LIBRARY
Michigan State University

PLACE IN RETURN BOX
to remove this checkout from your record.
TO AVOID FINES return on or before date due.

DATE DUE	DATE DUE	DATE DUE
JAN 31 2000		
JUN 28 2003		

1/98 c:/CIRC/DateDue.p65-p.14

THE RETRIEVAL OF A LEGACY: PERSPECTIVES ON PRESENCE AND PROGRESS OF NINETEENTH CENTURY WOMEN INVENTORS IN AMERICAN CULTURE

By

Denise E. Pilato

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

American Studies
1998

ABSTRACT

THE RETRIEVAL OF A LEGACY:
PERSPECTIVES ON PRESENCE AND PROGRESS OF NINETEENTH CENTURY WOMEN INVENTORS IN AMERICAN CULTURE

By

Denise E. Pilato

Nineteenth century American women inventors present a rich legacy in the history of technology, but one that remains unrecognized. Collectively, over 5,000 women received patents during the 19th century which substantially challenges gendered assumptions about women and technology, particularly the pervasive cultural and ideological stereotype of the prototypical inventor as male.

Individually, women inventors experiences reveal how the social construction of gender affected their technical creativity and how such technological innovation was perceived, accepted, and diffused. Applying interdisciplinary methodology which utilized patent records, legal cases, autobiographies, correspondence, 19th century newspapers and journals, material artifacts, and secondary scholarly sources, revealed systematic social barriers which operated in the American system of democratic technology since the inception of the U.S. patent office in 1790. Barriers regarding law, education, economic status, social class, gender roles, and labor practices historically affected men and women differently in how they expressed technical creativity. Like male inventors, what women invented during the 19th century bore the

imprint of social context. That context reveals a pattern of deterministic socialization which nearly half of the population responded with wild enthusiasm to the national mantra endorsing Yankee ingenuity and the self-made man while the other half was socialized to function as antitechnocrats.

By studying 19th century women inventors, evidence reveals patterns and cultural indexes which register flux in the social fabric of America's response to women's technological contributions. Gender based patterns of technological invention emerged as well as patterns of social change and control. A pivotal focus of my ongoing work in the history of gender and technology continues to address an important lacuna in the study of the history of technology: the contributions and impact of women inventors in the development of American technology.

Copyright by
DENISE E. PILATO
1998

Dedicated to my most excellent task master
and life's partner, Thomas O. Whipple. I cannot but suggest by this mere inclusion the depth of my gratitude for your uncompromising support and total devotion. As I shared this goal with you, so I share this success.

ACKNOWLEDGMENTS

It is with whole-hearted appreciation that I acknowledge my dissertation committee members who solidly supported me through to successful completion. To my chair, Dr. Ann Larabee, Professor of American Thought and Language, I am indebted to her unwavering support in all regards. She guided and taught me not only how to write a dissertation, but also how a cyborg successfully navigates through an academic career path in this field. Her enduring confidence in the face of many unexpected obstacles sustained and directed me more than can ever be measured by a conferred degree. It is with finely tuned appreciation that I look to my other committee members, Dr. Kurt Dewhurst, Director of the Michigan State University Museum and Professor of English; Dr. Joyce Ladenson, Director of Women Studies and Professor of American Thought and Language; and Dr. Maureen Flanagan, Professor of History, as they collectively and individually exemplify the multi-faceted meaning of what it means to be a scholar and teacher. Their experience, knowledge, and friendship proved invaluable in my need to be pointed and re-pointed time and again to the finish line. As I cross that line, they remain my exemplary models.

As mentors par excellence, it is with uncompromising gratitude that I acknowledge Dr. Judith K. Brown, Professor of Anthropology, Oakland

University, and Dr. Jane Eberwein, Professor of English, Oakland University. Both were instrumental in providing critical encouragement from the very inception of my dissertation ideas through to its final form. By virtue of their wisdom, excellent scholarship, and sincere affection, they represent the epitome of the ideal mentor, absolutely indispensable in the successful completion of this dissertation.

It is with equal distinction, that I acknowledge my family's contributions, *for everything*, of course. To my partner, Thomas, my mother and father, Patricia and Leonard Pilato, and my children, Bronson and Terra, who were not always sure what I was doing, but only that I needed help doing it. I thank you for your ingenious support in so many ways.

Also deserving of recognition and my heartfelt gratitude, I acknowledge Philip Maxwell, Attorney at Law and friend, who cleared the way for me so I could push ahead; and Rosemary Possanza, a most remarkable American Studies Administrator, who then kept the way clear through the maze of procedures and protocol. I am also indebted to independent scholar, Autumn Stanley, for her vested interest in this project and her ground breaking work, *Mothers and Daughters of Invention.* Finally, I thank the fine librarians at the National Patent Depository at the Detroit Public Library, the Special Collections staff at Michigan State University Library, and the Henry Ford Museum Resource Center.

TABLE OF CONTENTS

INTRODUCTION 1 -8

CHAPTER 1
THE U.S. PATENT SYSTEM: A FRAMEWORK OF LEGAL BARRIERS 9-46

CHAPTER 2
OUT OF THE REVOLUTION: SEEDS OF INDEPENDENT INVENTION 47-81

CHAPTER 3
JACKSONIAN DEMOCRACY: YANKEE INGENUITY AND THE SELF-MADE WOMEN? 82-122

CHAPTER 4
THE CIVIL WAR: IMPETUS TO INVENTING WOMEN 123-171

CHAPTER 5
NATIONAL RECONSTRUCTION VS. GENDER CONSTRUCTION 172-225

CHAPTER 6
AMERICAN PROGRESS: CELEBRATED OR RELEGATED? 226-275

CONCLUSION 276-279

BIBLIOGRAPHY 280-304

INTRODUCTION

> There have been very learned women as there have been women lawyers but there have never been women inventors. Voltaire, 1764
>
> For whatever reason, there are few women inventors, even in the realm of household arts... I cannot find a really conspicuous exception to cite. Edmund Fuller, 1955 (Rothschild 5).

Although these views are blatantly erroneous, they represent an attitude which has long permeated and dominated the history of technology. Voltaire, a leading French author and historian, is well known for his enlightened views on the nature of man. And Edmund Fuller, noted American historian, is best known for his work in the history of technology and invention in the mid-twentieth century. Beyond their enlightened vision and historical expertise, stands a sound and substantial record verifying that there have been countless women inventors through the ages.

Still, the legacy of women inventors and their technological contributions has not been recognized in the same light as male contributions, if at all. Their collective and individual contributions document a revised perspective of the history of technology, underscoring the "malecentrism" of the current body of the

history of technology. The woman inventor has been rendered as invisible and her inventions as insignificant. The purpose of this dissertation is, in part, to begin to retrieve the legacy of 19th century American women inventors. Beyond the retrieval process, this study provides a significant cultural context which reveals a pervasive attitude in the persistent cultural and ideological stereotype of the prototypical inventor as male. It also explores women inventors relationship to technology and how the social construction of gender affected their response to innovative technology, society's response to female inventiveness, legal entitlement, political impetus, and educational access. The evidence clearly undermines Voltaire's and Fuller's mistaken assumptions, but also explains, in part, how they arose.

Ample evidence of their existence is found from a wide range of 19th century sources. One of the most significant sources is a document entitled *Women Inventors to Whom Patents have Been Granted By the United States Government 1790-1888* (with an extension to early 1895) compiled under the direction of the Commissioner of Patents. Although this census is flawed by significant omissions of some inventors and the misclassifying of some inventions, it remains the single most useful source in documenting women inventors. Other sources, including 19th century journals, especially women's journals, autobiographies, probate records, legal cases, and museum collections of primary documentation in the retrieval of important women inventors who have

yet to be included in the celebrated canon of American inventors.

Technological change has historically been a process subject to struggles for control by different groups, and women inventors certainly constitute a different group than male inventors, one in which legal, social and economic control surfaces (Wajcman 22; Stanley xxxvi). Since women inventors are a group defined by gender, it is important to consider gender as an ideology, not just as a sexual or behavioral difference. Feminist historians encourage expanding our inquiries beyond what 19th century Americans called the "separate spheres," and avoiding the cultural construct of male "activity" and female "passivity" (Cutliff and Post 173). These three precepts guide my inquiry. Simply retrieving the legacy of what women inventors contributed to technological change in the 19th century is not enough to establish their value and impact. Recognition of women inventors must include their cultural placement in the gendered social context in which they invented.

Assumptions such as Voltaire's and Fuller's have persisted for more than 200 years. Correcting them will take more than simply cataloguing the accomplishments of women inventors, no matter how significant they may be. Nevertheless, it is a necessary first step. This dissertation seeks to contribute to the retrieval of the legacy of 19th century American women inventors by placing them contextually within the history of American technology.

The dissertation consists of six chapters, plus an introduction and a

conclusion. It is organized chronologically beginning with the opening of the Patent Office in 1790 and concluding with the 1893 Columbian Exposition in Chicago. My interdisciplinary methodology draws from a range of theoretical perspectives including, but not limited to, historical, social, technological, and feminist and utilizes primary documentation and secondary scholarly sources. The following discussion briefly outlines the focus of each chapter.

Chapter 1, "The U.S. Patent System: A Legal Framework for Undemocratic Participation," suggests that from the first Patent Act signed into law by President George Washington on April 10, 1790, the patent system functioned as a legitimate and legalized system of barriers to women's democratic participation in technical creativity. By profiling the legal cases of Harriet Ruth Tracy, Maggie Knight, Clarrisa Britain and Elizabeth Hawks , some of the legal obstacles women inventors experienced with patent law come to light.

Chapter 2, " Out of the Revolution: Seeds of Independent Invention," focuses on the hat industry in early United States history and several women inventors connected with that industry: Betsey Metcalf, straw braiding, 1798; Mary Kies, straw weaving, 1809; Sophia Woodhouse, manufacture of grass bonnets and hats, 1821; Lucy Burnap, hats & weaving grass, 1823; and Henrietta Cooper, straw leghorn whitening, 1828. The function of time, place, and resources is examined in context of gendered terminology and rhetoric which reveals some of the early gendered assumptions about technological innovation.

Chapter 3, "The Contribution of Jacksonian Democracy: Yankee Ingenuity

and the Self-Made Woman?" explains how and why the ideas and rhetoric of the "Age of Jackson" related to technology's relationship to women, particularly those advocating Yankee ingenuity and the self-made man (Meyers 15). This ideology of the American self-made man represented men across the class lines, but it represented them unequally. And the self-made woman, especially one who aspired to inventive creativity, was not represented at all (Dickenson xvii). The work of Charles Brockden Brown, Ralph Waldo Emerson, and Margaret Fuller present a contextual framework in which to illustrate how women were excluded from the characterization of the self-made man and how they mediated the gendered power relations as technology advanced at unprecedented speed. Inventors such as Catherine Greene, cotton gin, 1790s; Ann Harned Manning, mower and reaper, 1818; and Nancy Johnson, first ice creme freezer, 1843, shed understanding about the affects of republican virtue and Jacksonian democracy on women inventors.

Chapter 4, "The Civil War: Impetus to Inventing Women," provides evidence of the Civil War as a time of accelerated innovation for female inventors. Only about 50 patents were granted to women between 1790 and the beginning of the Civil War. But in the next decade, beginning with the War in 1861 until 1871, nearly 500 patents were issued to women. Gendered patterns of technological invention based on reception and diffusion emerged in this patriotically charged atmosphere in which medical, military, and industrial

inventions abounded. Martha Coston, pyrotechnic flare and signal code, 1859; Clarissa Britain, ambulance, 1863; and Mary J. Montgomery, war vessel, 1864, are representative of a new breed of women inventors who emerged during this time on a newly carved professional strata.

Chapter 5, "National Reconstruction vs. Gender Construction," explores how the end of the Civil War affected a shift in national reform issues which influenced the presence and progress of women inventors. At the conclusion of the War, abolitionists realized a victory toward race equality, but the advancement in sexual equality, however, remained unchanged. It has not been my purpose to trace the developments of the women's movement during the second half of the 19th century. Rather, I have made significant connections as to how women's increased access to higher education, efforts at community organization, and individual professionalization affected the status, opportunity, and success of women inventors collectively and individually in male dominated scientific and business communities (Rossiter xvii, 72). The prototypical inventor, much like the prototypical scientist, continued to be constructed in masculine terminology and imagery. Yet women inventors began an upward productive trend like never before in American history and showed early evidence of community organization and individual professionalization. My investigation profiles some of the individuals championed by Charlotte Smith, a public advocate for women

inventors during the late 19th century.

Chapter 6: "American Progress: Celebrated or Relegated?" focuses on the Philadelphia Centennial in 1876 and the World's Columbian Exposition in Chicago of 1893 as "significant social and cultural artifacts that reveal much about the times and the places that produced them" (Segal 125). They offer solid material documentation as to what women were inventing, suggesting that social and cultural artifacts were imbedded in women's technological records at such exhibitions. As Henry Nash Smith pointed out, the World's Columbian Exposition provides "something like a mark of punctuation in American cultural history" and one might add, in the history of American women inventors (xvii).

Nineteenth century American women inventors present a rich legacy in the history of technology with unique opportunities to discover gender based patterns of technological invention as well as patterns of social change and control. The obscurity of 19th century American women inventors is buried not only in old court documents, patent records, archives, literature, popular culture, and material artifacts, but also in the social fabric of our national heritage which continues to represent the prototype inventor as male (Wajcman 15).

Individually and collectively, 19th century women inventors contributed to the increasing feminization of American technology in ways which challenged the gendered assumptions about women and technology. Emerson believed that "we

are all inventors, each sailing out on a voyage of discovery, guided each by a private chart, of which there is no duplicate" (Emerson *Letters and Social Aims).* And in a unique way 19th century American women inventors charted many voyages and discoveries which persistently remain uncharted in the whole of the traditional history of technology.

Chapter 1

THE U.S. PATENT SYSTEM: A FRAMEWORK OF LEGAL BARRIERS

It is true that no overt discrimination was written into the Patent Act of 1790 or the subsequent major legal changes in 1793, 1836, or 1870, or any of the other many changes that transpired during the 19th century. No one was denied due process of a legal patent application based on gender, class, or race. The first patent act of 1790 firmly established this precedent when it authorized "any person or persons" to petition the Secretary of State for a patent. The statute explicitly recognized that "he, she, or they" might have "invented or discovered [a] useful art, manufacture, engine, machine, or device" (Merritt 289). Since that first patent act, the U.S. Department of Commerce has historically maintained that,

> The patent system is as basic to American democracy as the provisions of the Constitution that protect personal and property rights. That it offers the same protection, the same opportunity, and the same hope of regard to every individual...the American patent system plays no favorites. It is as democratic as the Constitution which begot it" (*The Story* ii).

The U.S. Department of Commerce astutely noted that the patent system was representative of American democracy as established by the provisions of the Constitution. In those provisions, one cannot overlook the fact that the Constitution did not recognize women as voting citizens until the 20th century. Nor was there democratic protection of personal and property rights to women through most of the

19th century. These provisions consistently correlate with the U.S. patent system's lack of recognition of women inventors throughout the 19th century.

Riding on the democratic shirttails of the Constitution, our first patent acts were written so as to intricately give voice to principles of equality based on race, class, and gender. Although these principles were imbedded in the rhetorical fabric of the various patent acts, there were exclusionary limitations which were consistent and important cultural determinants as to who actually received a patent. As noted in the above statement by the U.S. Department of Commerce, the American patent system claimed to played no favorites. Yet, the belief that opportunity and hope was extended to "every individual" who "invented or discovered [a] useful art" was certainly inconsistent with the experience of 19th century women inventors. It, in fact, cements the ironic truth of the statement that the American patent system has been "as democratic as the Constitution which begot it." The experience of women inventors proves such lofty ideals to be theory at best and callused discrimination at worst. The democratic principles which shaped and informed the U.S. patent system created a framework of legal barriers. Exclusionary limitations regarding property rights, education, and cultural norms affected women inventors in their creative pursuits of American technological progress.

