eventually learns that he can never be free of *science or nature*, that he cannot deny the human or the natural in favour of the scientific. *Frankenstein*'s overarching lesson clearly points to the danger of scientific endeavors that do not heed the human impulse, and the threat of the scientist who takes on the role of Creator and (re)produces without nature's female womb or respect for the feminine realm of nature.

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[1] See *Frankenstein* pages 80-86, 89-90, 154.

Shelley's metaphors of nature and the natural ultimately demand the need for balance and a more inclusive sphere of science: the novel warns against the abuse of nature and the denial of the feminine. In order to oppose Bacon's characterization of nature as an object to be endlessly exploited by science, she used her own metaphors of nature, art, and the feminine that demonstrates their power and demands their respect. She demonstrates that consideration of the human, particularly the female, and the natural are an essential part of the scientific process through Victor's own critique of his scientific practices:

> Who shall conceive the horrors of my secret toil, as I dabbled among the unhallowed damps of the grave, or tortured the living animal to animate lifeless clay?...I seemed to have lost all soul or sensation but for this one pursuit. It was indeed but a passing trance, that only made me feel with renewed acuteness so soon as, the unnatural stimulus ceasing to operate, I had returned to my old habits...The summer months passed while I was thus engaged, heart and soul, in one pursuit...but my eyes were insensible to the charms of nature. And the same feelings which made me neglect the scenes around me caused me also to forget those friends who were so many miles absent, and whom I had not seen for so long a time. (Shelley 82-83)

Here, Victor describes his separation from nature and his neglect of society as both the result of his scientific endeavours and, as he realizes later in the novel, the cause of his scientific monstrosity. Throughout the novel, Victor recalls such scenes of solitary obsession as being the source of his troubles – indeed, he becomes physically ill from

these misguided scientific practices, recovering only to be morally plagued by the monster as well. As D.L MacDonald and Kathleen Scherf note, in the above passage Shelley also echoes the concerns of William Godwin's *Political Justice*, which demonstrated the scientist's need for society and critiqued "the tendency of technology to reduce humans' reliance on each other" (83). But Shelley went further than generally advocating a wider range of scientific discussion that involves more than just an elite, male sphere of scientific thinkers. In critiquing Bacon's metaphors of science by demonstrating the consequences of scientific attempts to subdue nature and ignore society, Shelley illustrated the scientist's need for a more extended society that specifically involves the feminine. Through Victor's actions, she demonstrated that natural impulses and nature itself (and by association women) should be involved and respected in the scientific sphere.

Shelley's critique of isolated, narrow, and binary discussions of science that do not involve women has been taken up by other feminists who oppose the scientific community's overwhelming acceptance of Baconian gender metaphors. Her metaphors opposed Baconian assumptions by illustrating the need to respect and acknowledge nature and thereby women. In fact, Evelyn Fox Keller's critique of Baconian metaphors closely follows that of Shelley in *Frankenstein*. More than a century later, Fox Keller takes up the Frankenstein Inheritance by continuing Shelley's opposition to Baconian metaphors of science. As we have previously seen, Fox Keller reads the continued acceptance of Baconian metaphors that deny and suppress the feminine. Likewise, Shelley's *Frankenstein* also rejects Bacon's theories of science and nature by depicting a more complex, fluid dynamic between science/male and nature/female. She compares

the "lonely road" of male scientists to that of Coleridge's troubled Ancient Mariner, and critiques solitary male scientists like Victor who ignore or abuse nature, women, the humanities and natural human instincts (Shelley 82). By complicating and reconstructing prevalent Baconian metaphors, Shelley calls for more complex readings of gender and science that complicate a simply binary definition of nature as a feminine object to be subdued and that see science as an exclusively masculine arena. Victor's employment of Baconian notions of science that aim to conquer, rather than embrace, that which is outside of a male-dominated sphere of science ultimately leads to his misery and regret.

Perhaps the figure of Frankenstein's monster still remains a powerful image because he is, in many ways, the metaphorical instantiation of the scientist's rejection of the fluidity of nature. Echoing other novels of her time, Mary Shelley posed Victor and his monster as gothic doubles. This Doppelganger motif was a large part of the gothic tradition and appeared in numerous popular nineteenth-century novels, including Jane Austin's *Jane Eyre*, Wilkie Collins' *The Woman in White*, and Bram Stoker's *Dracula*. The monster represents the disfigured, deformed, and deconstructed "Other" (to invoke Edward Said's "Oriental" term), a figure who has long been the subject of folklore and scientific study. Frankenstein's monster is a gothic double that serves to reflect that which is both related to, but outside of, Victor's scientific realm, that which is Other, and the monster specifically reflects aspects of nature and gender that scientists like Victor wish to reject. His monster is made from nature, yet is "unnatural." It is masculine in both form and in intention, a representation of male ambition, scientific progress, and discovery; yet, its uncontrollable emotional and human "nature" and its organic origins point to feminine characteristics.

The monster represents the Other, that which is foreign and alien, but at the same time he is forever closely related to Victor because he is the child of Victor's own desires and labours. It is Victor's nemesis, as well as his gothic double. Victor's creation and, eventually, his misery are the result of his acceptance of Baconian science, and his attempt to control nature illustrates what Fox Keller argues is the appropriation and denial of the feminine. In his look at "The Ambiguous Heritage of *Frankenstein*," George Levine agrees that Victor and his monster act as gothic doubles and provide some important insight into the text: "[the doubles] can be seen, indeed, as fragments of a mind in conflict with itself, extremes unreconciled, striving to make themselves whole" (Levine 34). But the doubles' divided mind provides more than just a mirror through which to examine social and psychological complexities like schizophrenia that Levine describes. Because of his hybrid qualities, the monster is brought to life, willed into existence, through the unnatural appropriation of natural materials. However, the monster's existence is also denied because this appropriation makes him an alien Other which neither Victor nor the larger society is willing to accept.

The gothic double relationship between Victor and the monster provides further context for the larger importance of Shelley's work and the Frankenstein Inheritance. In specific, aspects of the gothic doubles reflect the social implications of technology, especially as these implications point to larger themes of gender and science throughout the Frankenstein Inheritance. Martin Tropp, for instance, provides an interesting reading of the gothic doubles that links this doubling in *Frankenstein* with technology. Tropp argues that "technology can never be more than a magnified image of the self" (Levine 35). Thus, just as the monster is a doubling and a reflection of Frankenstein,

technologies and technological tools also mirror the hopes, fears, and characteristics of the inventor. Levine explains this link between technology and the double of which Tropp speaks as warning against expressing the self in technology since it will lead to that which is uncontrollable and monstrous (Levine 35). It is interesting that, in a general sense, Levine's look at the ambiguous heritage of *Frankenstein* as it involves technology leads him to (intentionally or, in all likelihood, unintentionally) articulate his own version of the Frankenstein Inheritance:

> Thus, it would be absurd to claim Mary Shelley as a direct "influence" on the dominant literary and scientific forms of the century, we can see that in her secularization of the creation myth she invented a metaphor that was irresistible to the culture as a whole...In writers as central and various as Feuerbach, Comte, Darwin, Marx, Frazer, and Freud we can find Victor's activity: the attempt to discover in matter what we had previously attributed to the spirit, the bestowing on matter (or history, or society, or nature) the values once given to God... (Levine 28)

Though Levine is reluctant to name Shelley as a "direct 'influence'" on the realms of science and literature – indeed, he himself seems to be frightened by the lofty, uncontrollable concept of origins – he clearly credits Mary Shelley's figure of Frankenstein and his hybridized monster with the ability to cross-over and become a part of many nineteenth and twentieth-century conceptions of gender, politics, sexuality, science, psychology, technology, philosophy and culture.

The Importance of Tools, Genre, and Language as Technology

When one considers the continued influence of Bacon's metaphors and their social and scientific importance, it becomes increasingly clear that contemporary conceptions of science that employ Baconian rhetoric must be revisited and redefined. But to truly revisit such insipid rhetorical devices, we must recognize *how* and *where* such Baconian metaphors persist. One such recent patriarchal, scientific view of human/machine evolution which follows the Baconian tradition of denying a full consideration of gendered notions of science comes from Bruce Mazlish. Scientific accounts of history and science like those of Mazlish seem to represent the presence of a larger contemporary masculine scientific desire to resist the Frankenstein Inheritance and, thereby, a discussion of the importance of gender politics in science altogether. For instance, when considering the relationship (the differences and similarities) between animal, human, and machine, Mazlish asserts that what makes us human is the ability to create culture and tools of a complicated level, that "humans evolved from other animals through a continuous interaction of tool, physical, and mental-emotional changes" (5). Others, including Karl Marx and Benjamin Franklin, also referred in this way to their "fellow men as tool making animals," thus defining man's evolution by these tools and machines (Mazlish 213). However, though Mazlish discusses what constitutes the human, he seems to follow the male scientific tradition of resisting a full consideration of gender: he chooses not enter into the "gender and science debate," and instead casually mentions in his endnotes the hope that another scholar will approach the issue more fully (235).

It is difficult to comprehend this move to avoid the gender/science debate since such a broad historical and scientific account of tools and science in relation to human nature in a Marxist socialist context, especially one written at the end of the millennium, largely involves the prevalence of gender politics in the realm of science. Unfortunately, such male scientific efforts to ignore women in relation to high or "complex" tools and culture is representative of the male system of patriarchal control that Shelley's novel attempts to highlight: a fact that makes her and the Frankenstein Inheritance all the more relevant in the contemporary discussion of the human.

Yet, such scientific accounts of history and science from theorists like Mazlish do not deny the Frankenstein Inheritance on a general level. Rather, we can see the presence of such male refusals of the Frankenstein Inheritance (indeed, of gender politics as a whole) when Mazlish specifically takes on Shelley in his own look at human evolution. Mazlish not only denies the Frankenstein Inheritance in his refusal to discuss gender and science during his discussion of human nature, but also in arguing that the scientific references in *Frankenstein* are those of P.B. Shelley, thus placing Mary Shelley by the wayside of her own work. In reference to her understanding of scientific developments of her day as, Mazlish terms Shelley's understanding of science "a hodgepodge; she only dimly and intuitively grasped their meaning" (Mazlish 41). Furthermore, he seems either unaware of or unconcerned with other discussions of human nature and evolution, such as those from Donna Haraway, even though such feminist scientific discussion that erupted in the 1980s predates his 1993 text -- a move consistent with his denial of Shelley's scientific knowledge, her importance as a scientific and literary influence, and the Frankenstein Inheritance in general. Such initiatives make it clear that there are still parts

of the male scientific community that are unaware of (and, it seems, unconcerned with) feminists discussions that examine questions of human evolution and tools of progress. Nonetheless, it is important to note that, despite their seemingly opposite scientific discussions, present day male scientists like Mazlish and contemporary feminists like Haraway share a great deal of common ground in their depiction of the current state of human/machine dependence. They both, for instance, assert that society should take responsibility for technology, not demonize it (*Simians and Cyborgs* 181). Though they are clearly from different sides of the gender/technology discussion, both theorists demonstrate how human evolution (which Haraway articulates as the evolution of "bodies, politics, and stories") is tied up in an understanding of our tools and modern technology (*Simians and Cyborgs* 1). Yet, the difference between Mazlish and feminist theorists like Haraway exists in the way that feminists have claimed technology as *a tool for the imagination* of a new political topography through the cyborg: a claiming of the woman's role in both the organic and mechanic, a point I wish return to in more detail throughout Chapter Two. This contemporary feminist initiative argues that human evolution does involve both nature and machines as the Frankenstein Inheritance asserts, and so too must all humans transgress the demonization or idealization of either nature or machine, particularly in reference to gender.

Evolution and the Importance of Tools:

Genre as a New Technology

If the historical definition of human nature and evolution is explicitly related to tools and technology, as Bruce Mazlish and Donna Haraway suggest, then Mary

Shelley's role as the originator and Creator of the new genre of science fiction — a new literary and scientific tool — is particularly important (Mellor 107). In recognizing this evolutionary process, it is valuable to explore the origins of the technology of science fiction and the Gothic: in effect, to understand that this hybridized genre is itself a powerful commentary and revolutionary tool, itself a monster who is most certainly the predecessor of the cyborg. Through this technology of genre (science fiction), women are literally reduced to "pulp," as Judith Halberstam notes, a word that connotes not only the bloody dehumanization of women in the text of *Frankenstein*, but also male fears of "population/popularity" in the (re)production of the Gothic novel as a symbol of mass culture (49). Thus, Mary Shelley's literary invention of science fiction was threatening to male authority not only in content, but in form: popular print, like nature, became feminized, yet women employed this tool of (re)production to bring science out of an elite, isolated, scholarly male realm and into the public venue for discussion (Mellor 107). Following this tradition of popular texts like *Frankenstein*, cyborg writing occurs *through* science fiction just as it is *about* science fiction. It is about using imagination to seize the tools that will, as Donna Haraway states, "mark the world that marked them as other" (Mellor 107).

It seems crucial to explore this relationship between language, expression, and science as they pertain to a definition of the human that is based on our use of tools and technology. With this understanding of the importance of genre and language as technology, especially in reference to the tools of cyborg writing, let us turn more specifically to the role of language. Building on this tradition of the genre, particularly literary genres, as effective technology opposing traditional, canonical, male encoded

systems of power, the ever-present contemporary image of Frankenstein's monster on the screen has been reinforced to twentieth-century generations through another form of mass production: film. Since the story is a psychological thriller, it is not surprising that, as Halberstam notes, Victor Frankenstein becomes subject to the psychological Freudian theory of "projection" (45). Victor's projection, she notes, literally turns the monster into a screen (45). Not only is the monster a gothic double within the language of the text itself, but it also becomes the reflection of the scientist in the material form of the screen. The monster literally becomes the site where all of the male scientist's desires and anxieties are projected and reflected. Thus, since the monster is also the screen, he becomes the means by which the image of the scientist is received by and distributed to the public. The private, solitary scientist becomes the subject of public interest and critique.

But the point where projection becomes most relevant to defining the human is precisely between Freud's "mechanism of paranoia" and the *mechanization* of the human. Towards the end of the story, Victor calls attention to his own tendency to project:

> When I reflected on the work I had completed, no less a one than the creation of a sensitive and rational animal, I could not rank myself with the herd of common projectors...My imagination was vivid, yet my powers of analysis and application were intense; by the union of these qualities I conceived the idea, and executed the creation of man. (233)

Though Victor's reference here to "common projectors" most likely speaks to the more traditional definition of projectors as project creators, the importance of the psychological act of projection is still clearly a part of the relationship between monster and man.

Victor is the monster's double, and the monster receives and reflects the emotions and thoughts of his creator. The modern day image of the monster, through cinema and projection technology, symbolizes how technological tools are truly the means by which we realize the human. The genre of science fiction, and therefore Halberstam's notion of the "technology of the monster," evolves through the mechanized, mass distribution of literary pulp fiction to that of the projector in popular film.

If what is in question (human nature) is conveyed onto the monster/screen, then the medium itself (the projector) symbolizes human nature. This medium has a message, otherwise referred to in popular terms as the "moral of the story": in this case, a warning of the extremes of either Freudian paranoia or mechanized projection which excludes (and harms) the female. Essentially, as Marshall McLuhan points out in his infamous proclamation, we can see that the medium is indeed the message:

> In a culture like ours, long accustomed to splitting and dividing things as a means of control, it is sometimes a bit of a shock to be reminded that, in operational and practical fact, the medium is the message. That is merely to say that the personal and social consequences of any medium—that is, of any extension of ourselves—result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology...Many people would be disposed to say that it was not the machine, but what one did with that machine, that was its meaning or message...[however, we should instead realize that] "the medium is the message" because it is the medium that shapes and controls the scale and form of human association and action. The content or uses of such media

> are as diverse as they are ineffectual in shaping the form of human association. Indeed, it is only too typical that the "content" of any medium blinds us to the character of the medium. (McLuhan 7-9)

As McLuhan outlines in the above passage, media are extensions of the human. Any extension or medium, any tool of communication, "shapes and controls the scale and form of human association and action." Thus, the very act of projecting *Frankenstein* onto a screen is in and of itself a means of shaping and affecting the scale and forms of human discussion on the themes of Shelley's work. Likewise, the mass production of Shelley's text in popular print is representative of her genre's impact (science fiction) on the scale and form of discussions about science and gender throughout the nineteenth and twentieth centuries. Though there is a general tendency for scholars interested in media and communications to focus in on the medium itself, I instead see great possibility in looking at the message of media. It is by looking at the messages of our media – the greater contexts and implications of these structures — that we can begin to see how human relationships and evolution are implicitly tied to our tools of communication.