Such limitations and issues appear to fall quite outside of the legal due process of the patent application, but they presented very real barriers for women inventors in that process. Women challenged America's constitutional notions of democracy and due process by pursing patents in "the face of cultural, legal and administrative barriers" (Merritt 289). Getting a patent has always involved more

than a simple legal transaction between inventor and patent office. It was not merely the act of patenting which was legally codified, but the subtle and unspoken laws of the "business of inventing" which entered into the formula for success. Women inventor's experience during the 19th century clearly reveal that "social biases diminish[ed] the power of women to compete fairly for legal entitlements" (Merritt 306). Not only did such biases diminish their power to compete for legal entitlement but also to compete for manufacturing opportunity and recognition as significant technological contributors. And for women of color, these social biases were magnified and enlarged a thousand fold (Merritt 303-305; Hine 617-618).[1] The letter of the patent law was predicated on fairness and equality, but the spirit of the law encompassed social biases which surfaced in the decisions of the Patent Office as influenced by Constitutional precedents.

Early patent awards, such as one granted by the Republic of Venice in 1474, were "grants of monopoly intended to encourage invention and industry by means of a specified period of state protection" (Benagh 4; Walker 22-25). The Venetian institution of patents spread to other European countries, including England, and from there to the United States (Walker 24). According to Christine Benagh of the Library of Congress, Congressional Research Service:

> The word "patent" derives from Letters Patent based on the English practice of royal grants . . . In England, as in other countries, where royal prerogative was the source of the grants, abuses arose and public opinion was reflected in complaints to the House of Commons and in the submission of bills to curb the practice. The result was a Statute of Monopolies passed by Parliament in 1623. English law was reflected in the American colonies, many of which adopted patent statutes of their own (4).

Although, the colonies eventually completely rejected royal prerogatives of any sort, the conceptualization of letters of patent as grants of monopoly to encourage invention and reward inventors, was inherently adopted into American law in Article I, section 8, of the Constitution. For women inventors, Constitutional prerogatives proved to be no less abusive than their historical antecedents, royal prerogatives.

For example, the review process for patent applications reflected discriminatory biases in tandem with social prejudices. A woman's invention was sometimes undervalued by reviewers due merely to the fact that it was invented by a woman, who was designated as the "weaker sex" and, therefore, considered less technologically proficient. Even if patents were granted, recognition was seldom extended. For example, women like Sarah Mather who invented a submarine telescope and lamp (1845), Margaret Knight, the first machine to fold paper bags, (1870), and Harriet W. R. Strong, a dam and reservoir construction (1887) are among a host of 19th century women who invented things with far reaching technological significance but rarely received any acknowledgment or recognition for their patents (LWP).

Unlike the afore mentioned examples, many women invented things considered to be in "womanly fields," like feminine hygiene, child-rearing, or housekeeping. Due to the nature of such inventions, they were often considered less important than those in male dominated fields such as machinery, agricultural and mining.[2] According to a 1923 report by the U.S. Department of Labor's Women's Bureau, the "only criterion" for a patent was "the standard of patentability set up by

the United State patent law for an invention or discovery" to be "new and useful." The Bureau's report continued,

> In other words, for the purpose of this report the records of the United State patent Office have been accepted at their face value. Whatever fault there is in the standard affects men and women equally, so no bias results from accepting the standard in analyzing the achievements of women with those of men (9).

What the report neglected to investigate was that "face value" reflected technological male values consistent with "the sex-stereotyped definition of technology as an activity appropriate for men." Consequently, things such as baby bottles, uterine supporters, or domestic appliances, appear to have lesser value when "embedded in a culture of masculinity that is largely coterminous with the culture of technology" (Wajcam 17-19).

Based on just these two distinct gender biases, women's inventions sometimes did not merit the same consideration from the patent review board (Merritt 301). An 1869 decision by the Commissioner of Patents involving applications from two women and a man for a patent on a "ladies safety belt," designed to hold sanitary napkins, began by stating "the invention is not of the greatest magnitude, and the claims of invention must necessarily be somewhat trifling." It was with reluctance that the Commissioner "conceded that the invention "such as it is" was useful, and [could] be patented" (Merritt 300; *Bacheller v Porter*, 1869, Dec. Comm'r Pat. 64(1896)).

The basis for what was considered trifling was fraught with social bias predicated upon gendered values. For example, in the same year the Patent

Commissioner ruled in a case for competing claims for a patent on improvements in men's suspenders without commenting anywhere in the decision about the triviality of the invention. Quite the contrary, his decision was filled with the following laudatory remarks:

> The claim is for a combination of certain things described, by which the drawers fit easily, as well as being graceful, closely fitting the body and leg of the wearer, thus making not only a genteel, but comfortably fitting garment...It seems to me that the curved ankle band, together with a removal of the surplus cloth around the bottom of the leg and above the hips, is a very great improvement in the fit of drawers (Merritt 301).

The Patent commissioner's decision that a "ladies safety belt" was begrudgingly "useful and could be patented" stands in curious juxtaposition to the "great improvement in the fit of drawers" as achieved by this pair of suspenders. Face value of such inventions were clearly evaluated on a gendered scale informed by experience and cultural standards. As feminist historian, Ruth Schwartz Cowan, points out, "Women menstruate, partuate and lactate; men do not. Therefore any technology which impinges on those processes will affect women more than it will affect men" (Cowan in Trescott 30-31). And since all Patent Commissioners in the 19th century were men, the affect not only of the processes were biased but also final patent decisions.

A further example occurred in an 1871 decision which denied an extension on Orwell Needham's invention for nipple shields because as the Commissioner explained "the chief objection to the application consists in its unimportance. On the face of it the invention is of very low order of ingenuity. The evidence as to its value to the public is highly defective"(Orwell Nedham, 1871 Dec. Comm'r Pat. 3 (1871)

). One can only wonder about his lack of experience as a lactating woman in evaluation of the "unimportance" of the invention. In this case, a male inventor felt the brunt of gender discrimination based on the nature of his "womanly" invention. Because women were more likely to invent in these "womanly" fields, such bias was more likely to affect women inventors than men, but both men and women experienced the legal consequences of gendered barriers regarding the nature of the invention.

Cultural bias of this nature stemmed, in part, as historian Nancy Cott explains, from women's social position defined by their submissive roles as wife, mother, and chattel (Cott 1-18). In what was referred to as the Cult of True Womanhood, women were judged on their application of "four cardinal virtues—piety, purity, submissiveness and domesticity" in their respective roles (Welter 21). [3] The Cult of True Womanhood further socialized women to be anti-intellectual and the family depository of spiritual values. The ideal woman was emotional, impulsive and supra-rational, not logical, scientific or rational (Welter 71). If she was rational or intellectual or displayed any of the other traits deemed masculine, she was judged less than a true woman. Consequently, a woman who invented was viewed as less of a woman, something of a social misfit.

This social position contributed to the cultural stereotype of the 19th century American woman as an antitechnocrat, the antithesis of the characterization of an inventor which entailed legal barriers for women inventors. A woman's inventive contribution of a "useful art, manufacture, engine, machine, or device" was decidedly devalued by traditional norms due to her social position. The implication was strong

and clear that a woman's inferior intellectual capacity presented a natural obstacle to her in inventing anything of technological significance, particularly if it was outside of the domestic sphere. If she did excel in some scientific or technological pursuit, *Popular Science Monthly* in 1898 advised that she must be "strong enough to stand alone, able to bear the often unjust sarcasm and dislike of men who are jealous of seeing what they consider their own field invaded" (Bolton 511). Additionally, if she displayed some quality of genius, which inventors are often assumed to possess, she risked her very womanhood. The attitude was summarized as follows: "There are no women of genius; when they become geniuses they are men" (Bolton 511). The prototypical inventor was male from cultural concept to social reality in the legal arena.

In addition to cultural bias, women inventors experienced serious educational restrictions during the 19th century. Initially, even high school programs for women were rare. As late as 1852, the New England states did not admit women to their public schools (Merritt 293). By the 1820s, three female seminaries offered women an opportunity to go beyond the most basic education. [4] But these seminaries "never offered the classical option of the male academy" but rather "the English curriculum of the academy--history, philosophy, modern languages, and natural sciences," all designed to teach to be good wives, mothers, or teachers (Horowitz 11; Rossiter 27). Women were neither prepared for or encouraged to participate in the pursuit for technological advancement. Not until the late 19th century did women began to earn advanced degrees in fields such as chemistry, mathematics, and

physics, and even then most advanced levels of training remained hostile to women (Rossiter 35-38; Merritt 294).

Women's rights advocate and writer, Sarah Grimke, began her 1838 essay "Letters on the Equality of the Sexes, and the Condition of Woman" under the sub-title "The Education of Women," with the question, "Ought women to enjoy equal advantages of education with Men?" She answered the query as follows:

> We should neither be surprised nor daunted at the opposition made to giving woman the same educational advantages as men; it is but a few years since the same spirit rose in sterner rebellion against the laws providing for the education of the masses in some places (110).

Laws which prevented women from acquiring an education directly affected them in their pursuit of legal entitlement in obtaining patents as noted in 1923 by the Women's Bureau of the Department of Labor. Even though the Bureau believed that "the inventive spirit raises no educational bars against its search for human expression" it succinctly admitted that, "unquestionably the educated are better equipped to go through the processes of patenting inventions, and therefore, there may be more educated than uneducated patentees on the record" (6). Clearly, there were far more educated men who obtained patents than uneducated women during the 19th century.

Thus, a lack of education hindered women in the legal patent process by making it difficult or impossible for them to obtain "technical education that would have informed their attempts at invention." This was particularly critical for women because they also "lacked access to the informal training that many men enjoyed at home or on the job." Additionally, because women were denied access to higher

educational institutions with well-equipped laboratories and experimental equipment, they generally lacked knowledge about the methods and processes of documenting their inventions. When women did get patents, their lack of general knowledge about the industrial world of commerce made it especially difficult to exploit the manufacturing potential of their patents (Merritt 294). Grimke concurred when she wrote, "Open to them avenues of education, usefulness and independence, free and unfettered they can enter the temple of science and enjoy the privileges of the other sex" (117). But for women inventors, entrance into the "temple of science" presented a legal challenge.

Legal challenges increased even more for married women due to restricted property rights. *Blackstone's Commentaries*, published between 1765 and 1769, left its English common law imprint in American law after the Revolution. It determined that married women were not legal persons. According to Blackstone, the "husband and wife are in law but one person" and according to an American text published in 1890, *The Law of Husband and Wife, Compiled for Popular Use*, that single person was the husband (18). "Single women who were over twenty-one, and widows, had the legal rights of a citizen, but a married woman's legal individuality was merged into that of her husband" (Richmond-Abbot 11). Even after the first Married Women's Property Acts were passed in Mississippi in 1839, and in New York in 1848, women were still subject to the legal dictates of antebellum courts which regularly "upheld the claims of husbands to control the earning of their wives" (Hall 119-120).[5]

Legal historians generally conclude that reforms in married women's property rights failed to improve the economic status of most women during the greater part of the 19th century, and for women inventors, such persistent legal restraints contributed to the low patent rates for women (Kahn 385). This conclusion is supported by feminist, Matilda Joslyn Gage, in her 1883 tract *Woman as an Inventor*:

> Nor is women by law recognized as possessing full right to the use and control of her own powers. In not a single State of the Union is a married woman held to possess a right to her earnings within the family; and in not one-half of them has she a right to control in business entered upon outside of the household. Should such a woman be successful in a patent, what then? Would she be free to do as she please with it? Not at all. She would possess no right, title, or power over this work of her own brain. She would possess no legal right to contract, or to license any one to use her invention. Neither, should her right be infringed, could she sue the offender. Her husband could take out the patent in his own name, sell her invention for his own sole benefit, give it away if he so chose, or refrain from using it, and for all this she would have no remedy.
>
> It is scarcely thirty years since the first State protected a married woman in the use of her own brain property. Under these conditions, legally incapable of holding property, and trained, as she has been, to seclusion, dependence, and abeyance of thought, that woman has not been an inventor to an equal extent with man is not so much a subject of surprise as that she should have invented at all (488-489).

Although legal reforms which entitled women use of their "own brain property" should have reduced transaction costs and increased expected benefits, they did not substantially reduce the discriminatory affects women inventors experienced when they sought legal redress in patent infringement cases, denial of a patent application, or other patent issues (Khan 356, 358, 365). Patent rights were

carefully protected at the federal level, but as Gage noted, it was state protection which deemed women "incapable of holding property." Such state restrictions "exhibited inefficiencies based on the legal fiction of marital unity" for women inventors which granted a husband control of his wife's intellectual property and its benefits. Also, "commercial exploitation of patent property depended on the right to sue and to enforce contracts, in order to produce the invented article, to assign (sell) or license the patented invention, and to deter infringers" (Kahn 356, 386). Ultimately, in many cases, women inventors were left with no legal remedy or, at best, a codified system of legal barriers.[6]

A brief summary of the history of the U.S. Patent Office, defining its original mission and significant 19th century changes, is useful in understanding that getting a patent has always involved more than the actual filing of a patent application. Women inventor's experience with patent law encompassed a much wider scope than implied by the language of the first Patent Act of 1790. Incentive and gain in the face of legal obstacles and social prejudices are pivotal points of inquiry when addressing the barriers surrounding women and patents in 19th century America.

What did women have to gain in the passage of the first patent act? Was there incentive for achievement from the outset? Did the system "reflect a consistency in the Court's thinking as regards women and their "rightful" position in society?" (Otten 4). It is interesting to reflect on how women might have responded to President George Washington's Congressional address in January of 1790, which pressed for an aggressive understanding of the importance of establishing an official patent system. Washington stated, "I cannot forbear intimating to you the

expediency of giving effectual encouragement as well to the introduction to new and useful inventions from abroad, as to the exertions of skill and genius in producing them at home. . ." (*The Story* I). Did women inventors experience encouragement and introduction in the advancing new technologies? If so, such encouragement was not manifested in a rush of patent applications in the early years of the patent system. The first patent granted to an American woman by the U.S. Patent Office did not occur until 1809. And it was not until the Civil War era that women inventors experienced a significant increase in the number of patents awarded to them (LWP).

The Patent Act was signed into law by President Washington on April 10, 1790, to "promote the progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries" (Constitution of the United States, Article I, Section 8). Congress agreed with the President that it was imperative for the United States to encourage invention by providing patent protection for individual inventors with careful attention to the discouragement of exclusive monopolies (Bennett 54-67; Pursell *Machine* 98). [7] Founding fathers, including William Penn, Thomas Jefferson, and Benjamin Franklin were concerned about the negative effects monopolies might have on the economic stability of the colonies and later on the new nation. As an inventor of a new stove in 1744, Franklin declined a colonial patent because of the,

> "Principle which has ever weigh'd with me on such Occasions, viz. That as we enjoy great Advantages from the Invention of others, we should be glad of an Opportunity to serve others by any Invention of ours, and this we should do freely and generously" (Pursell *Machine* 32).

This kind of attitude influenced some of our early legislative development in their efforts to prevent exclusive monopolies. But it is clear that no legislation was enacted which rallied against the systematic legal exclusion of women from obtaining an education or from participating in the business of invention, which certainly had a negative effect on the promotion and progress of science and useful arts (Pursell *Machine* 103).

Still, patent records indicate that a very slim minority of women were motivated to participate in the business of invention. On the threshold of a new democracy, women were keenly aware of what was at stake and understood the significance of power over property. Although they were "dead in law" and were "denied the ability to make contracts alone," women played an active part in America's "property-conscious society" as evidenced in the volume of marriage transactions, bequests, wills, prenuptial contracts, power of executrixes of male estates, and bargaining for remarriage on the basis of property holdings (Cott 7). The incentive to participate as useful equal citizens hit a harmonious chord for women who were used to directing incentive and opportunity to serving others directly, especially family members (Cott 23). The young republic, much like a young family, needed the support of all of its members, and the language of the first patent act was silent on gender, race, and class, as it solicited the support of all patriotic citizens.

Inventors were presented with opportunities not only to support their country, but also to gain individual recognition and perhaps even wealth (Walker 16-17). Each patent awarded was guaranteed for a fixed number of years the right to exclude

others from manufacturing or capitalizing on the invention in any way. At the end of 14 years (later 17 years), the public had the free use of the invention. This time limitation was an established tradition by 1790 as Americans were accustomed to the idea of patents as reward for invention and as a protective return for ingenuity and effort based on the English Statute of Monopolies of 1623 (Dahn 344).

The law required that an inventor submit a patent specification sheet which became a public document accessible to the public to gain specific understanding of the nature and character of an invention (*The Story* i, ii). They were also required to submit a patent drawing to illustrate the invention. The drawing was accompanied by an oath and specification stating the object[s] of the invention (Aubrey 91, 97). This represented a procedural change as colonial patents generally had no drawings or written description of the invention (Dahn 345).

From 1836 until 1880, the submission of a patent model was required for examination which aided Patent Office examiners to understand the claims made for an invention. Many examiners were not trained to read drawings and preferred working models in addition to drawings. In 1870, this requirement was repealed, but the Patent Office, by its own rules, kept requiring them until 1880. Even after then, some were still submitted (Vance, Taylor, et al 8). The models eventually took up too much space and, because most were made of wood, they presented a fire hazard (Kursh 27-30;Vance, Taylor, et al 17-19). Both the drawing and model requirements posed barriers for women inventors, as few were capable draft or craft persons. The bottom line for most women was they had to have money to hire both a

draftsman and craftsman to meet such requirements. And, again, for most women, especially married women, access to money was problematic.

In addition to the cost of hiring someone to produce a patent drawing and model, one was required to pay a fee of $4 to $5, which included 10 cents a page copying fee for the specifications (Ray 1; Strulik 129; Walker 29-33). The first patent law change in 1793 included a fee hike to $30 (Toulmin 24-26). For most women, as well as many men, that amount was prohibitive.

Still, the 1790 Patent Act was the first time any government in the world gave recognition by a statute of "the intrinsic right of an inventor to the fruit of his intellectual labor" (Calvert 398). For many inventors, male and female, this represented substantial incentive. Case studies reveal that "women who filed patents were motivated by the same general incentives as men" despite the additional constraints they faced (Khan 359).

The first system was administered by a three person Patent Board of Commissioners: Secretary of State, Thomas Jefferson; Secretary of War, Henry Knox; and Attorney General Edmund Randolph. The Board examined all applications and discussed each in terms of the merit of their claims of being novel and useful (Klein & Klein 39; MacDonald 4; Calvert 398; Kursh 14-15). For three years this long and laborious examination process was utilized by the Patent Office. In the first year, only three patents were awarded, the first being assigned to Samuel Hopkins for "a new method of [making] pot and pearl ashes" (Klein & Klein 39). The next year, 1791, 33 patents were granted and in 1792, 11 were granted. No known women applied for patents during this time and records of any inventions not

patented by American women during this period remain silent. Even during the first decades after the opening of the Patent Office, few women filed for patents. According to the government list of Women Inventors to Whom Patents have been Granted by the United States Government, 1790-July 1, 1888, (hereinafter referred to as LWP) only 10 patents were issued between 1809 and 1828 to women. This list does not include all known patents. Significant omissions have been noted, and present some interesting speculation as to why, but even combining all listed and unlisted known patents, the number of patents granted to women was very small compared to later decades (Stanley *Conjurer* in Wright 118-128).

One early problem experienced by the Patent Office was insufficient time to devote to examining applications due to the press of their other official duties as Secretary of State, Secretary of War, and Attorney General. Thus, in response, the Patent Act of February 21, 1793, was passed which established a "registration" system designed to grant a patent to any one who swore to the originality of the invention, submitted the proper drawings, and paid the required fees. Examination based on novelty and utility was no longer required (Vaughan 19). This system eliminated the Patent Board, but provided the understaffed Patent Office with a superintendent and a few clerks, all located in one central building under the jurisdiction of the Department of State (*The Story* 1-3; Kursh 16; Toulmin 26).

All staff members were male until the mid 1850s, when Charles Mason, the fifth patent Office Commissioner hired women clerks to work not only on government premises, but also in the same room as men (Kursh 27-31). This was considered highly inappropriate due to the physical proximity of men and women

Cases of interference were handled by a specially appointed board consisting of a person chosen by the Secretary of State and one each by the disputants (Kursh 16). The Board's decision was final with no possibility of appeal. All members of the board were male, and thus it was implicit that although they followed the letter of new law, the spirit of it was subject to the whims, prejudices and discriminatory biases directed toward women inventors under the preceding law. The business of inventing continued to be conducted within a framework of legal barriers.

This system allowed inventors to patent almost anything and was subject to a great deal of legal abuse and outright fraud. It proved problematic in protecting the property rights of inventors, and particularly so for women inventors (Sokoloff 818). Valid inventions were challenged by unscrupulous attorneys, companies, and inventors. Infringement cases and other disputes over patents flooded the courts. Finally, a Congressional committee was appointed to investigate the alleged abuses. Senator John Ruggles of Maine began investigating the operating conditions in the patent office in 1835 and soon reported,

> For more than forty years, the Department of State has passed on every application for patent without any examination of the merit or novelty of the invention. Many of the patents granted are worthless and void. Many are in conflict with one another and a great many lawsuits arise from this condition (Ray 4).

He was not alone in his discontent with the patent law or his belief that patents had lost their value. Many shared his view that the original object of the patent law "to promote the progress of Science and useful Arts" had been defeated (Calvert 400; Kursh 20-21). The 1793 Patent Act simultaneously encouraged and protected the

working so closely together. Initially it was only as copier clerks that women were employed. Later, in 1872, Mrs. Anne Freeman was the first woman appointed as an assistant examiner. According to Charlotte Smith, a 19th century advocate of women inventors, women employees in the patent office "slowly but surely secured recognition, at first in the clerical force and afterwards in the examiners work." This work required a "full understanding of difficult inventions" and a search of foreign and domestic patents (Smith I, 3).[8]

Unlike the original three-man Patent Board which judged applicants based on examination, this registration system simply required inventors to submit a written description, pay a $35 registration fee, and swear an oath that the invention was not based on "prior art according to my belief" (Klein & Klein 41; Ray 1-2; Sokoloff 818). The substantial registration fee "presumably served to screen out many frivolous or valueless inventions," but in an economy where women consistently had less money than their male counterparts, this continued to be a particularly difficult obstacle for women inventors (Sokoloff 818).

The new system allowed for increased efficiency in granting patents by reducing the process to a mere clerical procedure, but it was fraught with other problems that originated in the concept of what constituted "prior art." It eliminated the requirement that an invention had to be "sufficiently useful and important" and established procedures to determine cases of interference (two or more persons applying for the same patent at the same time) (*The Story* 2-3; Calvert 399-400). This registration system was especially problematic when it came to protecting the property rights of inventors, especially married women inventors (Sokoloff 818).

Cases of interference were handled by a specially appointed board consisting of a person chosen by the Secretary of State and one each by the disputants (Kursh 16). The Board's decision was final with no possibility of appeal. All members of the board were male, and thus it was implicit that although they followed the letter of new law, the spirit of it was subject to the whims, prejudices and discriminatory biases directed toward women inventors under the preceding law. The business of inventing continued to be conducted within a framework of legal barriers.

This system allowed inventors to patent almost anything and was subject to a great deal of legal abuse and outright fraud. It proved problematic in protecting the property rights of inventors, and particularly so for women inventors (Sokoloff 818). Valid inventions were challenged by unscrupulous attorneys, companies, and inventors. Infringement cases and other disputes over patents flooded the courts. Finally, a Congressional committee was appointed to investigate the alleged abuses. Senator John Ruggles of Maine began investigating the operating conditions in the patent office in 1835 and soon reported,

> For more than forty years, the Department of State has passed on every application for patent without any examination of the merit or novelty of the invention. Many of the patents granted are worthless and void. Many are in conflict with one another and a great many lawsuits arise from this condition (Ray 4).

He was not alone in his discontent with the patent law or his belief that patents had lost their value. Many shared his view that the original object of the patent law "to promote the progress of Science and useful Arts" had been defeated (Calvert 400; Kursh 20-21). The 1793 Patent Act simultaneously encouraged and protected the

true inventor and supported the impostor. It also justified arbitrary decisions regarding the importance and value of inventions.

In effort to remedy the failing patent system, Congress passed the Patent Act of July 4, 1836, which re-established the examination system. It was once again necessary to determine the novelty and the usefulness of a patent application and to determine by research if there was evidence of the invention as "prior art." If the patent was not original, it could be denied on that basis. The new act also provided for increased personnel and, for the first time, this increased staff accepted appeals in cases of denial or challenged interference decisions. The provisions proved very useful to women inventors, provided they had the money to hire a good attorney to represent them. Inventors once again had to present drawings and specification sheets, and also models now. If granted, the patent was valid for 14 years with a possible 7 year extension. The Patent Office was established by law as a distinct and separate bureau in the Department of State. It charged increased fees in support of the new building an additional staff. American citizens were still required to pay $35, but British citizens had to pay $500 and all other aliens paid $300. [9] The present system of numbering patents consecutively began with patents issued under this law. Previously issued patents were not numbered and were recorded by name and date only *(The Story* 6-7; Calvert 400-402).

All of these changes worked together to increase the value of U.S. patents as individual assets. The system operated efficiently and resulted in phenomenal increases in the number of inventions patented by both men and women. Although the first 10 years of the new law saw a down swing of inventive activity due to the

more rigorous requirements, 1846 marked the beginning of increased inventive activity (Sokoloff 819).[10]

How did the various Patent Acts affect women inventors? Did the law treat men and women inventors differently? Or were they truly democratic? Court decisions reflect, to some degree, the prevelant attitudes and thinking of American society in general (Otten 4). In the case of patent law, a patent was not awarded solely on merit, but required increasingly more skilled management and interaction with businessmen, lawyers, patent officials and specialized technicians such as model makers, chemists, machinists and the like. The rational behind the decisions reflect social, cultural, and legal dictates (Otten 4). Patent decisions reveal that the law did treat men and women inventors differently.

The experiences of a select few individual women inventors left insightful legal records as to how the patent system created a legal framework of barriers. By examining the cases of Rebecca Sherwood, Elizabeth Hawks, and Harriet Ruth Tracy, perspectives on how cultural biases, educational restrictions and property laws affected women's patent pursuit emerge. The significance of their collective and individual experiences is shaped by the limits and assets of the available primary sources, and is drawn from a combination of "evidence and interpretation, circumstance and ideology" (Cott 18). The impact of their legal experiences upon traditional histories of technology and patent law suggest a redefining of significant technology which reveals "the complex relationship between 19th century women and the American patent system" (Merritt 237). Patent law has contributed to an

evolutionary germane system of socially constructed knowledge which shaped technology and women's submissive place therein.

This socially constructed knowledge surfaces not only in the rational of court decisions, but also in the nature of cases which reflect cultural attitudes toward women in general and women inventors specifically. Rebecca Sherwood of Fort Edward, New York, invented an "improvement in reducing straw and other fibrous substances for manufacturing of paper pulp" in 1866 (Stanley *Mothers* 475). This invention, no doubt, held particular commercial merit in view of wartime shortages during the Civil War. Although there is no known legal evidence that she sold the rights to anyone or made any financial gain, she felt strongly about securing this patent in her name as evidenced from the interference suit she filed in 1864. Sherwood's husband initially ran tests of the process at the local mill where he was employed. The tests met with ridicule from onlooking fellow employees, who taunted that "no woman could improve upon their methods" (Macdonald 21). This did not prevent Sherwood from going forth with her patent, but it necessitated the defense of its originality when the mill owner where her husband worked filed for a patent for a "suspiciously similar process." Sherwood was challenged to present "reliable evidence" that she was the original inventor. In her testimony, Sherwood described how she "converted her clothes boiler to hold a steaming cauldron of "a pretty soapy solution" in which she boiled straw until it was pulpy enough to substitute for wood pulp" (Macdonald 21). She produced witnesses who testified regarding specific dates and descriptions that,

> [S]he was attending to her household duties, but she apologized for her dirty stove and said she had been boiling her straw on it and it had boiled over...Some of the preparations were in teacups and bowls scattered around on the window sills and tables and on the mantel piece. . . She told me she knew how to make paper pulp. She was very positive of getting a patent and said she should have one (Macdonald 21).

Sherwood was able to produce pulp samples as prima facie exhibits for the patent examiners. These samples are still preserved as part of the her Patent Interference Case File in the National Archives Federal Records Center. Sherwood won her case, and was awarded patent #45,440 on December 13, 1864. This was in addition to her patent #40,577, November 10, 1863, for an "improvement in reducing hemp, flax, &c to a fibrous condition" (LWP).

There is no known legal record indicating that she ever sold the rights to the process (Macdonald 22). But it is not without profit that we examine her case as evidence regarding the kind of barriers women inventors faced in the patenting process. It is not in the filing an interference suit that we find this value. Many thousands of male inventors also had to protect their inventions through interference suits. But the background information contained in her case reveals the social bias which held women as antitechnocrats. It was assumed by mill workers that because she was a women, she was incapable of improving an industrial process. The attorney for the defense repeatedly referred to the patent application as her "so-called" invention and stated that it was so exceedingly vague that [it] baffles all ingenuity" (Macdonald 21). This gendered assumption about women's inventive ability was successfully challenged by Sherwood's offensive legal stand which

resulted in a patent. As recorded in the *Report of the Commissioner of Patents for the Year of 1864, Art & Manufacturing,* her invention is supported by three distinct claims. They generally concur,

> . . . the use or uses of the soapy solution prepared as herein described, in combination with any ingredient or ingredients which will combine with either in a heated state in a solution, and reduce straw or any other fibrous substance to a pulp for the purpose of being converted into colored or colorless paper, commonly known as white paper (Vol 1, 974).

It remains unknown whether this patent was ever applied in any commercial sense, but what is certain is that Sherwood successfully overcame the socially biased perception that women were incapable of inventing outside of the bounds of the "womanly fields." But technically her invention did have a connection to her domestic duties in that she boiled the mixture on her stove and virtually turned the kitchen into her workshop. The kitchen has traditionally been the woman's workshop, but, of course, as place for the purpose of food preparation and other domestic chores, not the development of industrial processes or technical devices. Making paper pulp in the kitchen with the intention of patenting the invention clearly stepped outside of proscribed womanly work.

This case reflects a significant bias which prohibited some women inventors to compete fairly for legal entitlements. As a woman, Sherwood was viewed as incapable of contributing any technological industrial improvement, thus her invention was suspect as to its originality and validity. The case also suggests why some women would not find sufficient incentive or adequate gain to pursue a patent for an invention outside of the domestic field. For all the trouble she would endure,

was the payoff enough compensation? If Sherwood didn't receive any monetary compensation for her invention, the question of incentive and gain remains speculative. Like male inventors, women inventors displayed perseverance, originality, and imagination in their creative pursuits (Rossman *Industrial* 41). And for some, male or female, motivation stemmed from "the excitement of pursuing an absorbing problem, the feeling that one's efforts are going to be a benefit to one's fellow man" or "the simply joy of taking an idea into one's own hands and giving it proper form (Vance, Taylor et al 22). These driving forces were all valid in the pursuit of creative invention and quite aside from dreams of fame and wealth.

Other barriers also surfaced in the pursuit for fair and equitable legal entitlements for women inventors, particularly factors of access. These factors were intricately connected to technology's relationship to the segregated workplace of women, which was primarily in the home with very limited access to higher scientific or industrial education. Even by the end of the century, it was noted in a *Popular Science Monthly* article "Scientific Instruction in Girls' School" that "for the large majority of girls, the science they learn in their school years represents for them all the science they ever acquire" (June, 1898, 253). For women inventors, this lack of accessibility constantly posed barriers in the patent process.

Such is the experience of a prolific 19th century inventor, Harriet Ruth Tracy of New York. She is credited with 16 patents, most all of a mechanical nature. They include patents for sewing machines, a stove, a safety elevator, automatic safety floors for elevators and a fire escape (LWP; Stanley *Mothers* 504). But her first invention, a combination bureau and trunk, was not patented. Although she lost the

patent right, she gained valuable knowledge about patent law and the business of inventing which served her well through the rest of her successful career as an inventor. Her legal fight for the patent left a record illuminating how the lack of educational accessibility and knowledge of secular business affected even the most successful of women inventors.