Further to this discussion of why and how the medium is the message, especially in reference to the Frankenstein Inheritance, it is important to understand how media affect human relationships in general. The metaphor of human as projector, as I have shown in the previous paragraphs, indicates the fleeting boundary between human and machine. Both Donna Haraway and Bruce Mazlish agree that this boundary between humans and their tools is increasingly transparent. Focusing in on the medium as the message, Haraway indicates the prevalence of such fleeting distinctions in her discussion of the artificial dichotomy between the humanities and the sciences:

> History is a story Western culture buffs tell each other; science is a contestable text and a power field; the content is the form. Period. The form in science is the artefactual-social rhetoric of crafting the world into effective objects. This is a practice of world-changing persuasions that take the shape of amazing new objects – like microbes, quarks, and genes. (*Simians and Cyborgs* 185)

Haraway tells us that "the content is the form," that the message is the medium, in order to underline how both history and science are packaged and relayed in deliberate ways that affect our world-view. The "amazing new objects" that we create are not purely objective, but are above all reflective of the social applications and understanding of these new tools and technologies. Indeed, our social understandings and perspectives not only shape how we use such tools, but they also influence what technologies we create in the first place. In essence, as we see with the relationship between Victor and his monster, it becomes increasingly impossible to separate human creators from their creations, their projections and their screens. The media that present Shelley's work – mainly film and literature – represent, participate in, and predict the very evolution that these modern theorists describe whereby it becomes impossible to define the human apart from its machines.

The monster's efforts to, in his words, "first become master of their [human] language[,] which knowledge might enable me to make them overlook the deformity," symbolizes for Shelley (and, according to the Frankenstein Inheritance, other feminists after her) feminist attempts to gain access to male power and eliminate the exclusion of women through the acquisition of information and education (Shelley 139). Certainly

language and metaphor seem to be the key to any debate about the human, nature, and technology. Anne K. Mellor suggests that, from a feminist perspective, the most significant relationship between science and literature exists in precisely this use of metaphor (in, for instance, literature and cinema, etc.) and language both *as* a technology and *within* technology: "The explanatory models of science, like the plots of literary works, depend on linguistic structures which are shaped by metaphor and metonymy" (Mellor 89). Through the Frankenstein Inheritance and its continued reinforcement of the medium as the message in mind, we can see how, historically, women have employed their ability to communicate and to use language as a means by which to enter and engage the male/scientific sphere.

Indeed, the importance of language as a technology and medium is a central part of both the text of *Frankenstein* and of the Frankenstein Inheritance as a whole. Just as the monster symbolizes the deformed Other who attempts to employ language as a means through which to be included, so too have feminists throughout the nineteenth-century and the twentieth-century employed language as a way to be accepted. Furthermore, these women often used language as a tool that enabled them to learn and teach others about inclusion. In his discussion of language, nature, and monstrosity in *Frankenstein*, Peter Brooks also finds the question of language to be an important implicit and explicit theme in the novel, especially when considering the problem of the monster (Brooks 205). He points out that "[t]hrough the medium of language, a first relationship is created. Like Coleridge's Wedding Guest, Frankenstein is compelled to hear out the tale of this cursed being" (Brooks 207). Hence, he shows how language is explicitly related to the "chain of existence and events" and a point of emotional origin for the monster

(Brooks 209). Through the Frankenstein Inheritance, women have directly taken up this attempt by the monster – and successful efforts by Shelley herself – to capitalize on the medium of language to create relationships so that they too might overcome the position of excluded Other. By following Shelley's example as an author who created new frames of dialogue through popular media, and by embracing the figure of the monster and his employment of language to demonstrate the "chain of existence" between supposed opposites like nature/technology, male/female, and art/science, feminists after Shelley have realized the importance of language as a technology.

Women have created the Frankenstein Inheritance by employing language to confront boundaries that exclude them from the realm of science. Brooks goes on to explore Lacan and the symbolic order involved with the semiotic components of *Frankenstein*, and brings this discussion of the medium of the language of the text to a more literary analysis of nature, Romanticism, and influential thinkers like Jean-Jacques Rousseau and Sigmund Freud. But it is important to note that his analysis of language in *Frankenstein*, though overtly interested in more of the literary than the feminist or scientific implications, agrees with and reinforces the overall reading of Shelley's work that many feminists and female scientists continue to advocate through the Frankenstein Inheritance: that "nature is not one thing, and those who think it so are caught in a self-destructive blindness" (Brooks 216). Language is an overarching theme in the text, and this theme continues to be an important part of contemporary discussions that attempt to articulate more complex and inclusive definitions of science and nature.

The Frankenstein Inheritance and Beyond

The importance of *Frankenstein* comes forth in many of these contemporary discussions of feminism, nature, and technology. The ever-present images of both the monstrous Other (women) and the solitary scientist (Victor) continue to haunt the sciences. Victor's desire to reproduce without women is still a prevalent desire among scientists, feminists, and even engineers (Hacker 349). Furthermore, the division of body as female and mind as male continues to define scientific discourse in a way that places women outside of scientific discussion and devalues their work. Indeed, the division of mind/body, organic/mechanic, male/female, high/low, humanities/sciences, and difference/equal rights feminism seems only reconcilable in the image of the monster, an image that is taken up by many authors, philosophers, and feminists in the twentieth-century. In fact, if we examine the prominence of Frankenstein's monster in relation to feminism and science, it seems clear that such monsters are still an important part of feminist theory, particularly in relation to technology and science. Shelley used metaphor, language, and genre to engage the Romantic, humanist ideals of her time, and to discount notions of nature (and the female) as passive. This nineteenth-century feminist opposition to such "natural" arguments which place women as outside of the patriarchal scientific system brings the present (particularly masculine) constructs of science into focus, particularly those of computer science and engineering, as we will in Chapter Two and Three.

The more one delves into the social and technological implications of these divisions, the more far-reaching and irresolvable they become. Yet, by embracing our Frankenstein Inheritance, particularly in the context of the cyborg, we take responsibility

for such divisions and work within them to imagine a movement between such binaries while realizing that these boundaries cannot be entirely resolved or completely erased.

Donna Haraway and the Cyborg Manifesto:
Where the Frankenstein Inheritance Meets Contemporary Feminist Theory

Given the immense influence of the story of *Frankenstein*, particularly as it has been played out through popular metaphor and different media, we can see that the Frankenstein Inheritance provides many insights into difficult and often illusive questions surrounding the contemporary feminist endeavor to embrace (hi)stories, origins, and the image of the monster. In their quest to dismiss problematic binary definitions of gender, contemporary feminists are particularly interested in how these (hi)stories, origins, and monsters are a part of reworking these binary definitions that place women outside the realm of science and technology. The Frankenstein Inheritance in many ways works to chronicle how feminists have employed this image of a hybridized monster to articulate a more inclusive alternative to gendered notions of science and nature, such as those of Sir Francis Bacon, that have been so widely and unapologetically accepted by scientists. Furthermore, as I will demonstrate in the coming chapters, the Frankenstein Inheritance is an important predecessor to and component of contemporary feminist theories. It is an important part of contemporary feminist theory that embraces the image of the disfigured monster, including the cyborg, in order to further articulate an alternative vision of the human and of nature that embraces postmodern notions of hybridity.

If we consider that many feminists, especially Donna Haraway, see great value in making historical documentation increasingly about the presence of "ongoing stories," then exploring the continued prevalence of *Frankenstein* becomes an essential part of realizing the presence of these stories around us, and an important part of seeing the ways

in which such ongoing stories work. The fascination with *Frankenstein* and its repeated significance for popular science into the twenty-first century is part of a network that ties together the evolution of such ongoing stories and how they begin to inform a great part of contemporary feminism. Indeed, the Frankenstein Inheritance seems to speak directly to Donna Haraway's desire to discover "how critically to live both inherited and novel kinships" *(The Haraway Reader* 1). The Frankenstein Inheritance does just that: it involves not only the inheritance of Mary Shelley's original story, but also the evolution of the original text into novel twentieth-century adaptations (on film, for instance) and *Frankenstein*'s presence among popular debates on science and gender.

Haraway takes up Shelley's critique of a *binary code* of exchange – binary structures that encode social relations through the use of domination and subversion. *Frankenstein* and feminist efforts like Shelley's are a crucial part of what Haraway calls "successor science." Her concept of "successor science" is the same inheritance that I am more specifically terming here as the Frankenstein Inheritance, and she describes successor science in the following way:

> I think [Sandra] Harding's plea for a successor science and for postmodern sensibilities must be read to argue that this close touch of the fantastic element of hope for transformative knowledge and the severe check and stimulus of sustained critical enquiry are jointly the ground of any believable claim to objectivity or rationality not riddled with breath-taking denials and repressions....Science has been utopian and visionary from the start; that is one reason 'we' need it...Western feminists also *inherit* some skill in learning to participate in revisualizing worlds turned upside down

> in earth-transforming challenges to the view of the masters. All is not to be done from scratch. *(Simians and Cyborgs* 192).

As we will discover in this following chapter, Haraway certainly recognizes the importance of Frankenstein's monster, as well as other feminist and scientific narrative. *Frankenstein* and Mary Shelley's influence as a feminist author is a part of Haraway's quest for feminist meaning, a part of her inherited skill in "revisualizing worlds." By looking at the Frankenstein Inheritance as it has affected and been taken up by Haraway and her theory of the cyborg and situated knowledges, we will begin to see the particular ways in which Mary Shelley's *Frankenstein* gives us incredible insight into the history of this feminism, its contemporary movement, and the possible future trajectories of feminist theory.

Keeping in mind the Frankenstein Inheritance and the importance of Frankenstein's monster as a feminist metaphor and the employment of language as technology that we examined in Chapter One, let us now turn to an exploration of the Frankenstein Inheritance as it pertains to twentieth-century feminism. Here, I hope to explore how contemporary feminism has taken up the Frankenstein Inheritance, particularly how this inheritance relates to Donna Haraway's notion of cyborg identity and origins. Also, I hope to examine how feminist Sadie Plant's ideas about history and technology provide some important and influential insights that help (re)form and rearticulate issues of technology and gender during the twentieth-century. Following in the footsteps of Mary Shelley, women of the nineteenth and twentieth centuries often employed their language and communication skills to bridge the gap between elite, male spheres of science and a more popular, inclusive realm of science. I intend to explore

how contemporary feminists like Haraway and Plant have used language to engage in areas of science and history that have often dealt with gender in problematic ways. This exploration of contemporary feminist theory will give new insights into the importance of reimagining the dynamic (hi)stories of gender and technology since the first publication of *Frankenstein*, especially (as we will see in Chapter Three) how these (hi)stories involve notions of gender during World War II.

Reinventing Nature:

Simians, Cyborgs, and the Frankenstein Inheritance in the Twentieth-Century

Donna Haraway's hugely influential work, particularly her seminal essay "A Cyborg Manifesto," has shaped many aspects of feminist discourse since the 1990s. Indeed, her success is partly due to her ability to speak so clearly on the gendering of science because she herself has been a scientist and feminist throughout her academic career. She has used her experience as a female Biologist to critique specific scientific theories and practices, especially components of the scientific field that rely on the Baconian ideals of male domination. But perhaps the most influential and intriguing aspects of Haraway's feminist ideology stem from her ability to speak to the contradictions and complexities within feminism and within a vast number of other movements and ideologies, including those involved with technoscience. She poses questions and formulates metaphors that create a more open dialogue of both the problems and the possibilities of feminism, especially as they relate to science and technology.

This more open articulation and engagement of feminist discourse, a discourse that has evolved out of the Frankenstein Inheritance, challenges problematic aspects of technoscience involving gender and identity politics. Moreover, Haraway's theories specifically take on technoscience in ways congruent with the defining characteristics of the Frankenstein Inheritance, a point to which I will return shortly. But before we can understand how Donna Haraway's theories continue the legacies of women like Mary Shelley, we must first examine three important components of Haraway's theories that have evolved out of the Frankenstein Inheritance: the politics of dominance, situated knowledges, and the cyborg.

First, like Mary Shelley's rejection of the dominance of nature and women in Baconian science, Haraway argues that *dominance* is not only the foundation of the historical evolution of scientific theories, but that it is also a crucial part of the theory and practice of contemporary science. Haraway challenges ideologies that rely on ideals of "pure objectivity" rooted in the split between subject and object that justifies the (traditionally Baconian) domination of man over nature and, subsequently, men over women. Haraway's questioning of the employment of the traditional subject/object split as it involves hierarchies shows that such binary categories are inherently linked to traditional dominant/subordinate splits. She deconstructs the subject/object split as it relates to the politics of dominance to illustrate the shaky ground on which contemporary scientific ideology stands: "without an organizing dominance hierarchy, social order supposedly is seen to break down into individualistic, unproductive competition" *(Simians and Cyborgs* 19). Following in the steps of feminists like Shelley who use the image of the monster to explore multiplicity and challenge theories of dominance that

advocate the masculine abuse of nature and of the female, Haraway's reading of dominance hierarchies challenges the politics of dominance that are so prominent in scientific theory.

She shows how hierarchies that inform many prevalent theories of social order and scientific theories of systems of exchange are inherently *male* systems that privilege dominance, particularly as these systems give some individuals the status of the "alpha" male *(Simians and Cyborgs* 19-20). Haraway notes how perspectives that account for more complicated theories of exchange and go against such hierarchies are typically *feminist* scientific and anthropological perspectives *(Simians and Cyborgs* 19-20). This "flexible process" makes room for multiple perspectives, and such flexibility fosters multiplicity and multiple modes of exchange that are similar to networks and webs of exchange. Multiple perspectives and webs of exchange resist binary systems that make the exclusionary categories of dominant/subordinate, science/nature, and male/female. Instead, Haraway sees possibility in exploring many models of social order and exchange, models where the status of a superior "alpha" individual is quashed. Just as Shelley critiques the scientist's attempt to create man by instead painting a portrait of Frankenstein's monster as a hideous anti-alpha male, so too does Haraway's rejection of hierarchies and binary classification that rely on the politics of inclusion/exclusion exist in quashing the notion of one dominant class, race, or gender in favour of wholly inclusive forms of exchange and classification involved with webs and networks.

Secondly, Haraway's articulation of "situated knowledges" critiques feminist ideologies, including social constructionist and Marxist Socialist feminisms, that promise transcendence or idealize bias/objectivity binaries *(Simians and Cyborgs* 186-187).

Instead, situated knowledges imagine world-wide connections and the partial ability to *translate* exchanges between traditionally separate binaries in place of efforts to create one language (or code) by which to define such exchanges. Mary Shelley created *Frankenstein* from the position of the "nearly silent listener," and attempted create her own scientific dialogue within the popular, public sphere of pulp fiction that was outside of the elite, male sphere of scientific discussion that excluded her.

Like Shelley, Haraway's concept of situated knowledges also attempts to imagine, envision, and repossess that which is outside of and discarded by traditional, male-controlled scientific and philosophical topography that relies on binaries of domination/ submission, male/female, science/nature. In Chapter One, we saw how language is an important theme of *Frankenstein*, and how text and the medium of language as a technology greatly shaped feminist and scientific discourse – a movement that was taken up by feminists after Shelley through the Frankenstein Inheritance. Moreover, the monster's attempt to engage in social relations through his employment of language, to "first become master of their language; which knowledge might enable it to make them overlook the deformity," is representative of the feminist attempt to gain access to male power (Shelley 139). The monster plays out a woman's desire to be accepted into such spheres through the acquisition of information and education. For both Shelley and Haraway, sensory experience and perception are important metaphors that attempt re-envisage and re-interpret traditional Baconian power dynamics by complicating and multiplying possible visions of nature and science, particularly as those possibilities become associated with opening the realm of science to women.

However, though Haraway uses the cyborg to take on the mission of Shelley's monsterous Other in its quest to gain access to multiple spheres of knowledge and scientific dialogue, the main difference between the cyborg and its monstrous ancestors is the cyborg's refusal of the notion of one redeeming, universal language in favour of multiple "situated" languages to be translated:

> The feminist dream of a common language, like all dreams for a perfectly true language, of perfectly faithful naming of experience, is a totalizing and imperialist one. In that sense, dialectics too is a dream language, longing to resolve contradiction. Perhaps, ironically, we can learn from our fusions with animals and machines how not to be Man, the embodiment of Western logos. From the point of view of pleasure in these potent and taboo fusions, made inevitable by the social relations of science and technology, there might indeed be a feminist science. *(Simians and Cyborgs* 173).

Haraway does not take on the Frankenstein Inheritance's search for this true, common language, but instead sees possibility in *not* resolving contradiction, in *not* aiming for acceptance through the acquisition of language and power dynamics that rely on the process of Othering in the first place. Such quests for a universal language and, consequently, origin and paternal acceptance is "totalizing and imperialist" according to Haraway. Instead, she sees possibility in a "powerful infidel heteroglossia" that would accommodate multiple rather than singular perspective and exchange *(Simians and Cyborgs* 181). Rather than attempting to find salvation in an original or universal language, Haraway does not reject the idea of shared communication: she reimagines and

reconceptualizes the idea of universal language into her dream of a shared network of exchange. She sees the heteroglossia as providing an opportunity for the *translation of* and *transition between* shared language and knowledge.

To Haraway, this dream of situated knowledge is instantiated in an "infidel heteroglossia" because it creates multiple perspectives and fosters participation through a web of references whose links create meaningful connections. Her notion of shared language through a multilinear[2] network of communication is perhaps closer to Vannevar Bush's early conception of the Memex than the feminist conception of a universal language.

In 1945, Bush wrote an influential essay called "As We May Think" that was published in *Atlantic Monthly*, where he described the Memex as a "memory machine" that would allow linking, archiving and retrieving knowledge in a less linear fashion than text (Bush 103-106). Bush's articulation of the Memex is certainly one of the earliest articulations of what we today call the Internet; though, it is important to note that others, including scholar Harvey Quamen, see H.G. Wells' *World Brain* as an even earlier source of this conception of links and nodes of data. We can see how Haraway's situated knowledges involve the inherited dream of a shared discourse that feminists like Shelley saw as a means to reject elite, exclusive male scientific discussion. Furthermore, Haraway's notions of shared discourse and situated knowledges are clearly influenced by twentieth-century thinkers, like Bush and Wells, who wanted to rethink the processing, sharing, and structuring of information. In form and in function, the Internet allows for

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[2] Though the term multilinear does not originate from him, scholar Andrew Mactavish's lectures at McMaster University have described multilinearity as a more meaningful conception of the hypertext experience. Mactavish argues that multilinearity avoids the problematics of the term "non-linear" since a user must experience hypertext through some kind of ordered chronology or path.

multilinear access to and sharing of information through networks of information. True to Marshall McLuhan's assertion that "the medium is the message," both the medium of the Internet and the content therein create a web of connections that manifests itself through situated knowledge. The Internet is, in fact, the infidel heteroglossia of which Haraway speaks.

It is relevant to recognize that Haraway's theory of situated knowledges was also influenced by and inherited from other theorists like Vannevar Bush and those technoscience and literary pioneers in the hypertext field. It is even more important, however, to see how hypertextual resources, such as the Internet, are not changing the way we read and write simply because they are non-linear. Rather, they are changing the ways we interact because there is a certain agency involved with hypertext's actualization of situated knowledge. Hypertext and the new media associated with it are extremely influential not because this technology confronts linearity, but because it is an instantiation of situated knowledge. The Internet, and any media that networks nodes and connects information systems that provide communication and community, is precisely what Haraway describes in her conception of an infidel heteroglossia. The Internet is itself an ever-changing heteroglossia with infidel origin and infidel children who are born and reborn again through combinations of metadata, text, images, video, and sounds. If situated knowledge and its infidel heteroglossia provide an opportunity for the *translation of* and *transition between* shared language and knowledge, then hypertext is the instantiation of this shared language which fosters exchange.

Haraway's dream of situated knowledge is realized in media like the Internet because hypertext allows for multiple perspectives and fosters participation through a

web of references whose links create meaningful connections. Hypertext enables community through the shared language of technology: the medium of the Internet *is* the message because its structure is literally built out of a language of communication, known commonly as hypertext markup language (HTML). HTML, or hypertext markup language, is itself a shared language, both a technical and linguistic means of translating exchanges. HTML is based on English, yet it is able to traverse the hardwired web of the Internet, and uses hierarchies and classifications to order (and, subsequently, retrieve) information. Even though HTML's protocol and classifications are based on their own legitimizing hierarchies, structures, and processes, its increasingly flexible means of exchange shows promise. Access to the technology of the Internet, and to that of HTML, is, of course, limited to those privileged computer users who can afford it. Yet, the collaborative communities and user-based frameworks of the Internet show potential in their flexible, shapeable hierarchies that are combined and increasingly temporal.

The Internet and its networks of users constitute the closest instantiation of Haraway's situated knowledges that exists in contemporary media. Based on a hardware infrastructure of ones and zeros, HTML translates and links exchanges between computer users through a network of many changeable connections and interactions. Programming languages such as HTML, as well as others like Perl, SGML, and XML (to name a few), enable users to maneuver through wires and pass along information and code. A communal, user-based vigilance occurs in these online communities that can protect and shape the direction of the spaces they inhabit. For instance, Wikipedia.org is an open-source online encyclopedia that represents the temporality and the user-driven flexibility

that is the basis of situated knowledge. As *Time*'s Charles Taylor points out in his article, "It's a Wiki, Wiki World,"

> Wikipedia is a free open-source encyclopedia, which basically means that anyone can log on and add to or edit it. And they do. It has a stunning 1.5 million entries in 76 languages-and counting. Academics are upset by what they see as info anarchy. (An Encyclopaedia Britannica editor once compared Wikipedia to a public toilet seat because you don't know who used it last.) Loyal Wikipedians argue that collaboration improves articles over time, just as free open-source software like Linux and Firefox is more robust than for-profit competitors because thousands of amateur programmers get to look at the code and suggest changes. It's the same principle that New Yorker writer James Surowiecki asserted in his best seller *The Wisdom of Crowds*: large groups of people are inherently smarter than an élite few..."A lot of corporations are using wikis without top management even knowing it," says John seely Brown, the legendary former chief scientist at Xerox PARC. "It's a bottom-up phenomenon. The CIO may not get it, but the people actually doing the work see the need for them." (Taylor 40)

What Taylor points out is not only the popularity of the largest online encyclopedia, but also how the nature of Wikipedia's online community fosters multilingual, world-wide, user-driven collaboration (Taylor 40-41). The "bottom-up" nature of online sharing and open-source parlaying embodies precisely the kind of shared knowledges and multiple perspectives of which Haraway speaks. Taylor outlines exactly the type of multiplicity

and communal user-vigilance that shape the exchanges on this site: "Wikipedia lets you put your favorite articles on a watch list and notifies you if anyone else adds to or changes them. According to an M.I.T. study, an obscenity randomly inserted on Wikipedia is removed in 1.7 min., on average...All kinds of viewpoints coexist in the same article" (Taylor 42). In effect, this referencing system is an existing, online "infidel heteroglossia" that literally redefines what it means to access and contextualize information. Wikipedia and its network of users challenge elite, academic spheres of privileged information both in its open-source form and its user-driven function.

Hypertext: A Cyborg Medium

We have established that the Frankenstein Inheritance involves not only the inheritance of Mary Shelley's original story, but also the evolution of the original text into new twentieth-century adaptations (on film and on the computer screen) and *Frankenstein*'s presence among popular debates on science and gender.[3] The medium of hypertext is itself tied to theories and theorists, such as Vannevar Bush, who reimagined linear, hierarchical media in the form of multilinear networks and webs. These hypertext pioneers see possibility in (particularly electronic) webs and networks because they allow the creator and user of the medium, as well as the content therein, to traverse multiple avenues of exchange, social order, and communication.[4] One of the reasons that Haraway's feminist theory was inherited from parts of the hypertext community is

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[3] Shelley Jackson's hyperfiction, *Patchwork Girl,* is one such recent engagement with Mary Shelley's *Frankenstein* that represents the quandaries of gender identity and science through the links and networks of a multilinear hypertext.

[4] Many scholars have debated the newness and (multi)linearity of hypertext or cybertext. For an indepth look at the debates surrounding hypertext and anti-hierachical media, see: Espen Aarseth, Roland Barthes, Janet Murray, Ted Nelson, and George Landow.

because both Haraway and the authors, computing scientists, and theorists involved with hypertext strive to confront hierarchies embedded within our systems of knowledge. As Ilana Synder puts it, "[h]ypertext disturbs our linear notion of texts by disrupting conventional structures and expectations associated with the medium of print" (17). Donna Haraway's conception of the heteroglossia also aims to disrupt conventional structures and expectations, particularly those male-encoded (and, scientific) ideologies that reinforce such rigid structures. This idea stems from Mikhail Bakhtin's definition of the term heteroglossia, which Michael Holquist re-articulates in the following way:

> The simultaneity of these dialogues is merely a particular instance of the larger polyphony of social and discursive forces forces which Bakhtin calls "heteroglossia." Heteroglossia is a situation, the situation of a subject surrounded by the myriad responses he or she might make at any particular point, but any of which must be framed in a specific discourse selected from the teeming thousands available. Heteroglossia is a way of conceiving the world as made up of a roiling mass of languages, each of which has its own distinct formal markers.[5] (69)

The infidel parentage of Haraway's heteroglossia, then, comes from feminists like Shelley aiming to open up avenues of communication through a common language, but also from other influential thinkers such as Bakhtin, as well as hypertext pioneers like Bush. Haraway's theories connect to all of her predecessors who also wrote in an attempted to disrupt hierarchies and rigid structures.

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[5] For further discussion of Bakhtin's notion of "heteroglossia," see Michael Holoquist's *Diologism: Bakhtin and his World* pages 69-70, 89, 111.

Rather than following in the footsteps of Frankenstein's monster who searches for a common language in order to achieve salvation, Haraway argues for exchanges based on situated knowledges that forgo any search for purity, objectivity, or salvation. Situated knowledges, therefore, confront the accepted view that scientific exchanges must only occur between the dominant, male scientific mind and the submissive, natural subject, and that such exchanges must rely on the Baconian ideal of a pure, wholly accurate scientific methodology based on universal truths. Instead, exchanges that are based on situated knowledge rely on "decoding and transcoding plus translation and criticism," so that multiple perspectives can be traversed, circulated, and played with instead of being assimilated into a congruous linguistic or semiotic whole *(Simians and Cyborgs* 196). I wish to return to the significance of "decoding and transcoding" as it relates to women in the history of computing and other contemporary feminist theories later in this chapter. For the moment, let us keep in mind the literal and metaphoric importance of binary coding and decoding as it is involved in Haraway's notion of situated knowledges and modes of exchange.

Lastly, Haraway's employment of the cyborg is the third and perhaps most well-known metaphor that has shaped discussion in both feminist and technoscience circles and, true to the Frankenstein Inheritance, embraced the image of a monstrous Other. This notion of the cyborg rejects extreme polarity, unification with nature, and the quest for true origin. The concept of origin has long been a part of religious (the Garden of Eden) and secular (Darwinian) quests that attempt to define the human, particularly what is spiritually or biologically pure or universal about humanity. Religious quests for origin attempt to trace back humanity to a single point in time or instance of purity; for

Christians, the end of human purity occurred when Adam and Eve were tempted by forbidden fruit and thus forced to leave the Garden of Eden. Secular or scientific quests for origin focus on human evolution, asking questions about where humans came from, how they came into existence, and how they changed and adapted into a present day form. Religious and secular or scientific quests for origin often deal in absolute terms. Religious concepts of origin often characterize humans as either good or bad, saved spirits or heathens, sexually pure or sexually corrupt. Along the same binary lines, secular or scientific quests for origin rely on characterizing inquiries for origin as true or false, accurate or inaccurate, objective or subjective, scientifically pure or scientifically tainted.

Instead, the cyborg creates possibility by rejecting binaries and realizing its place as an illegitimate hybrid who can traverse boundaries inherently connected with gender and identity politics *(Simians and Cyborgs* 150-152). Yet, despite Haraway's alliance with her feminist inheritance, she also takes time to well articulate the differences between cyborgs and monsters: "Unlike the hopes of Frankenstein's monster, the cyborg does not expect its father to save it through a restoration of the garden" *(Simians and Cyborgs* 151). Whereas the story of *Frankenstein* is essentially a story about the rejection of the monsterous Other despite his efforts to be accepted, the story of the cyborg is about the freedom of illegitimate offspring. The ultimate quest for unity and identification with nature that Frankenstein's monster so fervently (but, unsuccessfully) strives for is not at issue for the cyborg. Thus, rather than taking on the monster's search for acceptance from the position of the Other, the cyborg's position as an illegitimate being allows it to instead rework the nature and culture power dynamic so that they are

no longer the site of appropriation and incorporation of the Other *(Simians and Cyborgs* 151). The cyborg takes on many components of the Frankenstein Inheritance without attempting to legitimize its monstrosity or plead for acceptance into spheres of exchange from which it has already been outcast.

For both Mary Shelley and Donna Haraway, the problems of gender and science stem from binary exchange – through language, and for Haraway also through vision – that polarizes domination/submission, subject(ive)/object(ive) dynamics. When examining the evolution of the Frankenstein Inheritance as it is involved with Haraway's conception of cyborg politics, analogies of sensory experience become an important method of imparting metaphors of exchange. Perhaps the best articulation of this difference between the denial and acceptance of hybridity, particularly as it involves her notion of vision, occurs in the following quotation:

> From one perspective, a cyborg world is about the final imposition of a grid of control on the planet, about the final abstraction embodied in a Star Wars apocalypse waged in the name of defence, about the final appropriation of women's bodies in a masculine orgy of war (Sofia, 1984). From another perspective, a cyborg world might be about lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints. The political struggle is to see from both perspectives at once because each reveals both dominations and possibilities unimaginable from the other vantage point. Single vision produces worse illusions than double vision or many-headed monsters.

> Cyborg unities are monstrous and illegitimate; in our present political circumstances, we could hardly hope for more potent myths for resistance and recoupling. *(Simians and Cyborgs* 154)

Here, she argues that an acceptance of multiplicity, a recognition of the possibilities of plurality in place of binarity, applies not only to the *physical* boundaries that literally place the figure of the Other outside of the ideal "norm." Rather, her articulation of both the mutual acknowledgement of and resistance to such binaries creates movement between those *physical*, *psychological*, and *ideological* boundaries – boundaries that were created by and which have relied upon binary categories of dominance to subdue and conquer the Other.

For Haraway, vision is the site where perspective enables one to either be caught up in or able to partially traverse these boundaries. Like Shelley, she searches for more open communication: yet, Haraway sees vision as another medium through which old feminists notions of a "common language" can be turned into various shared experiences. For Haraway, multiple sensory experiences, including auditory and visual exchange, can provide many valuable situated knowledges in place of one language or means of communication. Furthermore, whereas single vision literally and metaphorically produces singular, limited "illusions" wherein binary definitions of gender, science, and nature triumph, double vision complicates but also enables exploration of the politics of such definitions. Manifold cyborg vision that erupts from such multiplicities and rejects these boundaries altogether can provide multiple vantage points that ultimately rely on partial views to gain glimpses of more meaningful (if also more dangerous) lines of sight. To Haraway, "monsters have always defined the limits of

community in Western imaginations," and an opening up of such limits exists in embracing that which is hybrid rather than seeking to incorporate it into the structures which rely on such extreme definitions of human, science and nature in the first place *(Simians and Cyborgs* 180). The figure of the cyborg, then, takes up vision as the site where the limits of the Frankenstein Inheritance could be re-imagined and reworked into possible, partial and potentially meaningful perspectives that entirely resist binary constructs.