Knowing very little about patent law and even less about the business of inventing or the wiles of entrepreneurial businessmen, she allowed a young mathematics and military tactics instructor to process her patent for a 50/50 share of the profits. He took the invention to the patent office of Munn & Company and applied for a patent in his own name. Tracy had complied, stating that "it was a matter of indifference" to have her name on the application. But what she did not know, was that part of the patent application process required the applicant to swear that they were the true inventors (Macdonald 62). When she realized this, it was too late. She did file suit to have the patent reissued in her own name, but again her lack of knowledge about patent law and her lack of skilled representation in the case, cost her that first patent. Her argument was defensively weak, and her inability to offer substantial evidence (unlike Sherwood), convinced the patent examiner to deny her request.

She argued that it was truly her original invention as the idea came to her in a "nighttime moment of flash of thought." She had no witnesses or scientific evidence to support her claim. To further weaken her case, she was unable to appear in person before the examiner because she had "been in feeble health much of the time since the model was finished [and] in very limited pecuniary circumstances" (Macdonald

62, 63). She knew that such absence would be detrimental to her case, and tried to make the examiner aware of this circumstance which she felt was quite out of her control. In a December, 1872, letter to the Commissioner of Patents, she explained, "Women cannot always do just as they would—they are sometimes incapacitated for all work physical and mental" (Patent Interference Case File #753). Such a characterization only worked to reinforce the female stereotype as physically, emotionally, and intellectually weak, all part of the assumptions as to why women could not possibly be successful inventors.

The attorney for the defendant argued that Tracy had used his client and that she had simply acted as a "confidence woman," took the entire idea from the poor unsuspecting scholar, and was in no way responsible for the original idea. Her defense of a "nighttime moment of flash of thought" was not valid proof. She soundly lost her right to the patent. She did not appeal, nor did she repeat this experience. Rather she utilized this knowledge repeatedly in her career as a professional inventor, acquiring financial gain and respect from her accomplishments. All of her subsequent patents were taken out solely in her name, and a step beyond that, she insisted that each of the manufactured sewing machines that she later produced included the name "Tracy" prominently displayed (Macdonald 63, 183; LWP).

It was not that Tracy was denied due process in her patent application. Like Sherwood, she had the legal right to appeal an injustice like all inventors, male and female. But because of social biases, she faced cultural obstacles in the competition for legal entitlement. Tracy's competency quickly improved in her ability to

overcome the legal barriers necessary to compete as a successful inventor. This was keenly evidenced more than 20 years later when Tracy entered an aggressive interference proceeding regarding her sewing machine patent application #535,330, filed on January 18, 1895, against Francis H. Richard's patent application #535,338, filed on January 26, 1895. This time she was represented by an attorney and was knowledgeable about how to protect her interests, despite the fact that the court decided on September 19, 1898, that "no substantial rights of either party" had been violated. (*Decision of the Commissioner of Patents*, 1898, 217-219; Merritt 255).

What is most significant about this case is the tenacity in which Tracy's counsel asserted her protective patent position. Her petition conveyed substantial input from her. She hired a skilled and capable patent attorney to defend her claims. The complexity of her claims suggests a well grounded knowledge of her rights as a patentee in contrast with her first patenting attempt. Her inventive experience excelled to an impressive professional level. Particularly worth noting is an incredible period of inventive activity between 1890-1893, in which she received 10 patents (Stanley *Mothers* 506). Public recognition of her inventions was duly noted at the Columbia Exposition in Chicago in 1893 where she exhibited both in the Woman's Building and in the Liberal Arts Building. Her inventions were considered meriting "great originality, ingenuity and utility" (Macdonald 183).

Tracy consistently fought hard to achieve that kind of recognition. It was accomplished by an added measure of perseverance, originality, and imagination. She won her hard earned recognition as an inventor not simply by inventing innovative technologies, but by effectively maneuvering through the due process of

patent law and acquiring a successful level of competency in the business of inventing .

Other women inventors, though, did not follow such a calculated path to success. Elizabeth Hawks of Troy, New York, received a patent for an auxiliary air-chamber for stoves on April 23, 1876. Like Tracy, her first patent was not without a fight for legal entitlement. But unlike Tracy, she won her case. Despite this major difference in outcome, both women's legal records provide suggestive insight into the adversarial relationship between female applicants and male examiners. The process of examination has and continues to be one involving extensive communication between the examiner and the applicant's attorney, or as in the case of Hawks, the applicant herself.

Hawks is a curious case, not without similarity to Tracy's first patent attempt, in that she claimed her invention sprang from divine origin. She left a legal legacy in the form of Patent Interference Case Files and Patent Assignment Files which include numerous letters written by her to the Commissioner of Patents. She was repeatedly concerned about the delays in awarding the patent and is convinced that such delays "stem from men's lack of experience with household stoves." She stated that if there were women examiners, the merits of her invention would have been evaluated differently (i.e. quicker) (Macdonald 39). Although the first woman assistant examiner was hired in 1872, women examiners continued to be the rare exception. It remains to this date that there has never been a woman Commissioner of Patents (*Scientific American*, July 1873, 249; Merritt 236).

Hawk's concern about the delay in granting her the patent were addressed in language and context that bore a distinctive domestic social stigma. She appealed on the basis of family need and poor health, both of which would be considered "womanly" weaknesses and might have biased the examiners as to the worthiness of her application. Hawks explained about her "debilitated state of health" and further, her call "on God for help for some way to be opened for me for means desperately [needed] as we have been very unfortunate since the beginning of the war...Therefore I consider it a gift from Heaven" (Macdonald 39). Family, health, and divine intervention were strongly associated with women's social role as wife, mother, and spiritual care giver. The connection between the delay in granting her a patent and her basis of argumentative appeal implies a cultural bias against woman's social roles which characterized women as weak, sickly, family dependent, and strongly associated with spiritual values, all cultural norms which excluded women as inventors.

Her divinely inspired "gift" came to her as an invention of a stove attachment specifically designed for baking bread. It consisted of an "oblong rectangular cover open toward the fire and at the bottom, [with] a slot in front for admission of a raker. It is used for heating the air previous to its entering the fire chamber" (*Annual Report of the Commissioner of Patents*, 1868, 742). But although this invention had commercial potential, her claim of divine intervention certainly lacked competitive credibility in the world of industrial manufacture and commerce. This claim squarely aligned her with a well known 19th century group, Spiritualists, a group that

advocated women's rights as well as a departure from the traditional social order and existing gender roles (Braude 3).

One Spiritualist leader wrote, "Women in the nineteenth century are physically sick, weak and declining" but if "the functions depending on force and muscle are weak. . . the nerves are intensely sensitive. . . hence sickness, rest, passivity, susceptibility, impressionability, mediumship, communication, revelation!" (Braude 83). And we might add, invention! Hawks, like other 19th century women, argued from the proscribed typical female status of being weak and declining, but still with incredible vigor and "revelation." She argued forcefully that her invention was divinely inspired, which did not mean watered down technological understanding. Her divine inspiration included precise dimensions, valid claims, and specifications, all of which translated into manufacturing potential.

Compatibility between science and spiritualism already had a public and popular acceptance, one which mutually respected the power of the other. The relationship between the two was not adversarial or antagonistic at mid-century. Rather, science and religion "each understood themselves as pursuing related inquiries into the nature of reality" (Braude 4). For example, this relationship was particularly true concerning electricity. In 1842 the "U.S. Congress found the use of electricity in the telegraph incomprehensible" and in the immediate years to follow this national response, the principles of telegraphy found "parallels between the instantaneous communication of messages over long distances rather by wires or spirit mediums" (Braude 5).

So although 20th century readers may find Tracy or Hawks claim of divine inspiration completely unscientific, such claims held significant merit during the 19th century. Hawks made the scientific boast that her stove attachment "baked differently from what it did without it...it baked all the way through leaving a tender crust on top." She was sure that "every housekeeper in the country" would benefit "since dust and ashes would not scatter about the room when the baker raked or dumped the coal grate""(Macdonald 41). For bread bakers, this represented a significant improvement.

Her confidence in the success of her invention may have also been divinely inspired, but she was not convinced of the examiner's ability to appreciate the merits of her invention. Her determination to get this patent was suggested by the continual modifications she sent to the Commissioner of Patents, even though they were regularly turned over to the examiner. She argued, in addition, that her stove had "been approved by all that has seen and used them. It has been said by many that the invention is the greatest blessing to a sick room that was ever known for it equalized the heat through the room" (Macdonald 41). This claim seems far afield from the claim as published in the Annual Report of the Patent Office in 1867, which merits the invention simply as an auxiliary air chamber for stoves. The significance of this claim suggests that she tried a new tact to justify the importance of the invention. In this case, she shifted the premise of her claim from a purely domestic one to one more community orientated, perhaps in the hope that it would be more favorable received if it was not so closely aligned with feminine motivation and inspiration.

Hawks was in a position to understand first hand what would take another 50 years for the government to admit. In 1923 the U.S. Department of Labor stated that, "behind and beneath the patent records are conditions and influences which have an intangible but far-reaching influence" *(Bulletin of the Women's Bureau*, No. 28, 1923, 4). This same government publication admits that although there are "no actual restrictions attach[ed] to women under the American constitutional and Federal laws providing for the issuance of patents. . . American invention has carried a general assumption of women's disability for creative labor" (4-5). As evidence of that long standing conviction by the general public, the pamphlet asserts, " Minors and women and even convicts may apply for patents under our law" (5). Even to the U.S. Department of Labor, it was apparent that women inventors had to overcome exclusionary limitations in the patent system, limitations which have culturally defined the prototypical inventor as male and relegated female inventive powers with minors and convicts, individuals considered as legal nonentities and social inferiors.

Both the democratic patent examination system and the registration system presented obstacles to women inventors. As the system evolved, it necessitated more skillful management, quite apart from the actual legal process of inventing a significant technological contribution. For both men and women inventors, the business of inventing and patenting grew steadily more complex. It was not enough to simply invent or discover "a useful art, manufacture, engine, machine, or device" (*The Story* 1). It required increasingly sophisticated knowledge of business and commerce, higher levels of scientific and technological education, legal recognition

and representation, economic presence, and professional and personal cultural acceptance in the face of increasingly more rigid gendered role definitions.

The democratic patent system legalized and legitimatized social biases which "diminished the power of women to compete fairly for legal entitlements" (Merritt 306). The complex relationship between women and the American patent system required successfully circumventing legal barriers built into a socially exclusionary framework. Lack of economic resources, educational access, and business know-how impacted how women secured patents which was, in part, premised on their subordinate legal status. A blend of written code and social assumptions permeated women's experience in their competition for patents and recognition as inventors.

Oliver Wendell Holmes, Jr. wrote in *The Common Law*, 1891, that "the law embodies the story of a nation's development through many centuries, and it cannot be dealt with as if it contained only the axioms and corollaries of a book of mathematics." The patent system, like the body of Constitutional law from which it arose, is not a book of mathematics. The patent application and award system was codified from its inception, but it remained far from being a mere formulaic equation with a right or wrong resolution. Rather, like Holmes suggests, it reflects the nation's development, and in this case, the nation's technological development. It also reflects the nation's cultural assumptions about the differences between women and men's relationship with technology and inventive innovation. Holmes continued to observe that, "the substance of the law at any given time pretty nearly corresponds, so far as it goes, with what is then understood to be convenient" (Otten 1). It was "convenient" in many respects to establish a male dominated system of

technological innovation. It does not take a math problem to determine the value of socially castigating half of the competitive population as legally subordinate and intellectually inferior in the quest for progressive technological contributions.

Opinions of the Patent Commission, patent infringement cases, and patent assignment cases provide insight on the combative turf where women competed for legal entitlement of patents. Although these experiences have yet to be included in the traditional history of the U.S. Patent Office or standard histories of technology, they have not gone totally unrecognized by historical observers.

As Matilda Joslyn Gage noted, it was not surprising that under the prevailing legal conditions that woman has not been an inventor to an equal extent with man, but what was "a subject of surprise was that she should have invented at all" which is soundly substantiated by patent records (489). Despite the lack of equal opportunity and access, and despite the short comings of a democratic patent system, women penetrated the legal boundaries and left a rich legal legacy reflecting their inventive spirit.

Chapter 1 - NOTES

[1] In addition to facing the obstacle of gender, African-American women faced racial discrimination. During the 19th century the number of African-American women who received patents was very small. Between 1885 and 1898, five are known to have received patents. Ellen Eglin of Washington D.C. who invented a clothes wringer in the 1880s, expressed the collective attitude of African-American women inventors when she was asked why she had sold the invention for a mere $18 in 1888. Her reply was to the point: "You know I am black and if it was known that a Negro women patented the invention, white ladies would not buy the wringer; I was afraid to be known because of my color in having it introduced in the market, that is the only reason" (Smith *Women Inventor* I, 3). Very little has been published about African-American women inventors to date. In addition to Charlotte Smith's brief article, "Colored Woman Inventor" in *Women Inventor* in 1890, other publications include *Black Women in America: An Historical Encyclopedia*, by Darlene Clark Hine; *Creativity and Inventions: The Genius of Afro-Americans and Women in the United States and their Patents* by Patricia Carter Ives; "From Africa to America: Black Women Inventors" by Autumn Stanley and "Sister Act: Inventing Runs in the Family" also by Patricia Carter Ives (Sluby). None of these represent a comprehensive study of African-American women inventors.

[2] Feminist historian of technology, Ruth Cowan Schwartz, observed the importance of female technologies is blatantly apparent in the exclusion of such in standard histories of technology. She cites the baby bottle as a "significant cultural artifact" which does not merit a single reference in any of the indices to the standard histories. She explains, "Here is a simple implement which, along with its attendant delivery systems(!), has revolutionized a basic biological process, transformed a fundamental human experience for vast numbers of infants and mothers, and served as one of the more controversial exports of western technology to underdeveloped countries, yet it finds no place in our histories of technology." She concludes that the history of uniquely female technologies has yet to be written, with the single exception of the technologies of contraception. This tremendous oversight occurred, in part, because "we do not usually think of women as bearers of technological change nor do we think of the home as a technological locale," both of which are "incorrect assumptions" (Trescott 31-32).

[3] "Authors who addressed themselves to the subject of women in the mid-nineteenth century used this phrase as frequently as writers on religion mentioned God. Neither group felt it necessary to define their favorite terms; they simply assumed -- with some justification--that readers would intuitively understand exactly what they meant" (Welter 204). Historians today understand this term to define the 19th century character of woman as virtuous, religious, domestic, and submissive.

[4] Although the early seminaries offered limited curriculum, by the 1820s three offered women unusual opportunities for intellectual development unheard of prior to this time: Emma Willard's in Troy, New York, 1821; Catharine Beecher's in Hartford, Connecticut, 1828; and Zilpah Grant's in Ipswich, Massachusetts, 1828 (Horowitc 11).

[5] The early married women's property law reforms were often premised not so much on ensuring women increased economic rights, but rather had the "intent to secure the property of a married woman from her husband's creditors in order to protect family assets." This was typified in 1839 Mississippi law which "merely protected slave holdings of white married women from seizure by creditors" (Kahn 361). These early little laws did very little to increase economic freedom for women inventors.

[6] The precedents established by this 1793 Patent Law continued to challenge women's property rights throughout the 19th century. "In *Fetter v. Newhall*, the defendant infringed a patent for drive screws, and tried to overturn the case by arguing that Mary Fetter, a married woman, had no right to assign the patent to the Fetter Drive Screw Company nor to sue for infringement, for "at common law a patent-right granted or assigned to a married women would be such personal property that her husband could by virtue of his marital right, reduce it to possession and make it his own." The judge ruled, though, that "a married woman, an infant, or a person under guardianship, might be an inventor, or the assignee of an inventor, . . .but the ability to make the instrument, or the aids to the disability, must be found in the laws of the states where all such rights are regulated." In this legal maneuver the judge believed that she "could make the instrument in writing by the laws of the state, and when she had made it, it fulfilled the requirements of the laws of the United States (Khan 382-383). So although the state and federal legalese benefited a married woman in this case, it was still an issue which she had to fight and even then, her consideration came under the categorization the same as an "infant or a person under guardianship."