From Public to Private:

The Homework Economy and Methods of Exchange

Certainly, when discussing dynamics of exchange, the gendering of labour and economic exchange comes into play. Haraway discusses these dynamics of economic exchange as a part of "The 'Homework Economy' Outside 'The Home,'" particularly focusing on the process of restructuring which has redefined work in female and feminized (and thus, vulnerable) terms *(Simians and Cyborgs* 166). In response to this feminization, especially that which occurs in the restructuring of full-time into part-time work, she calls for further investigation of power dynamics as they are involved in the similarities and difference of women and men. To Haraway, the "homework economy" is a concept that demonstrates the integration of home, factory, and market on a new scale where women are increasingly important.

In further reference to these economics of exchange, Haraway argues that the homework economy needs "to be analysed for difference among women and for meanings for relations between men and women in various situations" *(Simians and*

Cyborgs 166). Haraway's call for an analysis of difference among women and relations between men and women stems from her reading of the power dynamics of economic and scientific exchange as they involve gender. Parsing the evolution of different feminist camps has been an integral component of her theories and her ultimate criticism of extreme waves of feminism and science in favour of a more hybrid approach to these issues. It is crucial to understand feminist history, particularly the birth of difference and equal rights feminism in the 1960s and 1970s, in order to read Haraway's position on exchange, particularly as it is caught up in the politics of difference.

In order to read more perceptively the progression of feminist opposition to patriarchal structures of science and characterizations of women as "natural" objects outside of scientific discourse from the nineteenth to the twentieth-century, specifically as it is (re)presented and (re)interpreted by Haraway, we must first understand the different feminist rhetoric that has evolved out of this debate. Pamela E. Mack outlines the two most important feminist camps as "difference feminism" and "equal rights feminism." Difference feminists, sometimes called social feminists, typically argue that women are distinct and have unique strengths and traits because of particular genetic or biological traits that make them different from men, "either essentially or because of their upbringing and/or cultural history" (Mack 150). Difference feminism, she notes, had a great impact on first-wave feminism -- historically known before the 1960s. Second-wave feminism (after the 1960s) is based more on equal rights feminism (Mack 150). Equal rights feminism argues that there are no significant differences between women and men, thus presenting the rights of women as the same of men (Mack 150). Such divisions have created two different kinds of discourse in response to Baconian views of

natural female qualities that define women based on their reproductive roles which, as we will see, is still important in contextualizing the contemporary circumstance of women in computing science and engineering.

Such debates about the innate or learned traits and abilities of women, and whether these traits are either equal to or different from men, has great implications for the characterization of women in relation to their "natural" status. In a historical context, the separate spheres which divided women/domestic/private and male/public/economic/scientific largely affected the first-wave feminist movement which employed difference feminism. Shelley herself presented nature as something not controllable by men. She used Victor to represent the consequences of male production without the female by depicting both men and women as having their own values and characteristics-- but these values do not necessarily make men and women inevitably separate or separable. In Chapter One, we saw how Victor's efforts to (re)produce a living being makes him the "author of unalterable evils" (Shelley 119). Through Victor's consequences, Mary Shelley critiqued the role of a solitary, elite, and limited sphere of scientific discovery that does not involve balance and that relies on inflexible binary distinctions of gender, nature, and the human. Victor suffers many consequences because he was a scientist that did not heed his human impulse. Shelley warns of the threat of the scientist who takes on the role of Creator and (re)produces without nature's female womb or respect for the feminine realm of nature. Thus, she arguably employs difference feminism techniques in order to argue the validity, importance, and role of both male and female in cultural and scientific creation. The employment of difference feminism continued to be a strong force in the late nineteenth-century and early twentieth-century.

In the 1890s, for instance, women created opportunities for themselves in the public sphere based on arguments that they were "more moral, more concerned with protecting the weak, having the special skills of housekeeping" (Mack 150). The role of difference feminism during this period created a way for women to work within existing structures and participate in expanding a topography that included female skills and abilities.

But reinforcing such views of women as "naturally" capable of specific skills complicates the debate about gender differences and similarities, especially during the beginning of second-wave feminism: would embracing traditional views of the woman as natural and emotional result in opportunities for or the subversion of women in science (Mack 151-152)? Over time, second-wave feminists came to see privileging nature over technology as dangerous because technology is at the core of the patriarchal system (Mack 151). In 1980, Carolyn Merchant's book *Death of Nature* provided what is arguably the feminist impetus for theorists like Donna Haraway. Merchant outlines "the formulation of a world-view and a science that, by reconceptualizing reality as a machine rather than as a living organism, sanctioned the domination of both woman and nature" (Mack 151). For feminists like Haraway and Merchant, there is only possibility for women in combining typically binarized items like nature/machine, male/female, and high/low. By connecting spheres that are usually juxtaposed and placed within a hierarchy, both equal rights feminism and difference feminism can work together to create a topography not limited by categorization or subversion. Such techniques directly oppose recent patriarchal theories that account for human evolution from animal to machine in the Baconian sense, and discuss the human only in reference to machine/man, automatically subverting nature/woman.

In fact, by understanding the historical importance and evolution of these two feminist camps, one can see that Donna Haraway's concept of the cyborg and her theories of exchange very much strive to (re)connect both camps through the network of her infidel heteroglossia. Her theories are at least partially rooted in an attempt to avoid choosing her feminist allies based on two oppositional points of view. Rather, she attempts to demonstrate how feminists can work together and avoid choosing sides in a debate about gender. Haraway offers a third option for women caught between difference and equal rights feminism: the option of combining these theories and enjoying the hybridization of these camps in order to gain the benefits of *combined*, if partial, perspectives.

Situated Knowledges and Language Hierarchies:
Theory and Practice in Contemporary Technoscience

In 1818, Mary Shelley was positioned as a "nearly silent listener" outside of male discourse on science. In reference to the different language skills and voices of men and women, Margaret Lowe Benston, a scholar who has worked in many areas of science (including computing science), agrees that technology is itself a language:

> [F]irst, technology itself can be seen as a 'language' for action and self-expression with consequent gender difference in ability to use this 'language'. Second, men's control over technology and their adherence to a technological world view have consequences for language and verbal communication and create a situation where women are 'silenced' (Benston 33).

In effect, she outlines how language and verbal communication are still the means by which men create what she calls "tunnel vision" wherein men cannot parse female experience and their world view, and thus they "are literally unable to understand" what women say (Benston 40). In this kind of tunnel vision, men in engineering and similar fields in science and technology often view women's skills as lesser than those of men, and criticize women for not understanding "unwritten rules of conduct and, as a result, fail to effectively promote their strengths" (Mack 160). Yet, it seems that, if the language of technology is also the language of action, then it is men who misunderstand women rather than vice versa: women are continually parsing male-encoded language. Margaret Lowe Benston notes the modern tendency to expect men to learn about machines and tools, with an emphasis on rationality and objectivity. Women, on the other hand, are characterized as less rational and objective, but more emotional and better at interpersonal relations (Benston 33). Despite Benston's capabilities in math and science (she has a PhD in physical science), she often finds herself the silent listener when her husband (an English graduate) and his male friends discuss technical matters of cars and record needles (Benston 33). Like Shelley, Benston becomes a "nearly silent listener" of male scientific discussion. Later, as a computing scientist, she studied the social implications of the technology, focusing on the theoretical rather than the experimental problems. Benston's argument ties her experience to a more representative whole, to larger patterns and studies that demonstrate male control over technology and, consequently, the *language* and verbal communication of such tools which ultimately silence women (38).

Gender codes lead women to articulate and interpret language and technology in ways that, according to male structures of power, do not give them access to this unwritten male code of science and technology. Hence, as Haraway's theories point out, language which attempts to either enter into this dialogue equally or to emphasize difference is ultimately successful only to a limited degree: such polarized feminist rhetoric and theories of exchange, as we will see in Chapter Three when looking at the examples of women from World War II, creates a limited topography of agency through language. Ultimately, this difference between male and female perceptions of the merit of such *language as action* persists.

In fact, the dynamics of exchange are a crucial part of understanding the ways in which women are parsing male-encoded systems that are built on unwritten male codes of conduct. First, as Benson notes, language serves to provide the unwritten male rules of conduct for exchanges between men and women in the workplace. In Chapter One, we also saw how such masculine rules of conduct were involved in Baconian scientific theories of male dominance over nature and women. Such Baconian language that employs metaphors of domination is still prevalent in the sciences today. Hence, exchanges in this economic realm are very much defined by the presence of these male-encoded systems of linguistic exchange at work. Second, Benson points out that the male technological world-view still "silences" women working in technical fields. This means that gender dynamics in the workplace are such that women often disengage from discussions on technology because these exchanges are constructed by a predominant male world-view of technology. Consequently, women are constantly attempting to

parse – to read and to interpret – these unwritten male codes of conduct that still exist in the fields of science and technology.

Yet, since male forms of linguistic and economic exchange have been at the core of science and technology for centuries, men have not learned how to parse female codes of conduct. Women have had to learn how to parse male behaviour to work in these fields, yet men have not generally had to parse female behaviour since economic and linguistic exchanges in fields of science and technology are based on male codes of conduct. These codes are literally the foundation of exchanges (linguistic and economic) that in many ways affect and define gender in these fields. Hence, we can see that economic structures of exchange are very much "encoded" by the binary code of gender dynamics – that is, binaries that indicate the presence or absence of this male world-view of technology and unwritten male forms of linguistic exchange.

The implications for these gender encoded systems of exchange are twofold. First, we can see how language is itself a code that defines exchanges within and between different spheres. Language is a system of exchange that both defines and is defined by these encoded gender dynamics. Second, we can see that these exchanges, the very systems and structures that enable interaction between and within these separate spheres, also build and are built on gender codes. In this way, language and systems of exchange rely on each other: it is a symbiotic relationship. This symbiotic relationship exists because without language such exchange would not connect or develop, and without systems of exchange language would not evolve or be meaningful.

The symbiotic relationship between language and systems of exchange is precisely what Haraway calls situated knowledge. To Haraway, situated knowledge is defined by this relationship between language and systems of exchange:

> [C]ommunication sciences and modern biologies are constructed by a common move – *the translation of the world into a problem of code*, a search for a common language in which all resistance to instrumental control disappears and all heterogeneity can be submitted to disassembly, reassembly, investment, and exchange. *(Simians and Cyborgs* 164)

Here, Haraway articulates the connection between Baconian metaphors of dominance and exchanges that are defined by encoded language. The search for a common language occurs through technologies that literally encode and encrypt the systems (computer networks, the Internet, etc.) through which we make our verbal and economic exchanges. By translating our encoded structures with common linguistic, semiotic, and scientific tools, we can avoid the unwritten male codes of exchange that Benson discusses. Such tools allow us to (re)form scientific metaphors of dominance based on this male world-view of exchange.

In light of this encoded system of exchange as it involves technology and gender, Haraway's conception of economy takes on new meaning. Her idea of cyborg writing is partially inherited from Marxist feminism. According to Haraway, "cyborg writing must not be about the Fall, the imagination of a once-upon-a-time wholeness before language, before writing, before Man" *(Simians and Cyborgs* 175). Rather, Haraway explains cyborg writing in the following terms: "Cyborg writing is about the power to survive, not on the basis of original innocence, but on the basis of seizing the tools to mark the world

that marked them as other" *(Simians and Cyborgs* 175). Cyborg writing is a movement that employs tools in order to achieve agency, to "mark the world," and is very much related to using language and economic exchanges. In effect, Haraway is linking the "tools" of linguistic and economic exchange to Marxist feminist agency. Along the lines of Marx's call for a workers movement based on shared political values that attempts to level economic hierarchies and unbalanced power, here Haraway calls for collective efforts that attempt to overturn hierarchies which outcast the Other. Her conception of such a collective movement relies on cyborg politics that reject binary definitions of gender, race, and class that are the foundation of such hierarchies.

Following a Marxist tradition, Haraway's concept of agency ultimately advocates collective efforts on multiple fronts to change the systems of exchange that support these hierarchies. Yet, at the same time, she redefines the notion of Marxist feminism by rejecting the Marxist ideal of the salvation of the Other. According to Haraway, using these "tools" does not enable the Marxist ideal of a united movement that promises salvation. But these tools – especially, as we have seen, linguistic and economic tools – provide engagement with and the redefinition of systems of exchange that are the foundation of human interaction. Since tools shape and reshape the channels through which we create relationships and interact in meaningful ways, it becomes increasingly important to understand the encoding of such channels. It is no coincidence that the term "code" has gained substantial significance in explaining the literal and metaphorical, as well as practical and theoretical, importance of these (particularly digital) structures of communication. Donna Haraway articulates the importance of understanding these codes

when reading what she describes as the figurative and literal political struggle of the Other:

> The phallogocentric origin of stories most crucial for feminist cyborgs are built into the literal technologies – technologies that write the world, biotechnology and microelectronics – that have recently textualized our bodies as code problems on the grid of C3I. Feminist cyborg stories have the task of recoding communication and intelligence to subvert command and control. *(Simians and Cyborgs* 175)

She demonstrates how our bodies, landscapes, and modes of communication are based on the language of code. Power structures and hierarchies, too, are inherently built on the male world-view metaphors and codes of conduct. Furthermore, such hierarchies are built and defined by binary codes of gender, race, and class. Cultural communication has been literally built and encoded on these binary channels that either allow or deny access to these tools of exchange. The task of the feminist cyborg is "recoding communication" because such codes literally and metaphorically build and shape the structures and grids of human interaction that work to give power to some while subverting the agency of others.

Multilinear paths of new technologies, like hypertext technology and the Internet, attempt to redefine hierarchical structures by relying on more equalizing metaphors of "the web." Of course, these web-like structures are not completely equalizing since access to webs of communication is still limited and controlled. In fact, Haraway insists on foregoing the idealization of agency which is so much a part of other forms of feminism, including Marxist Feminism and social constructivism. The feminist cyborg

rejects attempts to find purity, origin, or salvation through efforts that are entirely and naively equalizing on all fronts. Yet, though it does not promise totalizing salvation, cyborg writing does attempt to open up access to and engagement with these structures of communication, such as the Internet.

The "recoding" of communication structures has begun and is gaining momentum. Discussion of these codes as they relate to agency, particularly as Haraway conceives of it in the image of the cyborg, has become more and more prevalent. Both literally and figuratively, hypertext technology is aiming to provide many paths through which we can access and affect systems of linguistic and economic exchange. In the next chapter, I will focus on reworking and rearticulating the (hi)stories of these exchanges to include a deeper, more complicated inquiry into women's interest and proficiency in areas of science and technology. In particular, I will examine how this link between metaphors and philosophies of exchanges manifest themselves in the politics of gender, especially concerning the history of women in computing. As we begin to understand where, how, and why our systems of exchange are encoded, we can open up such systems and begin to parse, (re)write, and rework these codes on multiple fronts.

History, Gender Politics and Numbers

Since the 1970s, there has been a great influx of computer technology into modern life, and computing jargon has become commonplace. The idea of the binary categorization of difference has taken on new meaning with the popular usage of binary coding that uses zeros and ones as a computing language. As we saw in Chapter Two, Donna Haraway embraces technological metaphors and science fiction in her metaphor of the feminist cyborg. Her promotion of a more hybrid feminist vision imagines alternatives to the longstanding binaries of nature/science, male/female, human/machine. By employing the tools that created these encoded structures in the first place, Haraway attempts to translate, traverse, and overturn the boundaries that have been built and defined by hierarchies and the politics of domination.

Like Haraway, Sadie Plant embraces technology and metaphors of code in order to articulate an alternative feminist vision of agency. She, however, puts emphasis on the material aspect of these codes in order to parse, edit, and rework the ones and zeros that make such binary distinctions. This focus on the material brings to the fore Plant's powerful, nitty-gritty detail of the hands-on labour required to work in, around, and between binary distinctions that have traditionally defined gender and science. She outlines the raw material aspects of technological evolution and human interaction in a way that brings together the technical and the organic components of the history of women in computing. Plant takes up the issues of gender and technology that Haraway constructs in the image of the cyborg, but her emphasis on the organic and the material aspects of women's (hi)stories brings the literal and physical human connections involved with these (hi)stories to the center of the debate on gender and science.

Throughout this final chapter, I will examine Sadie Plant's feminist rhetoric, particularly as it applies to forming and contextualizing the (hi)stories of women in computing. In charting these (hi)stories, I hope to outline several crucial components of the science and gender debate that have generally been left out of historical accounts of computing in the twentieth-century. I will explore how, historically, women have used code and the language of technology in order to write and rewrite the structures through which humans relate. These women, especially during World War II, parsed the politics of language to bring computing technology into a more popular, accessible realm. This female move to make science and technology more accessible despite a person's race, class, or gender challenges the traditional foundation of an elite, masculine world-view of technology. We have seen how twentieth-century male world-views of science and technology grew out nineteenth-century scientific theories of domination, like those inherited from Sir Francis Bacon. Now, let us turn to a more detailed exploration of how women gained agency by using the language of technology to traverse, parse, and rewrite male world-views of technology.

Sadie Plant's Ones and Zeros

In the previous chapter, we saw how multilinear paths of new technologies, like the Internet or "the web," are based on anti-hierarchical structures. These anti-hierarchical structures rely on more equalizing, multi-pronged systems of exchange, and are often described as "webs" and networks of communication. Web-like technologies of exchange are not completely equalizing since access to these structures of communication are still limited and controlled by those of privilege. Though it does not

promise salvation, cyborg writing makes an attempt to open the channels of human interaction. Indeed, the "recoding" of communication structures that Haraway advocates has begun and is gaining momentum. Hypertext technology, though not a completely equalizing tool, does provide many paths through which we can access and affect systems of linguistic and economic exchange. It is in understanding where, how, and why our systems of exchange are encoded that we can start to parse, (re)write, and rework these codes.

Sadie Plant's influence as a feminist thinker is largely the result of her commanding engagement with the same issues of gender and science that Haraway takes up. In *Zeros + Ones*, Plant powerfully portrays how gender is linked to the language of technology and the politics of exchange. Her style of analysis stands apart from other feminists who discuss the gender politics of science and technology because she typically engages with the *material* aspects of history:

> Just as individuated texts have become filaments of infinitely tangled webs, so the digital machines of the late twentieth-century weave new networks from what were once isolated words, numbers, music, shapes, smells, tactile textures, architectures, and countless channels as yet unnamed...The yarn is neither metaphorical nor literal, but quite simply material, a gathering of threads which twist and turn through the history of computing, technology, the sciences and the arts. In and out of punched holes of automated looms, up and down through the ages of spinning and weaving, back and forth through fabrics, shuttles and looms, cotton and silk, canvas and paper, brushes and pens, typewriters, carriages, telephone

> wires, synthetic fibers, electrical filaments, silicon strands, fiber-optic cables, pixeled screens, telecom lines, the World Wide Web, the Net, and matrices to come. (Plant 11-12)

Here, Plant reads contemporary networks of communication as a holistic comprisal of other, more isolated modes of expression. But unlike other feminists like Haraway or Katherine Hayles, Plant's mode of analysis does not focus on what is new or posthuman about contemporary, hardwired webs of exchange. Whereas Hayles and Haraway reimagine connections through metaphors of the posthuman or the cyborg, Plant instead draws a more detailed narrative of the human nature of these connections that is "neither metaphorical nor literal, but quite simply material, a gathering of threads which twist and turn." Rather than emphasizing the "newness" of postmodern communities that combine and weave new connections by embracing fragments, Plant's inquiries underline how many forms of weaving have always created important connections throughout history. She shows how community and agency has been (and still is) present in other modes of communication that rely on economic, scientific, and linguistic exchange. Her questions stem from a desire to understand the grass roots of these networks, particularly as they are involved with the roots of the history of computing. This gives new focus to understanding the physical, not just the mental, labouring and transformations involved in the history of twentieth-century technology. Her language uses material images, such as "yarn" and "wires," that bring forth questions about how natural and industrial skills have worked together in the past, and how this past influences our current communities and interactions.

Plant's rhetorical style draws together partial connections in ways that attempt to relate what theorists like Hayles call a "posthuman" situation to a more historical, human narrative. Her words illustrate the importance of physical processes that have built systems of exchange, not just the mental or cognitive perceptions, reconfigurations, and transformations involved with new digital technology. Her language highlights questions about who worked with different machines, how they did their work, and what kind of community was involved in these exchanges. Instead of asking questions about the posthuman or the cyborg, she vividly illustrates the human narratives and labour involved in working together the "material, a gathering of threads" which is "neither metaphorical or literal." This attention to the organic qualities of the history of computing, especially as it involves women, does not promote an idealistic vision of women as goddesses of nature or as the mothers of technology. What Plant does promote is an examination of the material, physical roots of the history of computing so that we can better understand how these roots have become fused with the contemporary gender politics of digital networks. This exploration of the roots of computing asks questions about how natural and industrial, masculine and feminine, and scientific and artistic qualities have all helped weave contemporary modes of communication.

One of the most poignant, overarching characteristics of Plant's work is her specific connection of language and webs of communication to the movement involved in exploring and linking typically opposite paths. Most importantly, she attempts to bring together the many different metaphysical, sensory, physiological, economic, and psychological aspects that created twentieth-century systems of links and nodes. In linking this long list of items together, Plant attempts to chart the paths through which the

politics of gender and science have always traveled. Here, we must be careful to see that her colourful portrait of the links and nodes of our social systems – systems of survival and communication – is not intended to be a metaphor. This portrait is meant to reflect the specific processes by which our definitions of science and gender morph, intermix, and are subject to boundaries.

Her elaborate list of items shows both the physical connections (punched cards, pixels, paper, virtual reality helmets, etc.) and the cognitive connections (the weaving of stories, fabric, wires, and the Web) of items that are typically defined as opposites:

> When the first of the cyberpunk novels, William Gibson's *Neuromancer* was published in 1984, the cyberspace it described was neither an actual existing plane, nor a zone plucked out of the thin airs of myth and fantasy...In the course of the next decade, computers lost their significance as isolated calculators and word processors to become nodes of the vast global network called the Net. Video, still images, sounds, voices, and text fused into the interactive multimedia which now seemed destined to converge with virtual reality helmets and data suits, sensory feedback mechanisms and neural connections, immersive digital realities continuous with reality itself. Whatever that was supposed to be. (Plant 12-13)

Here, Plant links the imaginary spaces of the cyberpunk genre with the physical development of an infrastructure of links and nodes in cyberspace: she links fictitious spaces to the development of real links and nodes between computer users on the Internet. Her approach takes a notable departure from Haraway's cyborg manifesto.

Haraway often emphasizes the literal and metaphorical impact of the image of the cyborg as it is played out through complex language that shows the melding of organic/mechanic/digital/ human. She focuses on the ways that tools define and create systems of exchange. Plant, however, uses more organic, nitty-gritty, historical language in emphasizing the material implications of this melding over the academic ones. She focuses in on the raw elements of building and tracing the roots of our systems of engagement. In linking manual weaving to the automated loom to the typewriter to fibre optics, she emphasizes how tools evolve and morph through both the physical and cognitive materials of exchange. By showing the connection between a cognitive and ideological fascination with virtual reality and cyberspace that emerged in the 1980s and 1990s after William Gibson's *Neuromancer* and the subsequent development of the links and nodes of the Net, she links imaginary spaces to the physical technological infrastructure of the Web, data suits, and virtual reality helmets. Rather than focusing on the literal and metaphoric qualities of these systems of exchange, she aims to reinforce the necessity of labouring with these materials, of working within and between these imaginary and real spaces.

Plant's articulation of the weaving of our webs of exchange ultimately relies on the idea that *labour* is the means through which we experience and rebuild systems of exchange: we create meaningful connections through labouring with tools. She focuses on the material, and disengages from the academic preoccupation with the literal and metaphorical, in order to illustrate how tools do not have significant meaning unless one can understand the processes of and progress made through labouring with these tools. Essentially, she demonstrates how our tools of interaction are inextricably linked to

labour. Labour is needed to employ such tools, to build and reconstruct systems of exchange. Likewise, these tools reflect and shape the ways in which we work to make change. Labour itself occurs through our employment and development of tools. Human interaction occurs not just in the communication that our systems facilitate -- our means of interaction, our human relationships, are born out of and evolve from our work with others. To Plant, labour is the primary means through which we define human connections, characteristics, and progress. By examining the importance of labour, we can see how labouring defines and shapes systems of exchange, and ultimately defines what it means to be human.

Sadie Plant illustrates how materials are worked and reworked but still contain reference to other, earlier tools that claim parentage to our systems of exchange. Plant brings together the manual and the automatic, the domestic and the commercial, the synthetic and the organic, the physical and the psychological, the artistic and the scientific qualities of these systems in order to show the connection between our history and our stories. Our current systems of exchange hold meaning not just because they signify many contemporary dynamics of human interaction – indeed, they signify how we define human interaction. Contemporary systems of exchange, like the web, hold references to the past and signify the ways we have laboured with these tools in order to rework previous definitions of what it means to be human.

Plant often employs weaving metaphors to describe how digital networks have grown out of other systems of exchange. She specifically outlines how women have worked with different technologies like the loom, the typewriter, and the punched card in order to illustrate the many ways that systems of exchange, particularly economic

systems of exchange, have changed along with labour. Her detailed account of women's work and their involvement with different economies demonstrates how women and their shifting roles in the nineteenth-century workforce shaped many of our contemporary models of exchange in a very particular, hands-on way. She details whose hands were involved in the work of change, how these hands worked with different technologies, and where this hands-on labour occurred.

Plant's emphasis of the importance of the hands-on labour process becomes most clear and compelling when we see how it is involved with the history of women's work and its ties to feminist agency through the "homework economy," a concept that Haraway discusses. In Chapter Two, we saw how Haraway defines the "homework economy" as the integration of home, factory, and market on a new scale where the marginalized Other, especially women, are increasingly a part of the workforce. Haraway sees the homework economy as the feminization of economic systems of exchange, especially those that occur in the restructuring of full-time into part-time work that relies on the society's most vulnerable, feminized, and marginalized citizens. However, Plant's reading of the implications of labour differs in that it shows how women have benefited from the shift from full-time to part-time work. In the following quotation, she highlights how the changing twentieth-century workforce, from networks of women telephone operators to female administrative assistants, has connected women in important ways:

> [T]he explosion of telephony meant that Strowger's [late nineteenth-century invention of the automatic telephone switching] system joined the women it had been intended to replace, and it was not until the mid-1960s that electromechanical crossbar systems were automatically connecting

> the calls both the women and their Strowger sisters once picked up...Telephones in the U.K were switched to the fully electonic "System X" in 1980. Recorded female voices became ubiquitous...There was now more of a risk that the women and their skills would become entangled with each other and wander off on their own. "The specialized nature of their work before automation had made it difficult to find desirable work elsewhere...But the new IBM machines caused greater standardization of procedure so that a trained operator could work almost as well in one establishment as another." They weren't only processing data for the boss. If they were pooled with their colleagues, their working environment was a hive of activity, "a permanent inventiveness or creativity practised even against administrative regulations" and hospitable to a multiplicity of informal networks, grapevine gossip riding on the back of formal working life: birth and death, sex and disease, birthdays and bosses, cosmetics and clothes. "In several exchanges reading clubs were formed, in others flower and vegetable gardens, and a women's athletic clubs in another." The content may have seemed trivial to him, but this was entirely beside the point. It is quite literally *the point* which is subsumed when means of communication begin to communicate with themselves. For these emergent systems of exchange, new lines and links are everything. (Plant 122-123)

Here, Plant again paints a powerfully detailed picture of the specific, hands-on labour initiatives of the twentieth-century. This portrait illustrates how work processes and

networks of communication are equally influential in defining human interaction. Contrary to some critiques of the vulnerability associated with the feminization of the developing "homework economy," she demonstrates how agency is involved with these new part-time workplaces. She depicts a new workplace dynamic that evolved as women became more and more linked through their labour processes. Through these new workforces, women experienced new communities and relationships while also participating in new avenues of economic exchange that enabled them to earn money and learn more economic skills. Through the development of part-time work, women were able to experience economic independence that was historically denied them. This workplace dynamic fosters not only a strong female community, but also networks whose links promote the sharing of new skills sets, an engagement with many diverse areas of interest, and the means through which to participate in these novel realms of work and play.

In her analysis of economic shifts, Sadie Plant uses the term "genderquakes" to describe the many identity changes that affected gender dynamics in the 1990s. Above, we have seen how Plant illustrates the subversive agency that exists "when means of communication begin to communicate with themselves." In particular, she argues how this agency develops and evolves through increasingly fluid, changeable links of play and work, life and death, men and women, science and language. We have seen how, throughout the nineteenth-century, women have adapted to workplace environments by enjoying the networks and community that were a daily part of their labour interactions. In the above quotation, we see how Plant depicts the beneficial aspects of new workplace communities for a new female labour force. Along these same lines, Donna Haraway

characterizes the homework economy as signifying this changing, fluid dynamic in workforces, even as it affects both men and women. However, whereas Haraway focuses mainly on the negative implications of this new kind of workforce, especially for women and other marginalized workers, Plant argues that this fluidity creates a positive agency for women. It is particularly interesting to see how Haraway and Plant discuss office work and other evolving female or "feminized" workplaces in different ways. In reference to the new homework economy, Haraway states that "[t]he consequences of the new technologies are felt by women both in the loss of the family (male) wage (if they ever had access to this white privilege) and in the character of their own jobs, which are becoming capital-intensive; for example, office work and nursing" *(Simians and Cyborgs* 167). Here, we can see how Haraway views these new networks of the part-time homework economy as increasing the burdens and demands made on women. Her dark description of capital-driven offices as places where women lose the positive characteristics that were involved with other labour structures in the past starkly contradicts Plant's rosier picture of women creating new agency in these business environments. Women, Haraway argues, feel the consequences of the unfavourable turn to a largely exploitative part-time workforce. Women are affected by these technologies, and even if there are new areas of high skill, there is also "large-scale deskilling" occurring in the economy *(Simians and Cyborgs* 166).

In contrast, Plant chronicles how this shift, what she calls "genderquakes," affected Western workforces by mainly focusing in on the agency that such fluidity provides. Unlike Haraway, she argues that women are actively defining (or, in some cases, rejecting) the characteristics of their office spaces and capital-driven workplaces.

Rather than describing this new economy as it affects women (as Haraway does), she describes the ways that women are affecting these new economies. Plant describes the complexities of genderquakes by demonstrating how these changing workforces were both defined by and created through more fluid definitions of labour, especially in the late twentieth-century:

> At the same time [as the decline of heavy industry that favoured muscular strength], all the structures, ladders, and securities with which careers and particular jobs once came equipped have been subsumed by patterns of part-time and discontinuous work which privilege independence, flexibility, and adaptability. These tendencies have affected skilled, unskilled, and professional workers alike. And, since the bulk of the old full-time, lifelong workforce was until recently male, it is men who have found themselves most disturbed by these shifts, and, by the same token, women who they benefit...There is enormous resistance to these changes whenever and wherever they occur. As their effects began to be felt in the early 1990s there were men who jerked their knees and went on TV to lament the fact that women and robots had apparently conspired to take their masculinity away...But many women had already set their sights beyond these traditional focal points. While the members of an older male workforce had found a sense of identity in their work, women were not only less able, but also less willing to define themselves through employment or a single career. Many of them were actively seeking opportunities to make and break their own working lives, not necessarily

> in favor of family commitments, but also in an effort to free themselves from the imposition of external constraints on their time and economic capacity. (Plant 38-42)

Plant's argument does not see the shift to female, part-time work as an easy transition. She notes the gender complexities involved with this change, especially the masculine counter-actions and resistance to these shifts. She certainly agrees that there are some difficulty involved with the growing pains of new industries where women are the centre of creative networks of exchange. Yet, ultimately, Plant is confident that women are the active agents defining this evolving workforce. She continually comes back to the freedom that many women experience in shaping their own careers, and reinforces how women have proven their ability to adapt to a new workforce that is constantly evolving as a result of technology.