[7] "Monopoly means control over supply: the total supply offered on the market is controlled by a single interest" and in the American patent system, a patent was designed as a legal monopoly granted on the theory that it promoted the progress of science and the useful arts (Bennett 70, 122). In this sense it was not truly a monopoly because a "monopoly takes something away from the public and a patent "gives the community something of value by adding to the sum of human knowledge" (61). Initially, monopolies were considered to have a negative economic impact on the newly independent United States by many of the democratic founding fathers. But eventually even Thomas Jefferson, who was particularly opposed to the idea of monopolies, came to favor the patent system while acting as first administrator of the patent system. In a letter to James Madison he commented;

> An act of Congress authorizing the issue of patents for new discoveries has given a spring of invention beyond my conception. Being an instrument in granting patents, I am acquainted with their discoveries. Many of them indeed are trifling, but there are some of great consequence, which have been proved of practice, and others which, if they stand the same proof, will produce greater effect (67).

[8] Historian Ann Macdonald claims that it was not until 1873 that the first woman, Miss Anna Nichols, was hired as an assistant examiner (39). Charlotte Smith makes no mention of Nichols in her 1890 article, "Women Employees in the Patent Office" in which she lists six early female assistant examiners. To date, I have not found adequate research sources to verify or deny either claim. For the purposes of this study, I have used the earliest dated sources.

[9] The difference in fees paid by inventors based on nationality established in the 1836 Patent Act represents a clear example of the Patent's Office discriminatory standards beneath the guise of democratic principles. In explanation of such desparity, it was, in part, based on the way Americans were treated by other national systems, particularly the English systems, which required Americans to pay higher fees for patent rights and extended waiting periods (*The Story* 6-7; Vaughan 242-243).

[10] Increase inventive activity is documented the following data: in 1830 the U.S. population was approximately 12,800,000 and the Patent Office issued 544 patents; in 1850, the country's population had almost doubled, while patents increased to 884. But in 1870, with the population at about 40,000,000, less than double the 1850 population, more than 12,000 patents were granted. By 1900, the population reached 76,000,000 and 24,660 patents were issued. Since the Patent Act of 1836 was passed until 1900, the rate of invention increased more than 40 times (Kursh 25).

Chapter 2

OUT OF THE REVOLUTION: SEEDS OF INDEPENDENT INVENTION

As historian David Noble correctly suggests, inventions are a function of time, place, and resources. The time is post-Revolutionary America, the place is New England, and the resources are American manufactured straw hats.

Post-Revolutionary America germinated a spirit of independence outside the realm of political freedom. It fostered the potentiality of a unique American character, distinctly different from its British ancestry. The roots of this American character grew out of the victorious fight for independence. But it also coincided with another momentous in-progress revolution centered in British culture, the Industrial Revolution. Both revolutions significantly affected the emerging American character, one which celebrated innovation and technological advancement.

From the issuance of the first American patent in 1790, this celebration has been shared by women and men in the creative pursuit for technological achievement. Although women and men shared in this emerging national innovative spirit, the American characterization was nurtured and reflected by masculine terminology and imagery from the beginning. National imagery grew and prolifically sprouted complex cultural and ideological responses which generally restricted and relegated women inventors from full participation in what was to

become characteristically a national past-time according to some historical observers. [1]

Although women were restricted and relegated from full participation in this national past time, as inventors they contributed technologically, socially, and culturally to the development and progress of the new nation. Seeds of independent invention germinated among the female population as well as the male population. The accomplishments of women inventors during this period are generally buried under historic neglect and cultural obscurity. Women inventors, like male inventors, have contributed some significant and some not so significant inventions. But unlike their male counterparts, women inventors technological contributions, regardless of their value, have not been considered in the traditional histories of technology. Their accomplishments go beyond the introduction of important technological developments in our early national period. They reveal some important early and persistent gendered assumptions about invention and women's roles in the pursuit of technological achievement.

Some of these assumptions surface through an examination of the straw hat industry in colonial and post-revolutionary New England. This specific industry serves as a particularly useful context in which to discover and understand some of the earliest contributions of women inventors in America. This context also provides a revealing framework of how women's inventions, like men's inventions, were a function of time, place, and resources.

Six women inventors are noteworthy in the early American straw hat industry: Sybilla Masters, Mary Kies, Betsey Metcalf Baker, Sophia Woodhouse

Wells, Lucy Burnap and Henrietta Cooper. Although their available biographic profiles are generally quite minimal in this period of early national development, they still reveal some of the gendered assumptions which confronted women inventors from the beginning of the 19th century. Their contributions were both technological and socially significant but generally ignored. But before considering the specific innovative contributions of these women, a brief historical summary is necessary to contextually place the manufacture of hats as an important component in the economic and technological development of early American culture.

It is a matter of historical record that the American hat industry, and the straw hat industry specifically, became an important element in shaping America's economic status prior to and after the Revolution and contributed a significant dimension to the national American character. By the 1820s it was acknowledged that, "There is, perhaps, no manufacture (of its amount) that can be regarded as so important to the welfare of society in the United States, as that of hats and bonnets, from straw, grass, &c" (*Niles Register*, April 17, 1824, 98).

The manufacture of hats was an early colonial endeavor, one which the British cultivated through an aggressive capitalist approach. An interesting record of such evidence is found in the premiums which were offered by the British during the seventeenth century to colonists "for the promotion of industry, especially in relation to cloth material" which included wool and felt hats (Bishop 321). For example, in 1662 the Assembly of Virginia offered "10 pounds of tobacco for every good hat made of wool or fur" (Bishop 321). A good hat in 1662 was skillfully crafted by hand. This skill had been transported to America with the Pilgrims who first settled

at Plymouth. Godbert Godbertson, a skilled hatter, was among the first colonists, as was Timothy Hatherly, one of the first investors to back the American hat industry (Severn 99). Along with this kind of expertise and backing, Colonists also had the advantage of abundant natural resources. Fur supplies were readily accessible by hunting, trapping and trade with Native Americans. This "plentiful supply of raw materials for hats soon attracted skilled workers from Europe" (Severn 100). It was a formula for success: plentiful raw material, skilled craftsmen, and British support through premium incentives and investment backers.

Colonists responded enthusiastically. Ten years after the first premium inducements were offered to the colonists, an association of Massachusetts hatters asked for "privileges and protection" from the colonial government to encourage American manufacture. A few years later in 1672, Massachusetts passed a tax law to keep traders from sending certain furs to England in order to make sure that local hatters had a good supply" (Severn 100). From existing records, it appears that colonists made productive use of the "good supply "of furs in the hat manufacturing industry. Reports from New York, New Jersey, Pennsylvania, and the New England region in general all attested that "great quantities of hats were being produced' (Bishop 340-371). It is interesting to note that "great quantities" produced in a preindustrial factory setting actually meant a maximum of 3 hats a day per manufacturer. Most colonial hats were produced in a home based cottage industry. The earliest pre-industrial hat factories typically employed males and included, on the average, one journeyman and possibly two apprentices in addition to the owner, who functioned as a productive member of the work force. But as the industry

expanded under the forces of the Industrial Revolution, women became the predominate operatives (Severn 102). [2] The cottage industry origins of the hat industry placed women as participants early in the industry's history, at first only as observers, later as unskilled labors, and eventually as skilled finishers.

By 1731, British support dramatically changed as evidenced by a complaint lodged in a "Report Made by the Board of Trade" in which "the company of hatters in London have complained to us that great quantities of these hats are exported to Spain, Portugal and our West India Islands" (Bishop 340). By this time, Americans had begun to profitably export hats to such an extent that it cut into the British market. Consequently, the Hat Act was passed which prohibited the exportation of hats from the American colonies (Bishop 342, Tunis 46). [3] The law was designed to cut American profits which eliminated British concerns.

> It prohibited anybody connected with the "British plantations" from putting hats aboard any vessel with the intent to export them "from thence to any other plantation or to any other place whatsoever, under penalty of heavy fine. . . Colonists were indignant and feeling ran high (Severn 101).

Colonists were further restricted by law to limiting the number of apprentices to two who could learn the hat trade. These restrictions were all part of the British government's mercantile economic theory which was imposed on the colonies with increasing pressure. [4]

The American response was anything but submissive. They persisted in the manufacturing of hats despite the loss of their most lucrative foreign markets. By 1748 restrictions had increased even further and fueled "some irritation of the public mind in New England" (Bishop 345). Rather than slow down hat production, it

appears that Americans were motivated to maintain a profitable market for their hats, which targeted their own burgeoning domestic market. Ironically, some of the same strategies employed by the British "for the promotion of industry" were adopted internally by colonists to encourage the continuance of quality manufactured hats. For example, the following premium was offered in 1753:

> "Liberal public offer was made by an individual in Delaware, which then formed a territory of Pennsylvania, to promote the industry of the lower countries:...for neatest and best hat, 40s, the premiums to be awarded on First Tuesday in November, 1754, and to be increased in following years" (Bishop 346).

By 1767, records indicate that "the manufacture of hats was...briskly carried on in Carolina, and a profitable export trade in hats existed with the Spanish Islands (Bishop 371). A resolution was passed that same year which revealed the colonists resolve to promote successful industry and also hinted at the growing disloyalty fermenting among the colonists. It stated that "resolutions were made by the colonists to abstain from the use after 1st December" of several foreign articles including "men's and women's hats" (Bishop 372). The American rebellion was fueled by such subversive economic actions which most Americans admired and abetted (Tunis 13).

Economic discontent and continued British discrimination fostered increasing disloyalty among American industrial subjects. More than hats were produced and marketed. A spirit of independence was fostered by the British imposed legal restrictions and the controlling economic competitiveness aggressively displayed by British industry. The winds of revolution blew across the American economic market and fueled Americans with "the spirit of a self-dependent industry." [5] It was

observed that this spirit "animated more or less every household, from the wealthy planter and oldest towns to the bark or log cabin of the frontier settler" (Bishop 415).

While the spirit of independence escalated throughout the 18th century, the British felt confident that the legal embargo on the exportation of hats had sufficiently stifled technological innovation in that field and, therefore, had successfully curbed the development of hat manufacturing technology. For 30 years following the law prohibiting the exportation of hats, British authorities were pleased to report that no "material advances [had been] made toward the introduction of the manufacture of cloth" (Bishop 342). They considered this a significant advantage for their economic prospects in the hat industry as such a technological lag impinged on the American manufacture of felt and wool hats, and to some extent, on straw and fur hats. But the accuracy of this conclusion is highly suspect given the profitability of hat manufacturing immediately following the Revolution when the new nation experienced the emergence of pre-industrial factories, which included hat factories (Tunis 48; Severn 101-103). [6]

The advantage of having raw materials and a well established domestic market for hats stimulated Americans to pursue technologically innovative ways to produce hats. According to economic historian Kenneth Sokoloff, inventive activity was positively related to growth in markets in early industrial America. With the interruptions in foreign trade caused by British restrictions, patented inventions emerged in a pro-cyclical pattern and began to grow rapidly particularly in the years between the Revolution and the War of 1812 (Sokoloff 813, 817).

Women inventors were part of this contextual history of the hat industry, but questions arise as to what extent they were involved. Ensconced within a traditional historical context, women participated only as consumers of hats. Records speak plainly that there existed a division of labor in the production of early hat manufacturing like in other manufacturing concerns. What motivated women inventors to produce technological contributions to the hat industry at this time suggests a division of labor outside of a woman's proper place and capabilities. What gendered assumptions about invention did they challenge or support?

A prevalent and enduring assumption regarding the relationship between women and hats has been that women have been socially controlled by fashion dictates. There is ample evidence to support that early American women were certainly influenced by European styles and imitated such style in dress, manners, and cultural tastes in the arts. As early as 1698 it was reported that "millinary ware exported to the colonies had reached a substantial amount" (Stephenson 1). [7] Continued demand throughout the next century required shop owners, as exemplified in Williamsburg, Virginia advertisements, to "frequently employ trained milliners or mantua-makers from abroad to keep the business alive and up-to-date with the newest and most fashionable modes of the day" (Stephenson 3). Like other enterprising colonial entrepreneurs, "Virginia milliners were very style-conscious and eager for the devotees of fashion to be their customers" (Stephenson 2). Generally, the relationship between colonial American women and hats has been predicated on this slavish notion of European fashion imitation. Although it

represents a limited relationship between women and the hat industry during the 18th century, it is not without some merit.

For example, "a new madness" was started by French women during the later half of the eighteenth century. Mounds of false, stiffened hair were piled over elaborate wire frames, standing several feet tall. They were fantastically decorated, sometimes depicting "entire scenes, such as a group of sportsmen hunting in the woods, a doll on a swing that swayed back and forth, or a company of toy soldiers on dress parade" (Severn 37). This quickly became the fashion rage in England and was subsequently transferred to the American colonies, as noted by John Lord Sheffiled (1783) that "America takes its fashions from England" (Stephenson 17). Although it never reached the extreme levels of popularity that it did in Europe, American women imitated this trend enough to provoke the ridicule of the American press.

The Boston Gazette in 1771 told of a young women who was thrown from her carriage and her great headdress was thrown off which "proved a revelation, for it was filled with tow, wool, yarn, curled hair, and hay." In 1777 a New Yorker wrote of a "party of eleven fashionable ladies who had among them on their heads "an acre and half of shrubbery, grass plots, tulip beds, kitchen gardens, etc." (Severn 39). The following anonymous poem published in 1768 describes the underlying ridicule toward this extreme fashion and women's effort to imitate it:

> When he scents the mingled steam
> Which your plaster'd heads are rich in,
> Lard and meal and clouted cream,
> Can he love a walking kitchen (Severn 39).

Attesting to the popularity of such styles, most women needed the assistance of a hair dresser to construct such fashionable towers and, in New York alone prior to the Revolution, more than forty-one hairdressers were registered and newspaper ads testified to the stiff competition for "composing heads" (Severn 39). These popular responses help to understand just how pervasive the wearing of hats was in colonial America. The relationship between women and hats as supported by the above examples, defines women as consumers motivated by conformity to the dictates of fashion.

But there was also another dimension in the relationship between women and hats, one which involved production rather than consumption. This aspect has traditionally been ignored in representative cultural images depicting women and hats. Generally, production modes have been dominated by masculine imagery which depict men in the role of producer as factory owner, skilled craftsmen, and producer of technological machinery and techniques. But the evidence is clear that women participated actively in the hat industry work force, both in the cottage industry and pre-industrial factory setting. The division of labor in these early manufacturing enterprises was quite typical, with women functioning as the unskilled laborers doing tasks which were classified as "women's work" such as needle and fine detail work. One source from a Danbury, Connecticut, hat manufacturer in 1780 reveals that, "The hat, once formed, was transferred to the gentler sex, whose fingers in the vicinage of a factory, found regular employment in picking out with tweezers the unequal tougher hairs from the nap" (Bishop 497). This description supports a later, more extensive description of women who work at

the alleged largest hat factory in the world in Bermondsey, England. In that factory women worked in the preparation of crude materials, by attending a machine that removed the fur without being cut, while others finished this process by using a small instrument shaped like a cheese cutter to remove remaining hair (Dodd 141-142). Women also were employed as trimmers, "all plying the industrious needle, and earning an honourable subsistence" (Dodd 154).

As much of our early technology was transferred from British origins, it is not surprising to find large numbers of American women employed and performing similar tasks in the early American hat industry. The following entries from the *Niles' Register* provide some insightful examples:

> "In four counties in the state of Massachusetts, the manufacture of straw and grass bonnets recently employed and subsisted 25,000 persons, chiefly females, and the value of their products was $825,000 a year... There is perhaps , no manufacture, (of its amount that can be regarded as so important to the welfare of society in the United States, as that of hats and bonnets, from straw, grass, &c. It is almost exclusively the work of young girls, and , at least so far as such things are necessary, the whole amount of the product is a clear gain to the country—for the females, if not so employed, would be idle or doing worse " (April 17, 1824, 98).