Plant's alternative vision of feminist agency is not in the image of the cyborg, which manifests itself more in a theoretical, imaginative, conceptual blending of human and machine that forgoes a search for origin and authenticity. Rather, Plant emphasizes the material, detailing the actual labour processes involved with the shifting identities that have affected gender dynamics, human relations, and our physical as well as cognitive aspects of communication. It is in this detail of the material, of the hands-on labour processes that have been created through and affected by technology, that Plant finds a certain feminist agency that connects many citizens and cultures, often those who were historically "Othered." According to Plant, this agency comes from women's adaptability to the material, from their fluid interpretation and definition of work structures in this increasingly changeable network of human communication.

The Language of Ones and Zeros

Last chapter, we explored the politics of language as they pertain to gender and science. We examined this language dynamic as it involves gender in scientific workforces by considering what Margaret Benston calls "tunnel vision." This tunnel vision involves language and situated knowledge, as well as sight, and occurs in men who "are literally unable to understand" what women say (Benston 40). Hence, men in engineering and other technological fields often view women's skills as inferior. Men in these fields subsequently criticize women for not understanding "unwritten rules of conduct and, as a result, fail to effectively promote their strengths" (Mack 160). I would like to return now to exploring how language has been a key part of defining gender and science by considering how women have used their skills and abilities throughout their role in the history of computing.

Like the ever-changing nature of digital technology itself, the definition of the word "computer" has morphed over time. The Canadian Oxford English Dictionary defines the contemporary reference to "computer" as "an electronic device for storing and processing data (usu. in binary form), according to instructions given to it in a variable program." But, as Sadie Plant notes, "computer was a term applied to flesh and blood workers" where the "bodies which composed them were female" (Plant 37). Plant goes on to describe in detail the ways in which women have been integral to the development – indeed, to the definition – of computers: "Hardware, software, wetware – before their beginnings and beyond their ends, women have been the simulators, assemblers, and

programmers of the digital machines" (Plant 37).[6] Women have been integral not only in the development of digital technology, but also in the fact that they themselves were referred to as "computers," as the people who calculated and performed computations. In a very literal sense, women have defined and been defined as computers.

Female "computers" were particularly important during World War II, when women were recruited to work for a variety of scientific and technical fields. As soldiers left their jobs at home in order to fight abroad, many women took up occupations that were never before available to them. For the first time, women were recruited to work in scientific and technological fields, including areas of public health and industrial chemistry. They were now encouraged to work with science and technology, and took new jobs in traditionally male-dominated areas that required specialized scientific and technical skills. Although these jobs were often classified as "women's work," Suzanne Le-May Sheffield notes that women did have a certain amount of agency within these new workforces:

> The majority of jobs open to women in science, inside and outside of the university, in the first half of the twentieth-century were classified as "women's work." Nevertheless, in all arenas – from the university to public health, to industry to warfare – women found employment that not only allowed them to work within their chosen profession but on occasion permitted them to work toward change within their profession. (Sheffield 149)

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[6] Note: though women were, in this context, referred to as computers, other items computing tools like the Abacus have been used throughout the centuries to do computations as well.

There were a variety of new occupations open to women during the 1920s, 1930s, and 1940s. Many of them got jobs as nutritional consultants, X-ray technicians, pharmacists, and even as industrial chemists constructing bombs (Sheffield 142- 147). Some bright young women who were strong in mathematics worked as "computers" for the United States military. These "computers" were women who developed firing and bombing tables that were needed, efforts that later led to the development of computing technology like that the ENIAC (Fritz 13).

As I noted in the introduction to this paper, women's efforts have been largely obscured from the history of computing in general. We can learn a lot about women and their role in the history of computing if we take into consideration their particular skill sets and abilities, especially their ability to traverse the language of technology. Women brought much to emerging computing fields, particularly through their work with the language of computing – they often worked with programming languages and software. Janet Abbate agrees that examining female and male similarities and differences is important in accounting for the marginalization of women's roles in early computing. She illustrates how, whereas men were the inventors of computer hardware, women have historically been involved with software initiatives during the birth of modern computing:

> [Women] also brought skills in mathematics, language, organization, and interaction that were sorely needed in programming and computer science. By attending to women's experiences and their often unconventional paths into the field, we can better understand the profession itself...Women's historical involvement with computers has not been widely publicized, in part because historians of computing until recently have focused mainly

> on hardware. Men have been the inventors of machines through most of the history of computing, because women did not usually have access to the necessary training and resources...More recent work by historians of computing has highlighted software development, academic computer science, and applications, areas in which a greater number of women can be found. (Abbate 4)

Women offered a variety of skills to the emerging field of computing science, including linguistic, organizational, and technical abilities. Yet, it is interesting to note that women were largely a part of the development of the language of this new technology – the software and programming languages, the applications of computers, and the academic areas of the field. There is clearly a feminine fondness for creating ways to translate the technical, hardware structures of computing developed by men into wider social and cultural studies, applications, and dispersals of this technology. This female role in creating languages, in programming ways to use computer hardware for different applications, promotes human participation in and interaction through computers.

Last chapter, we explored Haraway's notion of situated knowledge as a cautiously optimistic reinterpretation of Marxism that promotes the sharing, translating, and traversing of different forms of communication. The reworking and reimagination of structures of communication creates multiple forms of agency because these efforts promote a re-engagement with meaningful structures of human exchange as they incorporate, not marginalize, the Other. In the historical context of women working as computers and as the programmers of computing technology, we can see that their interest and abilities are largely expressed in translating the hardwired physical structures

of computer science into the more widely-used applications of this technology in daily human interaction. In effect, the development of programming languages brought forth many technologies, including the Internet, which enable people who have access to technology to play and work in ways that they help define. For example, as we saw in Chapter Two, communities like Wikipedia.org enable a "bottom-up" renegotiation of the retrieval, definition, and sharing of information. Through the Internet, platforms like Wikipedia are created with the intention of connecting to other uses of technology. Web-pages, blogs, and chatrooms exist through a creative, open-source infrastructure that promotes and enjoyment of community, of engaging in dialogue about different subjects, of fostering participation through these links and nodes and languages.

It is important to explore women's usage of the language of this technology in order to more fully understand how women have been involved in the history of computing. By using this language, or what Donna Haraway conceives as situated knowledge, women worked to bring elite, privileged male spheres of science to a more popular, diverse audience. Perhaps Sadie Plant best relays the importance of language and women's ability to traverse many means of communication in the following quotation:

> "Woman's desire," writes Irigaray, "would not be expected to speak the same language as man's; woman's desire has...been submerged by the logic that has dominated the West since the time of the Greeks." She is in search of "a different alphabet, a different language," a means of communication which would be "*constantly in the process of weaving itself, at the same time ceaselessly embracing words and yet casting them*

> *off to avoid becoming fixed, immobilized.*" Ada [Lovelace] wrote, "Of *what materials* my *regiments* are to consist, I do not at present divulge." But they will be "vast *numbers*...marching in irresistible power to the sound of *Music*. Is this not very mysterious?" (Plant 140).

What Plant demonstrates here is the female drive to be creative with language, to use language to participate in and to literally break down the barriers that have been historically used to confine them, to employ diverse "materials" by writing with symbols, numbers, music, and words. Whether women have contextualized or signified by weaving stories, textiles, or wires, they have been an important part of emerging structures of communication. In some cases, women have used a "different alphabet," whether this alphabet existed in the creation of programming languages or through situated knowledge, in order to rework gender dynamics and power structures that were denied them.

When we employ Sadie Plant's detailed style of analysis in reading other women involved in the history of computing, we can see a more detailed picture of the many ways women offered new qualities and perspectives to the fields of science and technology they entered. Plant's rhetorical techniques are effective in drawing together seemingly trivial histories that make up a more crucial whole. Her emphasis on an examination of the material brings forth the greater feminist connection between language, technology, and agency. By using these same techniques that Plant employs in her style of analysis, I will now delve into the realm of women in the history of computing as this (hi)story is told through three main figures: Ada Lovelace and Grace Murray Hopper. In reading the importance of these two women through a Plantean style

of analysis, I intend to show how these women's stories fit into the greater narrative of the Frankenstein Inheritance.

Ada Lovelace: A New Feminist Inheritance

The monster's efforts to "first become master of their [human] language; which knowledge might enable [him] to make them overlook the deformity" symbolizes a feminist impulse within the Frankenstein Inheritance to gain access to male power and eliminate the exclusion of women through the acquisition of information and education of science. Certainly, as we have seen in Chapter One and Chapter Two, language and metaphor are the key to this debate about (gender) the human, nature, and technology. In the previous two chapters, we have examined how feminists like Donna Haraway and Anne K. Mellor suggest that, from a feminist perspective, the most significant relationship between science and literature exists in metaphors of code (in film and popular print) that both define and are defined by technology: "The explanatory models of science, like the plots of literary works, depend on linguistic structures which are shaped by metaphor and metonymy" (Mellor 89). Through the Frankenstein Inheritance and its continued reinforcement of the medium as the message in mind, we can see how historically women have employed their ability to communicate and to use language as a means by which they could enter the male/scientific sphere.

Most of the notable women in the history of computing utilized this precise linguistic skill, in some form or another, as a way through which they could enter the realm of computing science. Ada Lovelace, dubbed the "first computer programmer," was distinguished in her field because of her mathematical genius *and* because of her

ability to explain (in her written documentation) Charles Babbage's notes on the Difference Engine better than he could (Greene 16). In fact, Babbage's mathematical errors frequently irritated Ada, and she set several severe conditions by which she would work with him on his projects (Plant 8). Lovelace was a brilliant mathematician and, in addition to her role as editor and communicator, she suggested a base of two as the best way to program the engine (Greene 16). She held a deep understanding of the importance of the Difference and Analytical Engines (Plant 17).

Lovelace was a mathematician, writer, musician and socialite. Born in 1815, she was daughter of Lord Byron and Annabella, Lady Byron. As Bejamin Woolley notes, Ada "worked with some of the most interesting and important scientists of her day, figures like Andrew Crosse, a researcher into electrical power who was said to be a model for Mary Shelley's Dr. Frankenstein" (1). Not only did Ada take interest in the science of Andrew Crosse (and, thus, the science in *Frankenstein*), but she also worked at making the language of mathematics and science more accessible and intelligible. Clearly, it is not coincidence that Ada, now widely celebrated as a computing pioneer, is also such an important part of the Frankenstein Inheritance.

Much of Ada's fame came from her work with Charles Babbage, especially her work translating, annotating, and adding important explanatory notes on an article by L.F.Menabrea on the Analytical Engine. An enthusiastic student, Ada became proficient in mathematics during an era when it was extremely rare for women to do so. More than a century after her death in 1852, a high-level universal computing language, "Ada," was named in her honour. Since the 1980s, Ada has been used to program the world's most powerful war machine (Woolley 1). As Woolley notes, "[w]hen America went to war, its

weapons were to be discharged in her name...It was in honour [of Ada's work on the Analytical Engine] that the US Department of Defense decided in 1980 to name the standard programming language it had adopted for its military systems 'Ada'" (1-2).

Yet, like Shelley (who, as we have seen, was another woman influenced by Lord Byron and others in the Romantic circle), Lovelace's work and name were largely forgotten even when other computer designers working on projects such as the ENIAC could have benefited from her (Greene 75). It is interesting that we can see throughout an historical account of women in computing this continued theme of the gendering of science, of women as natural/emotional/ interpersonal/reproductive and men as mechanic/scientific/objective/rational: in this case, the male scientist (Babbage) had the social and scientific connections necessary for the computing project, but Lovelace was deemed as the one with confidence who was "good with people" (Greene 18). She used her powers of language to translate mathematics, and to traverse the social terrain of the science world.

But Ada Lovelace's success in early computing should not be chalked up to her linguistic and mathematical prowess alone. Lovelace was a figure full of hybrid aspects of identity – hybridity that gave her the flexibility to traverse through spheres that were traditionally separate, such as scientific and artistic, domestic and economic. In his biography of Ada, *The Bride of Science*, Benjamin Woolley states that

> Her life spanned the era that began with the Battle of Waterloo and ended with the Great Exhibition – a period of barely forty years that saw the world transformed. This was an age when social, intellectual and technological developments opened up deep fissures in culture, when

> romance began to split away from reason, instinct from intellect, art from science. Ada came to embody these new polarities. She struggled to reconcile them, and they tore her apart. (Woolley 2)

Indeed, this incongruity perhaps explains why computing scientists are still fascinated with her, often naming projects and programming languages in her honour. Biographers like Benjamin Wooley and Doris Langley Moore play an important role in highlighting the details of Ada's life as it reflected and changed nineteenth-century culture. By writing about Ada Lovelace, they inherently argue for the significance of Ada's role as a mathematician, daughter, and socialite. The work of biographers like Moore and Wooley is a crucial part of undoing the marginalization of women who have often been erased from the history of computing.[7] It also lets us see how Ada embodied "new polarities" of her age, while also perhaps forecasting the twentieth-century preoccupation with understanding divisions, boundaries, and binaries that so concerned Ada throughout her life. Writing the (hi)stories of figures like Ada brings forth the stories of women who were integral in developing our contemporary systems of communication.

Yet, what these purely biographical accounts fail to portray is what Ada represents to the greater historical spectrum of women in computing. This is the contextual spectrum that the Frankenstein Inheritance embodies. Sadie Plant sees such incredible value in Lovelace as both a historical figure and as a part of a more complex, continuing story representing women in "the new technoculture" that her book *Zeros + Ones* is, in many ways, built on quotations and characterizations of Ada. Indeed, Plant

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[7] For other biographies of Ada Lovelace, see: Joan Baum's *The Calculating Passion of Ada Byron*, Betty A. Toole's *Ada, the Enchantress of Numbers*, Teri Perl's *Women and*

chooses Ada as the voice that characterizes the tenuous but meaningful links between past and present, science and art, and man and woman. For Plant, Ada Lovelace is the most appropriate figure to voice the greater narrative involved in a complex weaving of (hi)stories of women, machines, politics, and progress. What she points out is the greater literary, philosophical, scientific and social spectrum to which Ada belongs: a spectrum which encompasses the narratives of many other women in the history of computing.

In *Zeros + Ones*, Ada's voice tells many stories. Quotations that capture a historical/fictional fixation with Ada appear in excerpts, such as the one from William Gibson and Bruce Sterling's *Difference Engine*: "*...She wants to upset the universe, and play dice with the hemispheres. When* never *know when to stop...*" (Plant 8). Entries from her own personal diary bring to life Ada's own real-life struggles and intentions with early computing:

> Ada defined any "recurring group" as "a *cycle*...In many cases of analysis there is a recurring group of one or more *cycles*; that is, *a cycle of a cycle*, or a *cycle of cycles*..."...
>
> "*I am a* Prophetess *born into the world, & this conviction fills me with* humility, *with* fear and trembling!"
>
> Ada Lovelace, November 1844

Numbers: Lives of Women Mathematicians Plus Discovery Activities, or Dorothy Stein's *Ada, a Life and Legacy.*

> Ada hoped that the difficulties in the way of constructing either the Difference Engine or the Analytical Engine "will not ultimately result in this generation's being acquainted with these inventions through the medium of pen, ink, and paper merely," but she also had no doubt that the immediate construction of the machine was not the only key to its influence. Any such development, she writes, will have "various collateral influences, beside the main and primary object attained"...The Engine was left on the drawing board, and it was a hundred years before anything akin to Ada's software would find the hardware on which to run. Even the most interested parties tend to think that Ada, for all her foresight, had no influence on the machines which were to come...But technical developments are rarely simple matters of cause and effect, and Ada was right to assume that the Engine would have more than an immediate influence. While they may have left few trails of the kind which can easily be followed and packaged into neat linear historical accounts, Ada and her software did not evaporate. The programs began to run as soon as she assembled them. (Plant 20-21)

Here, Ada's description of cycles suits more than just the mathematical process of a punched card system. Ada's articulation of any "recurring group of one or more cycles" arguably foreshadows many twentieth-century (particularly postmodern) philosophies, literature, technologies, identities. She was thinking ahead to how cycles would be influential in the future, how these recurring groups would shape future modes of exchange. For this reason, Plant appropriately ties in quotations from Ada to other

twentieth-century thinkers that rely on the concept of webs and cycles to articulate human connections, such as Foucault, Freud, and Margaret Atwood, to name a few. Ada represents more than a feedback loop. Her "footnotes" not only helped make possible the modern technologies that work with mathematical cycles of logic, but they also represent early notions of recurrence and cycles that became increasingly important and prominent in our contemporary conceptions of exchange in cyberspace, the global village, and beyond.