Ten years later, the hat industry still continued to supply hats and proper female employment. "No other pursuit, perhaps affords so large a sum to each person employed as these beautiful manufactures--so happily fitted for females, and rendering thousands of them independent" (Oct. 25, 1834, 114).

Not only was the hat industry a lucrative one, but it provided employment for women outside of the home. This employment was particularly desirable, because it

was "so happily fitted for females." The manufacture of hats and bonnets provided women with appropriate female employment. Some even considered that working in a "straw shop" fostered attributes which made desirable wives (Copeland 36-37; 46-49).[8] Ideologically, masculine and feminine concepts have been, in part, traditionally constructed in relation to each other through division of labor and work experience. Technological change, such as occurred in the hat industry, is a useful context for understanding such gendered constructs. The sexual division of labor was not only a structural feature of modern capitalism, but also in this case, a basis for gendered assumptions about women's relationship with technology (Wright 6).

The evidence in this case challenges the assumption that women functioned as only consumers in a capitalistic technological innovative industrial system. Women participated in the hat industry as both consumers and producers, and, thereby, were in place as a function of time leading to productive innovation. As consumers, women continued to be interested in fashion while simultaneously committed to American economic independence and technological progress.

Consequently, American women took the lead in rejecting European fashion trends, including hats. Several distinctly "American" styles made with natural straw resulted, especially in women's bonnets. The Wethersfield bonnet and the Dunstable bonnet became popular American styles. Many variations and innovative styles using different kinds of braids became popular in the American marketplace.[9]

It is particularly significant that the function of time under consideration includes a strong sense of patriotic fervor. As England steadily increased taxation and trade restrictions, colonists rebelliously responded and worked toward economic

as well as political independence. Female inventors, like male inventors, were participants in this national quest for independence. The Revolution and its aftermath fostered a community spirit united in the goal for economic success based largely on the ability to produce goods from natural resources for a domestic and foreign market. This national endeavor in turn fostered an atmosphere ripe for technological innovation (Gies 21-24). Women played an important part in the success of the industry not only by creating a consumer market for such products, but by inventing significant hat technologies and advancing the success of American hat manufacturing (Stanley *Mothers* 44; Macdonald 6-7).

By the advent of the Revolution, the hat industry was well established in the colonies. Quietly growing up in conjunction with this industry was the manufacture of straw goods. By 1794, after the war, American made woven straw hats were introduced and became a significant and important element of not only the economic structure, but also as a political statement about the country's emerging national identity which favored domestic manufactured goods over foreign imports (Meyer 278; Klein & Klein 304). The introduction of straw manufacture spawned significant inventions by women and represent some of their most important technological contributions to early American industry. The industry prospered, advanced, and became critically important during the post Revolutionary period and crucially important during the War of 1812 (Macdonald 6).

As producers, women inventors played an important part in the history of the success of the industry. The first woman inventor connected to the hat industry was Sybilla Masters, a Quaker women who lived in Pennsylvania during the early 18th

century. By some authorities, she is considered the first American woman inventor, but due to the fact that she did not receive an American patent and the British patent was granted in her husband's name, her distinction is somewhat obscured. English Patent No. 401, granted on November 25, 1715, for a machine to prepare Indian corn was issued to Thomas Masters, Sybilla's husband. The document clearly credits "a new invention found out by Sybilla, his wife" (Vare & Ptacek 31). The next English patent issued to Thomas Masters was in 1716, "for the Sole Working and weaving in a New Method, Palmetto, Chips, and Straw, for covering hats and bonnets, and other improvements in that ware." This invention, too, was credited to his wife. "On July 15, 1717, the Provincial Council granted permission for recording and publishing Sybilla's patents in Pennsylvania" (Vare & Ptacek 33). What was particularly significant about this invention was that it presented a "new way of working and staining in straw and palmetto leaf to produce women's bonnets with New World materials." Later on, the palmetto leaf became as important to the manufacture of men's hats as straw was to women's hats (Stanley *Mothers* 44). Masters sold her bonnets in London, though, and did not cultivate an American market for her product or her technique. Nor did she live to realize how important hats were to become in sustaining the domestic American market. She died in 1720 and her husband died shortly thereafter in 1723.

It was 93 years later when the first woman finally received an American patent in her own name, and significantly, the invention pertained to the hat industry. That distinction goes to Mary Kies in 1809. But she was not the next women to

contribute a significant technological invention to the hat industry. That distinction clearly belongs to Betsy Metcalf Baker.

In 1798 Betsy Metcalf Baker of Providence, RI, invented the braid and weave which later became known as the American Dunstable bonnet which was in imitation of an Italian leghorn bonnet. Along with her aunt, she also developed a bleaching method in which the straw bonnet was held over hot coals and then sprinkled with sulfur. Although Pennsylvania Quaker girls were making straw hats for their own use in the late 17th century, Baker is generally credited as the one who first started the commercial manufacture of straw hats in American (Severn 83). At the age of 72, Baker wrote to her sister-in-law, Mrs. Jesse Metcalf, an account of how the process and business first started:

> At the age of twelve I commenced braiding. My father, Joel Metcalf, brought home some oat straw which he had just mowed. I cut the straw and smoothed it with my scissors and split it with my thumbnail. I had seen an imported bonnet but never saw a piece of braid, and could not tell the number of straws. I commenced the common braid with six straws, and smoothed it with a junk bottle, and made part of a bonnet, but found that it did not look like the imported ones. I added another straw, and then it was right. An aunt, who resided in the family encouraged me, while most of my friends said I should never learn" West Dedham, MA, February 11, 1858 (Baker 59-60). [10]

After experimenting further, she found that seven straws produced a braid that looked like the popular imported Italian braids in straw hats. The hats were made by hand, finished with ribbons and satin linings and sold for one dollar a piece. This was the beginning of one of the most important and successful post Revolutionary American industries, one which not only survived the economic upheaval of the War

of 1812, but actually prospered during that time (Tharp 3-5; Bowen 71-73; 108-109; Macdonald 6).

Baker did not receive a patent for her innovative technique because she did not apply for one. She said that she "did not wish to have my name sent to Congress" (Baker 60). According to her own further account, she was satisfied with her earnings, which she wrote, "could easily earn one dollar per day, and sometimes one dollar and fifty cents, for several weeks at a time" (Baker 60). She did not see any merit in obtaining a patent.

She, like other women of the time, dreaded the idea of being recognized publicly for something outside the traditional role of women. One account based on an interview with her late in life said that she was "then, as now, quite tenacious of her reputation as a Christian" and that "her name should never go to Congress" (Bowen 73; Baker 60).

Her response reflects a persistent and prevailing attitude among women inventors during the nineteenth century. Ida Tarbell, a late 19th, early 20th century, journalist and women's rights advocate published an article in 1887 entitled, "Women as Inventors" where she reflected on the relatively small number of known women inventors. She wrote:

> "There are good reasons why the list is not more extensive. If a woman does contrive a useful article it is ordinarily for her convenience; she is satisfied in meeting her own wants, or doing something "original." Her ingenuity usually has no higher ambition. Her life is so circumscribed that she does not see the advantages to herself and family of a patent on her device" (357).

For Betsy Metcalf Baker and countless other women inventors who followed after her, to be identified as a professional inventor was outside acceptable social bounds. Her relationship with the technology of hats was confined to consumer and laborer. Working in the hat industry was an acceptable form of female employment and was recognized as one that "seemed to foster attributes that made desirable wives" (Copeland 46). But inventors, producers of hat technology, made good husbands, not good wives. The sexual division of labor strongly categorized men as inventors, not women.

Because Baker did not pursue a patent, though, did not mean that she was not interested in sharing her innovative technique. To the contrary, she wrote that she "learned them [women] to braid from nearly all the towns around Providence, and never received any compensation for it. I learned all who came, to make bonnets, free of expense" (Baker 60). Nor was she focused on maintaining total anonymity as her role of inventor. In the same account, she gives careful attention to setting the matter straight as her claim of inventor. She wrote,

> It has been published that they first began to braid in Wrentham, but it is a mistake. Mrs. John Whipple, after she was aged, told some one that she thought it was Hannah Metcalf who first braided; but this was a mistake for she never braided (Baker 60).

She chose not to acquire formal public recognition or monetary gain from her invention due to the circumscription of her role as a woman in the community. It appears from Baker's comments and others, that it was considered immodest, unfeminine and inappropriate for a woman to be an inventor. It went against the social norm of women's primary role as wife and mother. The image of the inventor

was not just visually male, but socially determined as masculine. Women had long been socialized to be generous, virtuous, submissive and domestic, not mechanically creative, technologically innovative or as part of the creative moving force of the industrial revolution. For some women, like Baker, the idea of patenting was outside their appropriate place and they found it more acceptable and in line with feminine virtue to "freely pass their ideas on to relatives and friends, rather than seeking to patent and profit" (Stanley xxxix).

This kind of circumscription was commented on by women's rights advocates who were contemporaries of Baker and surfaces as an unspoken, subconscious social dictate from the earliest national records. Seventeen years before Tarbell published her thoughts on women inventors, Matilda J. Gage published an article entitled "Woman as Inventor" in 1870. Both articles introduce some of the early women inventors who were involved with the hat industry and, like Tarbell, Gage concluded that many women chose not to be recognized in this field due to pressures to conform to the standard restrictive roles proscribed as proper for women. She wrote eloquently how such standards affected women inventors:

> If women have ideas, they are taught to repress them as improper for their sex, and the genius which does them and their sex honor, is deemed a matter to be hidden from light. Instances have come to my knowledge in which families have been raised to affluence through some invention of a woman, which she was ashamed to acknowledge as hers ... If in this day of respect for woman, and of the printing press to disseminate knowledge, we find multitudes of such instances, we can well imagine of how much inventive reputation she has been robbed in ages past" (21).

It is impossible to tell how many women inventors have been "robbed" for the reasons Gage suggests, but the records verify that there were thousands of American women during the nineteenth century who applied for and received patents. Why did some defy conventional standards of proper female roles and occupations? Were they motivated by economic gain, patriotic duty or the creative spirit, all of which were characteristically associated with an emerging national image based on male imagery?

Although most existing records and primary sources provide minimal details regarding women inventors, there are valid clues which suggest that some women were motivated by a combination of such things. The male centeredness of the national image was culturally defined during the early years of the 19th century and, while most of the traits that were associated with it did exclude women in some very significant ways, the distinction was less apparent in its formation than when retrospectively considering the social status of women inventors.

In some ways, colonial women participated in a less rigidly defined social and cultural atmosphere. At a time when neither innovation nor individuality was nationally celebrated, women's roles in pre-Revolutionary New England appeared to be much more integrated with males roles, motivated and dictated by the reality of time and place. Historian, Laurel Ulrich, provides evidence from this time period suggesting that women's lives "were defined not only by gender but by a political structure, a geographic and demographic setting, and a matrix of cultural and religious values" (241; 4-5). The emergence of a national image based on male characteristics and values may have appeared less defined to some during this time

(Ulrich 3-10; Meyer 278-280). As the gap progressively expanded, defined increasingly by women's access to education, legal entitlement, restricted social roles of mother and wife, and employment opportunities, women inventors, ironically gathered force in growing numbers. Inequality based on gendered assumptions continued to present obstacles, but such circumspect definition of roles also created a collective view among women involved in the inventive pursuit as testified to by writers like Gage and Tarbell.

As mentioned the first woman to receive a patent in the United States was Mary Dixon Kies of South Killingly, Connecticut, in 1809. Like most women inventors, very little is known about her life, her aspirations or motivations. Her invention is often referenced simply because it was the first one patented by a woman. Kies invention is merely listed as "straw weaving with silk or thread" (LWP). It remains ambiguous as to how this invention should be correctly classified. It has been referenced as a machine, a device, and a process (Tharp 6; Jurate & Kazickas 34; *Scientific American*, 1903, 247; Macdonald 6). There is no consensus, and the one piece of conclusive evidence which might have provided some insight, the original patent record, was destroyed in the Patent Office fire of 1836 (Stanley 445).

The fact that it was accepted by the patent office, though, indicates it fulfilled the patent requirements which stated that an invention should be "sufficiently useful and important" (*The Story* 2). Although the specific nature of Kies invention may never be known, it may be assumed that it was useful in the preindustrial manufacture of hats and provided a transitional link to the industrial age where

mechanized factories revolutionized the way things were produced. The bonnet and hat remained a cottage industry for many years, but by the 1830s it had evolved to a factory industry (Tharp 9; Bowen 108). Kies was involved in the industry in some capacity other than consumer by virtue of her invention. Adequate biographic details remain hidden as to the original nature of her relationship to the hat industry, but enough evidence exists which merits a long over due in recognition of her inventive contribution to the success of the straw hat industry.

The next significant invention by a woman related to the hat industry was in 1821, and it is said to have superseded Kies invention. This lends some credibility to the assumption that Kies invention was a machine or device rather than a process or technique. A process or technique would be continually improved upon and not merit a patent, especially without the listed designation as an "improvement in" which became a common listing description in patent records.

But what is certain about Kies invention, is that it was a function of the time, a most fortunate function for the struggling and war threatened young United States. In 1807, just two years before Kies patented her invention, President Thomas Jefferson passed the Embargo Act which prohibited all exports. The Act had a two fold design: 1) to keep United States merchant ships off the seas to end all chance of attack and provocation, and 2) by denying American goods and markets to Britain and France, it was hoped that great economic pressure would effectual be leveled and cause them to moderate policies toward American shipping (Garraty 121). In reality, the Embargo was an economic disaster. It caused prices to fall for farm products and manufactured goods, seaman were unemployed and business were severely

disrupted. This was a time of national economic flux, with potential for ruin and renewed dependency upon France and England. Any technological contributions to advance and support American manufacturers were all too welcome. The hat industry is one of the few American manufacturing business that prospered during the upheaval prior to the War of 1812 and its aftermath, due in part to its strongly developed domestic market and advanced manufacturing techniques and mechanization (Macdonald 6; Copeland 36).

Unlike Baker, Kies patented her invention and received very public recognition for her contribution with no extent record of any reluctance on her part. By 1809, President James Madison was in office and his flamboyant wife, Dolly, made public recognition of Kies invention by commending her "genius in discovering a process to boost New England's hat industry" (Macdonald 6). Such public praise is evidence that some women did defy the gendered assumption regarding the male centered image of the prototypical inventor by accepting full public credit and recognition for participation in a socially determine male role.

The significance of this invention goes well beyond individual genius in its complex and diverse contributions to America in a time of crisis, By serving as an impetus for expanded and improved industrial factory technology, it was an important component of the early Industrial Revolution. Economically, it was a boost to the American economy. The process offered effective production of American made hats to a well developed domestic market and, thereby, helped to effectively combat the negative effects of 1807 Embargo Act. The invention also made a social statement about the potential for female creativity, which although

seems to have been very moderately received at the time, it was not without some measure of meritorious recognition. It would some time, though, before women's potential for technological creativity received consistent recognition and positively affect how technology, invention, and national identity were shaped.

Although this shaping was not always in clear terms, the affect of some of the early women's inventions encouraged and paved the way for other women to follow. Such was the case of the invention that is said to have supersede Kies' straw braiding process. Like Kies who was from South Killingly, Connecticut, the next woman inventor contributing to the hat industry was also from Connecticut. Her name was Sophia Woodhouse Wells and she was from Wethersfield. Wells was awarded a patent for substituting native straw grass, a kind of grass called spear grass and red top hay (Klein & Klein 304; Tharp 6). Although Wells' patent was not included in the 1888 LWP, she is listed as joint inventor with Gardner Wells in the *List of Patents 1790-1847* published under the direction of Edmund Burke, Commissioner of Patents in 1847. The invention is catalogued in that list as "hat, bonnets of grass" and the inventors are listed as being from Wethersfield, Connecticut. Gardner could have been her husband, brother, father or some other male relative.

The validity of her patent is further established by the fact that she sent a sample of one of her Wethersfield bonnets to the London Society of the Arts exhibition in 1821 and won a medal (Patterson 63). There is contradiction whether the medal was a gold or silver, but her invention was documented as being "superior in color and fineness to the best Leghorn Straw." She was requested to submit seeds

and a description of the process so British merchants could import and cultivate the grass. But she informed them that she had patented it already, and, therefore, was not at liberty to do so (Macdonald 7).

Although her patent was not included in the LWP, it did not go unnoticed by some of her contemporaries. It attracted attention from a New York business entrepreneur and in his efforts to market the process, he sent a "Wethersfield" bonnet to Louisa Adams, wife of Secretary of State John Quincy Adams, and later ordered several of them. It is not certain that she ever wore the hat sent to her by the New York businessman, but it was interesting that the hat was not returned which was Adam's customary practice to return all gifts. He later wrote in his diary that "it was an extraordinary specimen of American manufacture...[and] ingenuity of our country" (Macdonald 8; *American Woman's Gazetteer* 35). Although Adams made no mention in his diary that a women invented the process, he had to have been aware of the fact because as Secretary of State, he signed all patents along with President Madison (Macdonald 8).

Wells, with another unnamed woman, also won a prize for the "Best Grass Bonnet" at Hartford County's Society for Promoting Agriculture and Domestic Manufactures (Patterson 63). It was apparently this prize that prompted the enterprising William Cobbett to share Wells accomplishments and "his own extensive knowledge of American agriculture with British manufacturers" (Sloat 97). It does not seem merely coincidental that at about the same time "Parliament initiated protection for the British braiding industry by increasing the list of dutiable items in the tariff regulations of 1822" including imported straw (Sloat 97).

It is not certain what economic gain Wells made from her invention, but references imply that recognition involved manufacturing concerns. Her motive may very well have been, in part, for monetary gain given the lucrativeness of the straw market and it being one of few industries that women were able to participate in with the potential of economic compensation and social approval. Many women inventors who followed Wells were highly motivated to make a profit from their inventions regardless of the social criticism.

Both Kies' and Well's inventions were functions of time, place, and resources. Their inventions in the hat industry were significant in promoting the national economy in times of political and economic turmoil through technological advancement, a pattern followed by both male and female inventors. Also like male inventors, women inventors during this time utilized American resources. But unlike male inventors, women inventors defied the gendered assumption about their abilities and roles as mother and wife by stepping into the industrial creative sphere where technological invention occurred. And for those women who ventured to invent technologies in the hat industry, they broached a three-fold barrier. One, of course, was simply by inventing something; another was by inventing something in the industrial and manufacturing sector of society which was clearly segregated by gender roles and division of labor. The third barrier came in the form of defying a moral shibboleth. The following account illustrates how this barrier pressured the female population, and particularly would have targeted women who were interested in promoting the straw industry through invention.

Dr. Stanley, a minister in Attleboro, Massachusetts, delivered his sermon entitled "Vanity of Straw Hats in the Meeting House" which "protested the appearance of straw bonnets in the meeting house sometime during the early nineteenth century. It was reported that,

> He made direful forecasts of dissolution of character, sinful luxuries, neglect of duty, passion for balls and fashions, and carelessness as to health and studies. Women who earned money, he said, would become independent of men and assert their superiority. He implored them to give up their bonnets and return to the industry and frugality of the past (Bowen 108).

An opposite viewpoint countering the above moral chastisement is exemplified in *Niles' Register* of April 17, 1824. Speaking of the manufacture of "hats and bonnets, from straw, grass, &c," it argued that the industry,

> ...is almost exclusively the work of young girls, and, at least, so far as such things are necessary, the whole amount of the product is a clear gain to the country--for the females, if not so employed, would be idle or doing worse. Industry is better than preaching, for the preservation of morals; and the idea of independence, which naturally follows a knowledge of the fact in the mind of a young woman that she can maintain herself, is the greatest, perhaps of all the preventives of vicious and depraved habits...And besides, if we must or will have articles of luxury, hats at 40 or 50 dollars a-piece, is it disadvantageous that the manufacture of them should give a decent support to so many females, and essentially contribute to the checking of crime? What is the effect of the female character on society? Who so amiable as a virtuous girl earning her support by the labor of her own hands, and providing for the wants of others--who so injurious to the community as young females becoming worse than brutes to get bread? (*Niles' Register*, April 17, 1924, 98).

Moral conflict concerning "dissolution of character, neglect of duty and the admonition to "return to the industry and frugality of the past" was not an

atmosphere wherein women were encouraged to publicly present innovative technologies which would place themselves distinctly outside of the acceptable perimeters of their proper social roles. But as the editorial piece in the *Niles' Register* suggests, there was some support for women who ventured outside of gendered social roles. This conflict continued to overshadow women inventors throughout the 19th century, a pressure male inventors did not confront on any social level.

Although the evidence is clear that women did participate in the industrial creative sphere from our earliest national period, traditional histories about American invention and technology consistently minimize women's contributions. Historical writers during our early national period were predominantly male and were influenced and biased against women inventors in the same vein as Dr. Stanley. Such bias has had a long and rich tradition and produced fodder to the prototypical image of an inventor as male. Most recorded history of technology bears the imprint of this long standing traditional male bias, thus it is not without surprise that so few early women inventors are known, let alone celebrated (Wajcman 15).

Even though the available documentation on Kies and Woodhouse is minimal, there is enough evidence to verify the validity of their inventions. Others, though, are shrouded in even denser obscurity. Such are the inventions pertaining to the hat industry of Lucy Burnap and Henrietta Cooper. On February 16, 1823, Burnap of Merrimac, New Hampshire, was awarded a patent listed as "hats, weaving grass" (LWP). This has been noted as an improvement on the process patented by Wells, but it is not listed as such in the Patent records. According to the same

source, this process was adapted by a hat manufacturer and led to big business in women's straw hats (Klein & Klein 304).

Three years later, in 1826, Henrietta Cooper was awarded a process for whitening leghorn straw. This invention is different than Burnap's in purpose and substance. Whitening was a process whereby the straw was bleached to a white color before braiding. Originally, this was a very simple process sometimes done by just scalding the straw in a barrel of hot water to remove the green sap and then laid out in the sun for bleaching (Sloat 91-92). "After thirty days, it might be bleached further in sulfur fumes: bundles would be stood on end in boxes around a dish containing pieces of sulfur, which were then ignited" (Patterson 63-64) Reminiscence about "Straw Towns" are characterized by the memory of the sulfur odor produced by bleaching straw (Patterson 64). There is no known description of Cooper's invention, but the brief name implies that the invention, either process or machine, would have filled the need to bleach straw quicker, in greater quantities, and with more uniform whiteness. As the demand increased for whitened straw when hat factories became more mechanized, relying on sulfur fumes and 30 good dry days in order to bleach a bundle of straw would certainly have been risky at best and ruinous at worst.

The biographical profile on Burnap and Cooper remain illusive, and the nature of their inventions reveals a skeletal suggestion as to the functions of abundant natural resources such as indigenous straws and grasses. They shared in the quest for a national identity based, in part, on technological innovation, advancement, and economic self-sufficiency. Like Kies and Wells, they stepped outside of their proper

sphere as women and publicly claimed credit for their inventions by patenting their inventions. And given some of the financial records available, it appears that they would have stood to make a profit by their inventions in the straw industry (*Niles Register* April 17, 1824, 98; Dec 5, 1835, 232; Jan 8, 1848, 298)

Like Kies and Wells, too, their inventions were functions of time and place. They actively participated in the sweeping industrialization that shaped the American factory system. The 1820s ushered in a trend of declining prices for straw braid due, in part, to the effects of an 1822 British tax law and the U.S. Tariff Act of 1824. It was argued by Congress that the law would not "impose a higher rate of duties on the consumption of the poor than on the rich" and when enforced it "virtually exempted all imported Leghorn hats and braid from duty" (Sloat 97). This put an undesirable competitive edge on American produced hats, as Italian Leghorn hats and braid were considered to be of the highest quality. The "renewed importation of hats from Italy [caused] a decline in the value and quantity of hats manufactured in the United States" (Sloat 96). In addition, the British tariff regulations of 1822 added "a new duty upon Leghorn hats...on plat not made up and even a duty...upon IMPORTED STRAW" (Sloat 97). The economic forecast for the American straw industry was not promising. Efforts to produce a quality hat more efficiently and cost effective was badly needed and, consequently, well received. Recognition of women's specific technological contributions in the hat industry lay historically dormant today, but at the time of their utilization, the importance was not totally overlooked.

Sophia Wells was duly recognized by the Hartford Agricultural Society for her grass bonnet. Although Wells patented the use of native grass for hat

manufacturing and was recognized by some of her contemporaries, her contribution has received little recognition in the annals of the traditional history of technology. It is not surprising that Burnap and Cooper have received even less, but their lack of recognition does not diminish the importance of their inventions. All three of these New England women who invented significant hat industry technologies in the 1820s, were motivated by some of the same factors: national interests, economic gain, and technological curiosity.

From Sybilla Masters on, women inventors have stepped outside of their properly proscribed social roles of mother and wife. Although American culture has consistently celebrated technical innovation as a national heritage, both men and women were socialized to view gender as an ideological construct which dictated the proper relationship each sex should have with technology. In post Revolutionary America, women's relationship with technology was constructed and defined as consumer. Those women who chose to function as producers by creating innovative technology were an anomaly. Social characterization of the inventor was steeped in masculine ideology, and that enduring trend has been predicated not upon biological sex difference but rather the historical and cultural construction of gender. In particular, the concept of masculine and feminine were produced in relation to each other through work, with technological change functioning as a causal variable. Early American women inventors, such as Kies and Woodhouse, have been excluded from the indices to the standard histories of technology because since the inception of the Patent Office, "the history of technology represents the prototype inventor" as

male which has infused an overwhelming male bias in most technology research and traditional histories (Wajcman 137, 17, 15).

The recovery of these women's contributions lay not in some treasure chest of old forgotten documents, but rather buried in the annals of the history of the straw hat industry in early America. The function of time, place, and resources helps to contextualize and document their illusive contributions as part of the whole of the history of American technology. Their inventions provide insight not only into technological progress, but how such advancement was affected by political, economic, and social contingencies.

Gendered assumptions about the proper role of women shaped their technologically innovative contributions, which most of the time meant it was prudently "deemed a matter to be hidden from light." Gage commented upon this unspoken but widely acknowledged assumption as, "custom, that unwritten law." Her indictment against custom concerning inventive women was scathing:

> Custom, that unwritten law, has for years frowned upon any attempt of woman to take such a step [get a patent in her own name]. If she has been gifted with an inventive genius, she has either stifled its exercise, expended it upon style of dress—that being deemed her legitimate province...Women have not dare to exercise their faculties except in certain directions, unless in a covert manner. A knowledge of mechanics has been deemed unwomanly (Gage 6).

To misuse or "stifle" inventive talent, Gage elaborated was an "outrage against society" (Gage 6). Although incomplete in most cases, solid evidence exists suggesting that women inventors such as Sybilla Masters, Betsey Metcalf Baker, Sophia Woodhouse Wells, Lucy Burnap and Henrietta Cooper defied custom and

invented significant hat technologies. While half of the population in the post-revolutionary period and through the 1820's were socialized to participate in the celebration of Yankee ingenuity, the other half was conditioned to view their participation in such national inventive activity as another sort of "outrage against society."

Yet women were motivated like men by economic gain, patriotic duty, and creative technical talent. The women inventors who contributed to the hat industry in the early 19th century carried a germinated spirit of independence from the political realm that fought and won the Revolution for Independence to the scientific and technical battleground where the Industrial Revolution was in full bloom. Despite their historical neglect, their contributions represent significant evidence that women inventors were part of American seed of independence. The persistent gendered assumptions about invention and women's roles in the pursuit of technological achievement was an on going a struggle for independence long after the war was over. Despite the brilliant potentiality of women as inventors, their contributions were suppressed by "custom, that unwritten law" for the duration of the century.

Chapter 2 - NOTES

[1] Historian, M. D. C. Crawford observed that although "the industrial revolution belongs to Europe, especially to England" that in the United States "the physical results" were more manifest than in any other part of the world due to Americans ability to increased the use of the machine and develop a greater amount of power than Europe (383). By the 1830s French philosopher, Alexis de Tocqueville, observed that American's progress was premised on American minds being "predisposed" to "every new method which leads by a shorter road to wealth, every machine which spares labor, every instrument which diminishes the cost of production, seems to be the grandest effort of the human intellect" (Oliver 236-237).

[2] List of sources supporting women's predominance in labor force of hat industry: Niles Register: April 17, 1824, p 98; Oct 25, 1834, p 114; Patterson 63-64

[3] Act of Parliament, King George II, January 13, 1731: AN ACT to prevent the Exportation of Hats out of any of His Majefty's Colonies or Plantations in America, and to reftrain the Number of Apprentices taken by the Hat-makers in the faid Colonies or Plantations, and for better encouraging the making of Hats in GREAT BRITIAN (Tunis 46).

[4] The British government imposed a mercantile economic theory and practice on the colonies. This system held "that a nation is more important than its parts--or its colonies; that it should try to make everything it uses; that it should strive to sell abroad but not to buy there; and that it should fill its vaults with all the coin it could lay hands on--and keep it" (Tunis 12). This system encouraged the colonists to produce whatever would best serve the interests of England, and became increasingly oppressive to American subjects. Sanctions and restrictions were imposed beginning in 1660 with the Navigation Acts which included a published list of "enumerated articles that the colonists could ship to British ports only. Such restrictions continued throughout the seventeenth and eighteenth century, and as late as 1774, the last control law was implemented which forbade export to America of tools used to make wool cloth, an industry which was designated as strictly British. Americans were to continue to supply raw materials and were expected to buy British wool, but they were not to produce it themselves for domestic consumption or export. The mercantile system extended to importation laws, whereby colonists were expected to buy for cash certain items from England only. These restrictive policies had application in the hat industry, and contributed to the increasing discontent and rebellion toward the Crown (Tunis 12). They fueled a nationalistic spirit which motivated technological contributions in support of American industry, which included the highly successful American hat industry.

[5] During the last quarter of the 18th century Americans exhibited a strong degree of determination to resist dependence on British industrial support. They were determined to be economically as well as politically free of British domination. The hat industry flourished, in part, because of this kind of motivation. Materials and labor were readily available from native American resources, and there was an enthusiastic market for anything American made. Dependence on foreign import or export was largely avoided in the early American hat industry (Bishop 345-372; 415).

[6] According to hat historian, Bill Severn, the establishment of Zodac Benedict's hat factory at Danbury, Connecticut, in 1780 was among the earliest of the first real factories in the United States. Within the next 20 years, Danbury witnessed the establishment of 50 more hat factories. The 1820s marked the introduction of mechanized equipment which increased the speed of production and the quality (101-102).

Massachusetts also was a noted center of early hat factories. The following are representative examples of specific straw hat manufacturers: 1810, Asa & David Thayer, Franklin, MA; 1820s, Stoddard & Knowlton Company, West Upton, MA; and 1820s, Union Straw Works, Foxborough, MA (Tharp 6; Patterson 63; Brown 108).

[7] "The *Oxford English Dictionary* defines milliner thus: "a. A vendor of fancy wares and articles of apparel, esp. Of such as were originally of Milan manufacture, e.g. 'Milan bonnets,' ribbons, gloves, cutlery. B. In modern use, a person (usually a woman who makes up articles of female apparel, esp. Bonnets and other headgear. From the many literary references noted under haberdashery or millinery, one sees that the two were closely connected in the 17th and 18th centuries, and that at no time were milliners confined to the trimming and selling of hats exclusively. This connotation is of modern use. The 18th century milliner was a dealer in small articles, ribbons, gloves, trimmings, jewelry, as well as hats" (Stephenson 1)

[8] The idea that women working in a straw shop produced good wives was idealized in an early American poem entitled "The Straw Shop Girl". The poem praises the shop girl as being industrious. They work, "From early morn 'til twilight, / And often later still." They are intelligent: "The styles I can't name over, / And it takes more brains to make them /Than most of them will cover." They are spiritually minded" The Straw Girl goes to meeting/ On a pleasant Sunday night." And, She looks uncommonly pretty / Is richly dressed, perhaps, / And excites the admiration / Of all the nice young chaps . . ." It is this kind of girl the poet writes is "the angel of my dreams" and the one he wants to take as wife.