If Haraway were to imagine a cyborg from late nineteenth-century England, it might take the form of Ada Lovelace. Ada was at once "very much afraid" of her genius, but she was also confident of the importance of her work with Babbage (Plant 8). Though she was regarded as being "good with people" and kept a close eye on any social moves by Babbage that would sabotage their research, she herself was not always fond of the social arena (Plant 8). She could be social then reclusive, cautious then reckless, confident then lacking self-esteem (Plant 32). This hybrid mixture of contradictory characteristics allowed Ada to traverse typically separate spheres of men and women. She used her understanding of social spheres to avoid clashes with the British government that would hinder her and Babbage's work. At the same time, she knew the mathematical ideologies behind Babbage's concepts, and took these details to another level by understanding the importance of creating a type of programming language for this work. Ada also had a vision of the larger significance of the Analytical machine. She used her many diverse abilities to move between the smaller, more detailed mathematical schemes and the larger ideological and social arenas within which their work might be accepted. In the context of recent postmodern feminist attempts to understand women

who were confined historically to binary constructs of gender while also escaping such binaries of male/female or nature/

technology, Ada's complexities and contradictions point us to the interesting possibilities that such historical hybridity allows.

The most compelling part of this understanding of Lovelace's role in this venue of science is how she might have employed (either directly or indirectly) a kind of difference feminism that distinguished her skills. Ada's diverse abilities with organization, writing, and mathematics, makes her a clear precursor to other women who entered fields of science and technology and offered new skill sets that improved these areas. She holds an important place on the timeline of the Frankenstein Inheritance because her diverse perspectives and her struggles symbolize what skills women in particular offered as they entered emerging realms of science and technology throughout the twentieth-century.

Through her particular interpersonal and metaphorical and communication skills, she created an opportunity for herself in the sphere of science and math. However, the limitations of difference feminism become apparent when other (largely male) computer scientists all but marginalize and forget her contributions. This marginalization was easily compounded by her habit of only placing her initials, A.A.L, on Babbage's papers so that, as a woman, she could not be "accused of bragging" (Greene 16). Just as many other women were overlooked and obscured from the history of computing, there were male attempts to deny the importance of Ada's work on the Analytical Engine. Woolley agrees that one of the reasons that Ada wanted her initials on her work so that people

could distinguish between her work and that of Babbage. However, this confusion, Woolley argues, was Babbage's intention:

> Little did she realize that confusion was precisely Babbage's intention. As Ada beavered away in the summer heat at Ockham, secret meetings were taking place in London to discuss the decision announced by Babbage that his statement should appear as a preface to Ada's memoir, and should be unsigned. (Woolley 278)

In a historical context, having Ada's initials to clearly distinguish her work is an important part of establishing that women did have a role in the evolution of modern computing. It also indicates a greater move, largely by men, to subvert or cover-up the work of women in fields of science and technology. Initially, moves like Lovelace's created a place for women within the male dominated sphere of computing science; but, as equal rights feminism demonstrates, such spaces for women are often confined and subordinated by male efforts. Haraway's image of the feminist cyborg, of combining feminist rhetoric and embracing play and hybridity that women scientists like Ada employed, argues for both male and female capabilities. It does, however, demonstrate in particular how women who embrace improvisation and flexability are better able to move within and around boundaries that rely on male power structures. Hybridity and fluidity, characteristics that helped women like Ada resist male dominance, become important parts of circumventing categorization and, thus, the subordination of women in these fields.

Women and Wartime Computing

Throughout the twentieth-century, many other women in the history of computing science also used their strengths with metaphor and language to create a place for themselves in computing science. In *Women and the Machine,* Julie Wosk explores many sides of these inspiring and confining dualities present in ads and images of women and machines from the twentieth-century. Her work explores both the possibilities and the limitations that women using technology faced. She notes, for instance, that prior to World War I, women did not often use machine tools (Wosk 10). Classical images of women using tools and machines, especially early depictions of females automobile drivers, portrayed women as dangerous, inept users of new technology (Wosk 7-8). In addition, she notes how some technologies like the sewing machine were crafted especially for women. The shift to promoting women in different economic roles during World War II overturned much of these earlier messages deterring female use of most any machines and tools. Despite the fact that many technologies like the typewriter and the sewing machine were developed for women and supported the notion that women should only have a limited, controlled, or domestic usage of technology, women were still able to benefit in many ways from participating in these new areas of technology.

Even women who worked in areas outside of science and technology used their language abilities in order to find a certain amount of agency. For instance, Sadie Plant points out how language has been a factor in women's work as secretaries. She cites women as the "interface" for their male bosses, often writing and speaking on behalf of these men (121). The shorthand that women used became a "private female code, 'another language, another alphabet...'" (Plant 121). In addition to this female

improvisation of and adeptness with business language, writing tools became designed for these women. For instance, the typewriter, introduced in 1874, was largely intended for women (Wosk 22). The marketing of technology specifically for one gender at first glance seems to reinforce a binary, limited view of gender roles and agency. Machines like the typewriter did limit the kinds of work that women did and directed them into clerical careers where they usually worked as secretaries and aids to their male counterparts. However, the typewriter also helped women gain entry into respectable business jobs (Wosk 23). Furthermore, female literacy rates soared after the introduction of the typewriter, thus demonstrating that women's language abilities only grew stronger after they entered the workforce (Plant 121). Thus, machines like the typewriter afford a limited movement for women that allowed them to expand their skill set and work in different sectors of industry.

In understanding the relationship between language, technology, and the complex gender identities that evolved during the 1930s and 1940s war efforts, it is often true that pictures of women using technology can say a thousand words. The new medium of the photograph was used for many propaganda pieces urging women to join the war effort by working in industrial areas at home while men were in combat abroad. Photographs were the visual proof that women could, in fact, do the jobs of men (Wosk 187). In fact, this same marketing rhetoric urging women to use technology for their domestic duties was employed during World War II to convince women to leave the home and enter industries previously dominated by men. Propaganda ads in the United States insisted that women who could operate sewing machines could also learn to operate tools and machines needed to make munitions and supplies for the war (Wosk 28). Images of women as

technologically inept were replaced by images of women empowered by technology. For instance, images of women as dangerous automobile drivers that had been prominent since the early twentieth-century all but disappeared during the 1930s and 1940s. Instead of showing women as unable to change a flat tire, images during WWII held captions praising female workers as "transformed" and "doing their bit" to help the war (Wosk 183). The chaotic nature of the war era allowed women to experiment with new identities, particularly as such identities related to technology.

Likewise, women who were employed as "computers" during WWI and WWII learned valuable skills and were vital resources to their respective countries. Even if women's emergence in fields of science and technology during wartime was limited and fraught with gender stereotypes, the possibilities and problems involved with this agency is a crucial issue in the on-going story of women in computing. W. Barkley Fritz notes that the acknowledgement of women's efforts as "pioneers" of computing is long overdue (Fritz 13). Moreover, Fritz draws a detailed picture of women's work in computing during WWII:

> During the time period covered by this paper, 1942-1955, women were seldom involved in the design of hardware. However, both men and women were employed as computers (in this era, a computer was a person who did computing)... Many more women were employed as computers...The job of computer was critical to the war effort, and women were regarded as capable of doing the work more rapidly and accurately than men. By 1943, and for the balance of World War II,

> essentially all computers were women as were their direct supervisors. (Fritz 13)

Teams of women who were able to do mathematics were employed as useful resources to the government through the Second World War. They interacted with each other through networks of communication that supported and facilitated their scientific and mathematical tasks. Women were even able to study science and technology in an academic environment, and then use these skills in a workplace environment.

These women created a (programming) *language* through which they could literally "comment" (a term used in modern-day language to describe the process of including notes on programming work) on computing science. They used this language as a tool by which others could engage with and understand computer science. The language itself became a technology, a medium by which women could both build and display their abilities and argue for their place in the realm of science.

Grace Murray Hopper's Computing Legacy

> "If you ask me what I'm most proud of, the answer would be all the young people I've trained over the years; that's more important than writing the first compiler."
>
> -- Grace Murray Hopper

Perhaps the most exemplary instance of a woman using language and metaphor as a kind of medium to expand the topography of women in computing science is Grace Murray Hopper. Like Ada Lovelace, she has become a modern heroine to women in science and computing fields who challenge boundaries and opposition based on their gender. Indeed, she holds a place in both the hearts and imaginations of feminists,

historians, and scientists alike. Born in New York City in 1906, Hopper became a student of math at Vassar College and went on to greatly influence the development of personal, business, and military computing technology until her death in 1992. The following list indicates just some of the distinctions Hopper earned during her lifetime: Naval Ordnance Development Award, 1946; fellow, Association of Computer Programmers and Analysts, 1972; dedication of the Grace Murray Hopper Center for Computer Learning, Brewster Academy, Wolfeboro, N.H., 1983; Ada August Lovelace Award, Association of Women in Computing, 1983; Living Legacy Award, Women's International Center, San Diego, Calif., 1984; Unsung Heroes Award, Ladies Auxiliary to the Vetrans of Foreign Wars, 1986; National Medal of Technology, 1991; National Women's Hall of Fame, 1994 (posthumously).

After earning her PhD from Yale University in 1934, Grace Murray Hopper became an assistant professor of mathematics at Barnard College in 1943. In late 1943, she joined the US Naval Reserve and was soon assigned to the Bureau of Ordnance's Computation Project at Harvard University. Although Hopper did not have a desire to work with digits, she became what she called "the third programmer on the world's first large-scale digital computer," the Harvard Mark I. She relied on her linguistic and communication skills to bring the world of hardwired computing technology into the realm of software applications and language manipulations. Grace Murray Hopper's work in many ways continued the legacy of women like Ada Lovelace. These women are a part of the Frankenstein Inheritance because of their passion for computers and science. Both women inherited the work of Shelley's monster who symbolizes a desire to redefine the language and parameters of science that have been so caught up in means

of exclusion, of "Othering." Grace Murray Hopper was fond of teaching, and liked to challenge what she called "the establishment." These women wanted to be a part of scientific areas where women were largely excluded, and used language to bring science to a more popular, accessible audience. The Frankenstein Inheritance forms a spectrum of stories that details these varied aspects of the history of women in science.

Grace Murrary Hopper and Ada Lovelace both hold the characteristics that define the Frankenstein Inheritance and its role in bringing forth the stories of women in science. In fact, both Ada and Hopper used their skills to write on the technology as it could be manifested in the future applications. Just as Ada Lovelace's worked to translate notes on Babbage's computing designs, so Hopper worked to draw together the mimeographed notes about the Mark I in to a comprehensive manual. And just as Ada's role as the author of the influential writings on Babbage's machines was often obscured, Hopper's work on this highly successful and important manual was also marginalized. Grace Murray Hopper's work on the 500-page volume has been widely published and is influential because it explained how to set up the Mark I and detailed the operating principles of computing machines. Yet, despite Hopper's work as both the editor and a major contributor to the volume as it appeared in both the *Annals of the Harvard Computation Laboratory* and *Reprint Series on the History of Computing*, she is given no title page credit. She wrote about new areas of technology, working with language in order to present these developments to a larger audience, to help people learn about and become interested in computing advancements. Yet, some of her efforts in the world of computing, such as her work with the writings mentioned above, were obscured. Though she was, eventually, widely recognized for her work during the 1970s, 1980s, and 1990s,

her early work in emerging areas of computing have only recently been highlighted and praised in the greater computing community. The Frankenstein Inheritance, then, brings together both the triumphs and trials of women as they involve language, gender, and technology. Grace Murray Hopper holds a place in this inheritance because of her abilities, her skills with language and science, but also because she represents a contemporary fascination with her heroism and the importance of her work in an area so dominated by men. Her legend is one that looms large, particular in reclaiming the forgotten stories of women in the history of computing.

Hopper truly evolved as a computer pioneer throughout the 1950s and 1960s, particularly during her work on COBOL (Common Business Oriented Language), a significant development for computing in the field of business. The importance of Hopper's work on COBOL was her creation of a symbolic language, using mnemonics and English abbreviations rather than mathematic notation or formulas (Greene 79). She also predicted the importance of symbolic manipulation for future programming. This work is clearly an important part of the evolution of computer programming as we know it today. Furthermore, such attempts by Hopper to use language was a means of making computing easier to understand for people outside of scientific and mathematical spheres. And at the same time as she was making a more universal and accessible language of technology, she was working within military, academic, and commercial structures, all of which are decidedly male-dominated spheres. Her goal was for all people to use and program "society's newest tool" (Greene 80).

In all of these examples of women in the history of computers, we can see that each worked towards a more universal language of computing that would demonstrate

their technical abilities and enable women to have more agency within and access to the field. In addition to these accomplishments, an important part of Hopper's legacy is continuing her use of language and value of accessible means of communicating and understanding technology. One of the most significant pioneering efforts by Hopper was her creation of a dialogue about computing. She was one of the first computer scientists to emphasize communication and bring people together through national meetings to discuss ideas and share their concern (Greene 80). As a public spokeswoman for dialogue on and within computing, Hopper has been hailed as a woman who has " done more than any other person in computing technology to bring people together to share their knowledge" (Greene 80). Her legacy is certainly one tied up in both her scientific and linguistic abilities that fostered a greater communication between those within and outside of this technological, male dominated sphere.

Grace Murray Hopper once forecasted that "[s]ome day, on the corporate balance sheet, there will be an entry which reads, Information; for in most cases, the information is more valuable than the hardware which processes it" (Ament 1). Her insights into the world of computer science and commerce were progressive during her time, and like Shelley, she was able to foresee important issues in the evolution of technology and set an example that predicted the importance of understanding and communicating information.

The recent developments of both feminist theory and technology further reinforce not only the historical importance of women like Ada Lovelace and Grace Murray Hopper, but also the important ways women employ language as a tool and medium through which to challenge scientific constructs in a patriarchal system. Both Ada

Lovelace and Grace Murray Hopper are infuential pioneers of computing whose legacies have become prominent in the minds and imaginations of computing scientists and feminists alike. Indeed, there are biographies which outline the importance of these women and describe their individual skills and genius. Yet, what these purely historical accounts fail to examine is how these stories fit into a larger narrative of women in science. They do not compare the challenges Grace Murray Hopper faced, for instance, to the larger circumstances of women working in the emerging field of computing during WWII. This broader narrative of women in computing is what I have linked more generally to the Frankenstein Inheritance, a narrative that attempts to bridge these gaps between individual struggles and successes and those of women in general.

As we have seen in the past three chapters, the Frankenstein Inheritance takes its name from Mary Shelley's work as a woman writing about science and bringing the elite male sphere of scientific discussion to a wider nineteenth-century audience. It also takes up the image of Frankenstein's monster as a feminist metaphor that contemplates hybridity and challenges prevalent Baconian views of science that privilege male dominance over women and nature. Throughout the nineteenth-century and twentieth-century, the Frankenstein Inheritance comes to stand for a larger lineage of women in science that includes both the individual and the collective voices of women attempting to use language as a tool through which they could enter the realm of science and technology. This lineage includes feminist theorists like Donna Haraway and Sadie Plant, who attempt to reimagine and rearticulate notions of women in science that includes a broader understanding of their historical roles. It also includes women who experienced first-hand the changing ideas about gender and science, especially during

World War II when social and political circumstances finally allowed for women to work in new areas of science and technology.

The Frankenstein Inheritance ties the theoretical intentions of contemporary feminists to the more specific, often obscured (hi)stories of women who were "computers" or X-ray technicians or telephone operators or secretaries. It is through understanding how these broader narratives fit with the more specific history of women in computing that we can begin to open up discussion on our current ideas about science and gender. By exploring the ambiguities of the past, perhaps we can embrace lofty notions of science that opt less for binaries of gender and more for multiple perspectives of what it means to be man, woman, or human.

Where Do We Go From Here?

Science and Gender in the New Millennium

Throughout the previous chapters, we have seen how defining what is human is, in many ways, involved with defining the "natural" or innate qualities of gender. Indeed, such definitions of the human have separated women from women, men from women, and (hu)man from nature, as we have examined through Bacon's widely accepted scientific assertions. Binaries work to demonstrate the differences of things, to create both imaginary and real boundaries (and hierarchies) of exclusion and inclusion. With the conceptual or physical separation of such things, the act of polarization or binarization, ones and zeros work to group together things that are similar and to separate opposites: on or off, male or female, present or absent, good or bad. These notions of good and bad, male and female, natural and un-natural have shaped the way we look at women in the history of science and technology. Indeed, they have shaped the ways that women have been excluded from and represented in the scientific tradition.

Throughout Chapter One, we explored how Mary Shelley used language to respond to her position as a "nearly silent listener" of elite, male spheres of scientific discussion. In particular, we saw how *Frankenstein*, as one of the first pieces of science fiction, fostered accessible, popular discussion of typically exclusive scientific issues. Shelley's reworking of Baconian metaphors challenged problematic, binary definitions of science that advocate male domination over their submissive natural or feminine objects. Many other feminists continue Shelley's legacy through the Frankenstein Inheritance, which chronicles female efforts to overturn domination politics in science that exclude access to science and technology based on gender.

In Chapter Two, we explored how contemporary feminist Donna Haraway's image of the cyborg takes up the Frankenstein metaphor in a modern-day attempt to revamp the monster as a powerful feminist metaphor. Haraway's notions of situated knowledge and the importance of successor science is a reframing of the Frankenstein Inheritance that attempts to recontextualize issues of science and gender in the Digital Age. Such reworkings of the monster metaphor provide a powerful challenge to binary constructs of identity. The cyborg promotes an acceptance of multiple, partial perspectives which ultimately involve more meaningful exchanges through vast networks and communities.

The Frankenstein Inheritance is also a part of understanding how women have contributed to the developments of computing, especially during World War II. In Chapter Three, we examined the particular historical elements of the politics of gender in areas of science and technology. Sadie Plant's articulation of the material, physical, and cognitive components of this history provides a larger frame for incorporating women into the history of computing. Keeping in mind Plant's methods of contextualizing the importance of labour and the process of working with scientific and technological tools, we explored the historical significance of female "computers" during the war era. Further to this look at the general presence of women in the fields of science and technology, we took a more specific look at the historical importance of computing pioneers Ada Lovelace and Grace Murray Hopper. This analysis of the roles of women throughout the late nineteenth and twentieth centuries underlines the particular strengths, linguistic as well as technical, that women contributed to areas of science and technology, despite their limited access to these fields.

In a very real way, such binaries encode the modern systems that we have become so reliant upon. Hierarchies are built and defined by binary codes of gender, race, and class that perpetuate male world-view metaphors and codes of conduct. Our bodies, landscapes, and modes of communication are based on the language of code – metaphors of domination and submission – and on encoded systems of exchange. According to Donna Haraway, the task of the feminist cyborg is "recoding communication" because the structures and grids of human interaction are encoded – written and parsed – in ways that open channels of power to some and close these channels for others. Systems of communication have been literally built and encoded on these binary channels that either allow or deny access to these tools of (ex)change.

Recently, the gender-science debate has gained new momentum. Remarks from Harvard President Larry Summers this past January fired a frenzy of outrage and criticism, both inside and outside academia, over his views of women's abilities in math and science. Summers stated that the gender gap between top-tier tenured science professors could be explained in the following terms: firstly, women are not as interested as men in making the sacrifices required by high-powered jobs; secondly, men may have more "intrinsic aptitude" for high-level science; and finally, women may be victims of old-fashioned discrimination (Ripley 1).

Larry Summers' comments and the subsequent backlash from Harvard faculty and the extended community was extensively covered by the national media, including such widely read magazines as *Time* and *Vanity Fair*. Amanda Ripely wrote about the debate in her cover feature for *Time*, outlining a much more detailed look at the differences between men and women as they appear in the brain, especially in reference to sensory

experience and perception styles. In particular, she notes how scientists do not yet understand the different brain architectures of men and women:

> The deeper you probe, the more interesting the differences. Women appear to have more connections between the two brain hemispheres. In certain regions, their brain is more densely packed with neurons. And women tend to use more parts of their brain to accomplish certain tasks. That might explain why they often recover better from a stroke, since the healthy parts of their mind compensate for the injured regions. Men do their thinking in more focused regions of the brain, whether they are solving a math problem, reading a book or feeling a wave of anger or sadness. Indeed, men and women seem to handle emotions quite differently. While both sexes use a part of the brain called the amygdala, which is located deep within the organ, women seem to have stronger connections between the amygdala and regions of the brain that handle language and other higher-level functions. That may explain why women are, on average, more likely to talk about their emotions and men tend to compartmentalize their worries and carry on. Or, of course, it may not. (Ripley 4)

Many studies have shown the ways that girls acquire language skills and mature more quickly than boys. Likewise, there are studies that show the innate technical and scientific competencies of boys. And popular culture certainly highlights the differences between male and female ways of expressing (or, repressing) emotions. Yet, we have

seen throughout the past few chapters that these differences between men and women often push us further in the quest to develop better tools and resources of communication.

We have seen how women like Ada Lovelace and Grace Murray Hopper brought strong language abilities to the male realm of computing science. These women helped shape the larger applications and popular, widespread usage of computer hardware. At the same time, we have seen how discussions about science were broadened by the literary efforts of science fiction authors like Mary Shelley. Science fiction brings forth debate and encourages imagination about the possibilities of science, making it more interesting and more accessible to the public. Language affects scientific application and teaches use about its uses; science provides the basis of much literary discourse and the impetus for imaginations about the future of (hu)mankind.

The Contemporary Science and Gender Debate

The latest discussions over innate versus constructed gender-science dynamics lead me to wonder what the current circumstances of women in fields of science and technology entail. The recent developments and progression of both feminist theory and women's work with technology further reinforce not only the historical importance of women like Ada Lovelace and Grace Murray Hopper, but also the important ways women employ language as a tool and medium through which they can both challenge and master masculine scientific constructs. In the field of engineering, it appears that combining the two philosophies of feminist discourse (difference and equal rights feminism) could provide a means of escaping the tropes of extreme, dissociated feminist camps. In her discussion of feminism in engineering, Pamela E. Mack notes that though

equal rights feminism created jobs for female engineers through affirmative action, gaining women access to the mainstream of engineering, difference feminism has often argued for women's abilities to be innovative contributors in whatever field they enter (Mack 162). What Haraway and Merchant demonstrate is that accepting and reimagining both schools of equal rights and difference feminism, rather than just one, and embracing *technology* enables more possibility for women to both enter the mainstream and offer their strengths to existing fields.

There is certainly a great need for feminist possibility in the field of engineering and computing. Between 1970 and 1980, there was large growth in the field of computing science, especially for women. During this time, there was a forty-four per cent increase in the number of women computing (Goyal 37). However, despite this growth, there were still many frustrations for women in the field of computing. For instance, in 1987, during the development of second wave feminist theories like those of Haraway and Merchant, 27 per cent of men believed the abilities of women engineers to be inferior to those of their male counterparts (Mack 159). Furthermore, there was a "technical locker room" phenomenon in young high tech companies where "aggressive displays of technical competence [were] the criteria for success" (Mack 160). Not only do men perceive women's abilities as worse than theirs, but the environment and measure of success by which women in technology and science are measured is male-defined, one where men are better able to "appear" to be successful engineers (Mack 160). Along with the Frankenstein Inheritance, there has been a constant Baconian view held within these realms of engineering and science: the female struggle to resist exclusion from science based on an alignment of female with nature and emotions has continued.

Perhaps such views become so ingrained in Engineers because this belief is learned in an institutionalized way, as the controversy surrounding academic figurehead Larry Summers might suggest.

In her influential work in the 1980s, Sally Hacker traces these conceptions of the female as part of nature as an important part of the study and teaching of engineering. Hacker's comparison of men in both the humanities and the engineering faculty is interesting. When interviewing these male subjects on why women as are associated with nature she quoted Bacon as a part of her inquiry. She found that no male respondent made an association between women and nature himself, but both sets of scholars linked women to nature through references to physical appearance and physical reproductive qualities of females while also linking men with qualities of the mind (Hacker 345). The main difference between humanities and engineering faculty was that men from the humanities were the only respondents to see both women and nature as "unpredictable, uncontrollable and dangerous" (Hacker 345). One can conclude, therefore, that male scientists see women and nature as the objects for inquiry that are more controllable and predictable. Hacker also notes that Engineers see social relations and social sciences as less important than technical expertise.

Such views suggest that women hold less socially valuable roles and occupy a lower place in a patriarchal system of hierarchy than men who deal with the technical. Hacker conducted numerous studies, finding several pertinent conclusions: managers interviewed justified exploitation, largely because their work is easy to control during periods of technological change (342); those in the most scientific fields of engineering did not view themselves as taking pleasure in sensual and physical pleasure (345);

engineering faculty valued a hierarchical system of management whereas humanities faculty valued an egalitarian system (346); engineering professors frequently told jokes at the expense of those technically incompetent, especially women and minorities (347). All of these conclusions demonstrate a contemporary male preoccupation in the sciences that associate women with nature and outside of a value system which privileges the technical/male system of knowledge. And, in particular, this male world-view of science was presented and taught through an institutionalized, academic environment.

During the 1990s, there was more optimism for women in the field of computing science. In 1996, Amita Goyal argued that women preferred to enter the field of computer science since it was a relatively young industry that had perhaps avoided some of the gender stereotyping of other scientific fields (Goyal 36). However, despite these encouraging elements of computing science as a new industry, Goyal noted that there is a "perpetual glass ceiling" for women working in this area. She demonstrated how there were still low numbers of women in computing science, and the arbitrary salary gap between men and women was cause for concern (Goyal 36). Furthermore, a 1996 survey indicated that of information systems professionals, women made up 18 per cent of the workforce and only seven out of 100 of the nation's top executives were women (Goyal 36).

Perhaps Larry Summers' assertion that women were not as interested in the high-powered careers in science and technology stems from the fact that women in these fields often hit this "glass ceiling." Summers might have mistakenly seen this as a female "disinterest" in science, when in reality there is female frustration with limited career paths that do not involve the same economic rewards or promotions that men experience.

Furthermore, what has been characterized as a simple "disinterest" in high-powered jobs in science and technology could indicate that women generally place less social value on high-powered careers. As we saw in Chapter Three, Sadie Plant demonstrates that "[w]hile the members of an older male workforce had found a sense of identity in their work, women were not only less able, but also less willing to define themselves through employment or a single career" (Plant 41). This frustration with scientific career paths, as well as a general female reluctance to define themselves by high-powered careers, provides a more complex picture of women's relationship with science and technology.

Where Do We Go from Here?

Gender and Science in the New Millennium

Many reactions from the scientific community in reference to the recent science and gender debates emphasis the complexity of the issue. There are many social and environmental factors that influence genetic and biological human qualities, and vice versa. Both a physician and psychologist, Leonard Sax is one of the few who believe in both the innate abilities of men and women and that there are environmental factors that can be changed so that these qualities do not become limitations (Ripley 6). Sax notes that learning is an important part of developing a fondness or aversion to certain subjects for young boys and girls:

> "If you ask a child to do something not developmentally appropriate for him, he will, No. 1, fail. No. 2, he will develop an aversion to the subject," he says. "By age 12, you will have girls who don't like science and boys who don't like reading." And they won't ever go back, he says. "The

> reason women are underrepresented in computer science and engineering is not because they can't do it. It's because of the way they're taught." (Ripley 6)

Appropriate education is an important part of making both linguistic and scientific skills for men and women more accessible. In a recent *New York Times* article, Evelyn Fox Keller responded to the recent controversy surrounding Larry Summers and the gender-science debates. She concurred that many social and environmental complexities, as well as quantitative and qualitative research strategies, should be examined when discussing the genetic traits of men and women. In a talk at Harvard during this past April, Fox Keller stated that it was "wrong to view genes as acting on their own to produce certain characteristics because their expression in the body depends on the actions of other genes, chemicals in the cell and other factors" (Dean 3). In learning to understand the different genetic and social factors that affect gender disparities, it important to see the possibilities of reconciling these differences through education and training. Not only must we teach more broad, inclusive perspectives of male and female roles in the history of science and technology, but also we must teach these subjects in a way that appeals to the skills and interests of both boys and girls in spite of their innate differences.

In fact, new studies show that boys have as much to gain as girls in the quest to understand gender differences in learning. Just after Larry Summers' controversial statement on women's aptitudes in science, Jeanne Whalen and Sharon Begley of *The Wall Street Journal* reported on new research on gender and science dynamics. They cited studies that indicated how new methods of teaching math in British classes were helping close the gender gap between boys and girls, showing that girls were even pulling

ahead of boys in mathematics (Wolcott 96). Such studies support current scientific philosophies that argue how genetic or intrinsic traits are subject to social and cultural forces, forces that help determine the complicated ways in which a biological trait might manifest itself in a human's abilities and behaviour (Wolcott 96). In fact, many people are noting how the gender gap in education affects boys as much as girls. Ann Hulbert argues that boys are the ones being left behind in the classroom. She argues that more women go on to higher education than men (Hulbert 13). Hulbert also notes that recent educational trends for boys are cause for alarm:

> What Summers didn't spell out is that boys owe their edge in math to the unusually high performance of a relatively small number of boys in a pool that also has more than its share of low-scoring students...The gender disparity widens among low-income and minority students...Females have yet more strides to make in the sciences, but they're building on success. A boost-the-boys educational endeavor faces the challenge of dealing with downward shift. Clearly, the nation needs an impetus to tackle the large problem of growing social inequity. Worries that it is boys who are being left behind could be the goad we need. (Hulbert 13-14)

Gender differences between boys and girls are related to a number of social factors, especially when these factors are linked to economic status. Both Hulbert and *Vanity Fair*'s James Wolcott point to the economic factors in education, citing class difference and economic disparity as perhaps the largest factor in poor scholastic performance for both boys and girls. Summers' statement that women may not be suited for science

overlooks many other social, economic, and racial factors that clearly contribute to academic performance and workplace aptitudes.

And let us not overlook how general social, economic, racial, and gender factors affect more than just disparities in science. These factors play a great part in many of the dynamics of our systems of exchange and communication, especially our daily human interaction through the media. As James Wolcott argues,

> What exploded [after Summers' comments], methinks, was a protracted buildup of exasperation over the persistent under-representation of women in positions of prominence and authority, and the mulish inability of powerful men to recognize the scope of the problem, or their tendency instead to rationalize it with voodoo genetics and Victorian-parlor sociology. Women are sick of hearing the same old sea chanteys. They've had their fill of men who insist on protecting their privileges and pretend it's the natural order of things. (Wolcott 96)

Wolcott goes on to demonstrate how science is not the only area affected by gender differences. He shows how women are also largely under-represented in the media, noting that in 2004 women made up only 37 per cent of the staff at newspapers in the United States, and only six per cent were women of color (Wolcott 98). Despite the numerous studies that indicate how women excel in arts and language skills, gender disparities are rampant in industries outside of scientific and academic spheres as well. These much broader trends demonstrate that problems of gender disparity do not occur in fields of science and technology alone, but include the fields in the arts, business, and media.

The importance of *Frankenstein* comes forth in many of these contemporary discussions of feminism, nature, and technology. The ever-present images of both the monstrous Other (women) and the solitary scientist (Victor) continues to haunt the sciences. Furthermore, the division of body as female and mind as male continues to define scientific and cultural discourse in a way that places women outside of scientific discussion and devalues their work. Indeed, the division of mind/body, organic/mechanic, male/female, high/low, humanities/sciences, and difference/equal rights feminism seems only reconcilable in Haraway's theory of the cyborg that embraces a more fluid (not binary) articulation of these items.

The more one delves into the social and technological implications of these divisions, the more far-reaching and irresolvable they become. What's especially clear is that the Frankenstein Inheritance urges us to take responsibility for such divisions, to work within them to imagine a movement between such binaries while also realizing the impossibility of forgetting them.

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