The poem also lends insight on the capabilities and appropriateness of women working in a straw shop in the almost rebuttal-like lines as follows:

Yet, in all our cities
One cannot fail to see
Men occupying places

Where women ought to be.
If men are really better,
What is the difference, pray?
Both work in shops together
Because they need the pay.
No shame, nor yet dishonor,
Can rise from one's condition,
But rather in the manner
Men slight their occupation (Copeland 46-49).

[9] The hat collection held by Henry Ford Museum & Greenfield Village in Dearborn, Michigan, holds several fine example American-made straw bonnet types. Their collection contains numerous examples of a late 18th century and predominately 19th century straw bonnets, both hand sewn and machine sewn. For specific examples note the following ID numbers for archival computer access: 41.214.1775.39; 94.0.18.70; 94.0.18.128; 68.5.18; 91.0.11.2880; 94.0.18.115; and 94,0,18.117.

[10] Betsey Metcalf Baker referred to smoothing the six straw braids with a "junk bottle" because the braid began to curl. A junk bottle was a "general utility container of thick dark glass, the result of early European and American efforts at glass making." It was a "junk man" who bought and sold these bottles and broken glass to be melted and used again." Such bottles, of course, are not considered junk by today's standards and collectors criteria (Tharp 3-4).

Chapter 3

JACKSONIAN DEMOCRACY: YANKEE INGENUITY AND THE SELF-MADE WOMAN?

When Andrew Jackson first became president in 1828, he embodied the fruition of democratic individualism, an elevation and celebration of the self-reliant common man made possible through the free pursuit of economic gain. The appeals of Jacksonian democracy are exemplified in the ideas, rhetoric, policies, and public gestures which mark his eight-year presidency (Meyers 15). The ideas and rhetoric of the "Age of Jackson" bear close scrutiny in the discussion of technology's relationship to women, specifically addressing women inventors, because they reflected Yankee ingenuity and self-reliance at a time when the social construction of gender promoted and celebrated invention in context of only approximately half of the population, the male half. [1]

The rhetoric and ideas voiced by President Jackson, reformers, and literary voices offer substantial insight into this paradox. Such historical texts explore the affects that republican virtue and Jacksonian democracy had on women inventors by describing how the American character was perceived, shaped, and idealized. Gendered assumptions which socialized women as antitechnocrats were enriched and perpetuated in the celebrated American characterization of Yankee ingenuity. During a period of heightened national celebration of technological advancement and scientific progress, the self-made woman embodied as inventor was not celebrated. She was hardly remembered.

Although the historical documentation of her contributions is obscure, the traits and values ideally inherent in the celebrated individualism of Jacksonian America surface in the annals of women's patent records. Patent records bespeak of resourceful, self-reliant, determined, and creative women inventors who challenged the image of the prototypical inventor as solely male. The perception of the ideal national character as exclusively the "self-made man" possessed of exemplary Yankee ingenuity is contested by the record of women inventors. [2]

The historic function of the self-made man and the idea of self-help had both positive and negative affects on American culture. It glorified material progress and the encouraged lowly and common man to defy socially stratified class distinctions and rise as far as their talents would take them. It honored activity above response which judged merit on the basis of achievement (Wyllie 151). In no activity was this more apparent than in the pursuit of technological advancement.

On the negative side, however, it inspired new dimensions in the pursuit of the American dream which could only be had by a relative few. It condemned the majority who failed and dismissed their attempts as a delinquency in character. It fostered and enriched values in which "success required no explanations and failure permitted no excuses" (Wyllie 151). The ideology of the American self-made man represented men across the class lines, but it represented them unequally. And the self-made woman, especially one who aspired to inventive creativity, was not represented at all. "For women Jacksonian America was not

the land of opportunity: rather the land of *shrinking* opportunity" (Dickenson xvii).

Such distinctly American characteristics were revealed, in part, by those who lived and observed life in antebellum America. Cultural conditions owing to abundance, mobility, and environmental conditions helped to create the phenomena of the self-made man and the collective view of the dependent woman (Pessen 5-7). The composite version of this self-made man emerges from contemporary accounts encompassing political, intellectual, and literary voices. The work of Charles Brockden Brown, Ralph Waldo Emerson, Margaret Fuller and others, present a contextual glance of how women were generally excluded from this characterization. It also reveals how, at times, women mediated gendered power relations as technology advanced at unprecedented speed.

The American character was idealized in heroic proportions during the Age of Jackson. Heroes were virtuous men, honest, brave and forthright (Bode xvi). They also possessed the ranking virtue of inventiveness, proudly referred to as Yankee ingenuity. This was a new category of hero, the inventor (Breeden 78). Individuals produced new ideas, new products, and new systems that were "so spectacular [that] they revolutionized entire industries, created new industries, or developed new processes which advanced the industrialization of the nation" (Remini *Revolutionary* 14). Inventors were inspired to pursue new levels of technological development and advancement because they "had a notion that they could do anything if they tried hard enough and long enough. They could outshine anybody under the sun" (Breeden 78).

These were individuals who moved aggressively forward to transform America from an agrarian and rural nation into an urban and industrial one. These exemplary characteristics were culled from an ideology which arose from two distinct and different political persuasions, the Jacksonian Democrats and the Whigs. While the Democrats fought against capitalism in every form, be it banks, corporations, or manufacturers, the Whigs staunchly believed that Americans "depended on the profitable investment of the moneyed capital of the country" (Rozwenc, *Ideology* 352-353). Despite the largess of these political pinions, the country came together in support of the elevation of the common self-made man and his ability to gradually rise from small beginnings. [3] Notwithstanding the opposing political ideology, both parties supported the enormous energy that people poured into economic development where,

> . . . as the reward of merit and industry, and where they can attain to the most elevated positions, or acquire a large amount of wealth, according to the pursuits they elect for themselves. No exclusive privileges of birth, no entailment of estates, no civil or political disqualification, stand in their path; but one has as good a chance as another, according to his talents, prudence, and personal exertions. This is a country of *self-made* men, than which nothing better could be said of any state of society (Colton qtd. in Rozwenc *Ideology* 356).

This idea that "one has as good a chance as another," written in 1844 by leading Whig intellectual, Calvin Colton, was what many *believed.* [4] It was clearly far from the truth when even the most superficial examination of the social position of blacks, native Americans or women is considered. And although women inventors held particular kinship with this Jacksonian ideology in their "merit and

industry" and "according to [her] talents, prudence, and personal exertions," the value of their technological contributions and their role as inventor remained circumscribed by the sincere belief that "women did not need equality" (Remini *Revolutionary* 17). Historians suggest that Americans did believe democracy had come to America, but not because it actually had. Rather, "the people at the time *believed* democracy had come to America and they believed it in part because it was repeated to them over and over" (Remini *Revolutionary* 79).

By the end of Jackson's second term as President, the rhetoric and politics of opportunity had become the premise of Jackson's administration. On March 4, 1837, the last day of his second term as President, Jackson addressed the nation summarizing the leading principles of the Democratic party. His speech has been characterized as one of the most "eloquent and comprehensive statement[s] of the Democratic version of the politics of opportunity" (Davis 188). In it he reviewed "America's proud heritage, present greatness, and future mission" (Davis 188). He assured his "fellow citizens" that the test of the last 50 years proved that,

> Our Constitution is no longer a doubtful experiment, and at the end of nearly half a century we find that it has preserved unimpaired the liberties of the people, secured the rights of property, and that our country has improved and is flourishing beyond any former example in the history of nations. . .
>
> In the legislation of Congress also, and in every measure of the general government, justice to every portion of the United States should be faithfully observed. No free government can stand without virtue in the people and a lofty spirit of patriotism . .. (Davis 188-195).

His lofty and noble choice of words regarding "unimpaired liberties," ring with stinging poignancy when applied to women inventors. In order to preserve such liberties, they first had to be secured. For women inventors during Jackson's administration, they never were. Quite to the contrary, legal, economic, social, and educational liberties, which were necessary in the pursuit of technological advancement, were systematically denied to women inventors. The celebration of the nation's advancement was, in fact, distinctly and ironically characterized by its socialization of half of its population as antitechnocratic. But nevertheless, it was with a sense of triumph that Jackson concluded his address:

> . . .The progress of the United States under our free and happy institutions has surpassed the most sanguine hopes of the founders of the Republic. Our growth has been rapid beyond all former example in numbers, in wealth, in knowledge, and all the useful arts which contribute to the comforts and convenience of man, and from the earliest ages of history to the present day there never have been thirteen millions of people associated in one political body who enjoyed so much freedom and happiness as the people of these United States (Davis 194).

The echo of the Patent Office's national mission cannot be missed in Jackson's laudatory praise of the "knowledge, and all the useful arts which contribute to the comforts and convenience of man." But what is missed in the ideology of progress is the collective contribution of the entire populace. Technology and its scale of advancement can be viewed as a symptom of our culture. It has not been merely a means to an end, but a human activity ladened with values (Rybczynski 106). The values inherent in the politics of opportunity reflect an inequity of national proportion for women inventors. The spoken values and the practiced

values of American antebellum culture for women inventors was symptomatic of impaired liberties in their pursuit of technological advancement in "all the useful arts."

The spoken values flourished, though, in the rhetoric of the democratic party. For example, the noted Harvard scholar, historian, and Jacksonian democrat, George Bancroft, in his "philosophic essay on the natural wisdom of the common man" wrote in 1835, "The absence of the prejudices of the old world leaves us here [in America] the opportunity of consulting independent truth; and man is left to apply the instinct of freedom to every social relation and public interest" (Rozwenc *Meaning* vii, 17). There is ample evidence that women inventors applied "the instinct of freedom" to the public interest in some of the their inventive pursuits. But such names and inventions as Nancy Johnson, ice cream freezer (1843), Emma Stienhauer, cook stove (1831), Sara Mather, submarine telescope and lamp (1845), and Mary Ann Cook, the sad iron (1848), along with more than 30 other known women inventors during the Jacksonian Age have evanesced from the annals of the history of American technology. And while men and women alike may have believed in the democratic mantra of equal opportunity, the lack of equal competitive opportunity and recognition for women inventors was to be their threnody for most of the 19th century. In 1883, Matilda J. Gage, author and women's rights activist, wrote that "the inventions of a nation are closely connected with the freedom of its people" and the reason that "the proportion of feminine inventors is much less than of masculine...arises from the

fact that woman does not possess the same amount of freedom as man" (Gage *NAR* 488).

Still, women, like men, were motivated to invent with the prospect of economic success, by a community spirit motivated to improve society, or out of sheer inventive talent and ambition. And like male inventors, women heard over and over how all America loved the inventor and the patriotic opportunities to contribute to America's national mission of progress. But unlike their male counterparts, women inventors in antebellum America were subject to the "prejudices of the old world" along with all the new world prejudices that saw women almost exclusively as mothers and wives committed to upholding "piety, purity, submissiveness, and domesticity" (Pessen 85). Such prejudicial social casting often led women inventors to invent in men's names or jointly with a man (which then were usually listed under the male name), and it can be surmised that many women simply did not patent their inventions (Gage NAR 483-484; 488-489). The incentive and gain to go through the trouble and expense was more than minimal when faced with the reality that a woman had no rights which would ensure her success, profit, or recognition:

> She could not vote or hold office; her "right" to property was limited; she could not enter most professions; she could not make a will, sign a contract, or witness a deed without her father's or husband's consent; and her children could be taken from her if her husband so directed (Remini *Revolutionary* 17).

The ideas and rhetoric of Jacksonian democracy, no matter how many times they heard it, remained just that for women inventors, ideas and rhetoric.

This rhetorical pattern had been well nurtured from the proceeding revolutionary era. Its tenants and application were strongly entrenched even as the first women entered into the inventive arena. Although it was not until 1809 when the first woman received a US patent, the experience of 18th century American women inventors such as Sybilla Masters, Betsey Metcalf Baker, and Catherine Greene foreshadowed the barriers that would challenge women inventors in the Age of Jackson. Although most profiles of early women inventors are relegated to historical obscurity, Greene's case remains additionally obscured in unresovable controversy. Her experience reflects how women's relationship with technology was socially constructed to devalue her inventive contributions on the eve of Jacksonian democracy,.

There are many historical references linking Catherine Greene with Eli Whitney and the cotton gin. The accounts of the invention of the cotton gin are varied with little agreement and no conclusive evidence as to the truth. They do agree that Whitney came to stay with Greene at her Mulberry Grove plantation in 1792 and that Whitney had a reputation as a mechanic (Gies 71-73; Gage *NAR* 3). Beyond that, three basic theories as to her involvement are summarized as follows:

> First, that Catherine Greene was the real inventor and Whitney merely her model maker; second, that Whitney was the inventor but Greene solved a crucial problem with the first model; and third, that the story of Greene's contribution is just a pleasant--or puerile--fantasy (Stanley 796).

Several 19th century sources support the first and second theories, but modern sources generally site the third theory as fact or simply omit the account entirely. [5] Some variation of this account surfaces in more than 15 consulted sources, which makes it "hard to imagine such acres of smoke without at least a small fire" (Stanley 47). Despite the fact that Greene's participation cannot be conclusively substantiated, the conflicting accounts reveal some of the basic power struggles women mediated in their relationship to technology during the inventive age.

One interesting aspect of this relationship was embedded in a woman's identity. Unlike Eli Whitney, historical records about Greene's personal life are scant. Little is known about her childhood or education (Stanley 797). She is usually cited as "the widow of General Nathaniel Greene of revolutionary fame" and later the wife of Phineas Miller, who entered into partnership with Whitney (Burlingame 170, 174; Gies 72). She is also noted as Mrs. Gen. Green [sic] and the other usual addresses denoting her marital status (*Shaker Manifesto* 164; Mozens 351; Gies 71). Her identity is consistently connected with her role as wife. Her support in the inventive process is often characterized as a helpmate, much like the submissive role of wife (Burlingame 172).

One account, begrudgingly mentions her in the context of "a popular story, origins unknown but not confirmed by Whitney" as the one who suggested that he try using stiff-bristles like that of the hearth brush instead of his idea of wooden teeth to separate the seeds from the cotton. She is said in this account to have further supported him by inviting "the neighbors in to admire the new

invention" (Gies 72). Her identity in relationship to the invention is in context of her domestic position to hearth and hostess.

Interestingly, in another account which credits her as inventor in fact, not popular story, her identity is constructed differently. Matilda Gage opened her 1870 Woman Suffrage Tract-No.1, "Woman as Inventor" with Greene's account. She wrote that Greene,

> . . . proposed to Whitney the making of such a machine, and upon her idea he commenced.
>
> The work was done in her house, and under her immediate supervision. The wooden teeth first tried did not do the work well, and Whitney, despairing, was about to throw the work aside, when Mrs. Greene, whose confidence in ultimate success never wavered, proposed the substitution of wire. Whitney thereupon replaced the wooden by wire teeth, and within 10 days from the first conception of Mrs. Greene's ideas a small model was completed (4).

In this account, the gendered language denoting a submissive role as wife, helpmate, and domestic is conspicuously absent other than in the marital title. There is no mention that the wire came from a domestic tool, that she facilitated his fame as hostess, or that she functioned as a submissive helpmate. It was her house, her instructions, her idea and her persistence, according to Gage, that resulted in the invention which became the object of "infinitely great national importance" (5).

Although there is some limited evidence that Greene eventually saw some financial gain in the form of royalties paid to her which supports that she had more than a cursory involvement in the invention, the record stands clear and uncontested that she did not patent the cotton gin (Stanley 797). Whitney holds

that singular distinction. Gage responded to the still anticipated question, Why didn't Greene patent the cotton gin herself? Gage explained further in her suffrage tract,

> To do so would have exposed her to the contumely and ridicule of her friends. Custom, that unwritten law, has for years frowned upon any attempt of woman to take such a step. If she has been gifted with an inventive genius, she has either stifled its exercise, expended it upon style of dress--that being deemed her legitimate province--or, like Mrs. Greene, suffered some man to claim the award her due. She shrunk from the persecution that would have attended her claiming the patent, while by associating herself with Whitney as his partner in the manufacture of the machines, she hoped at least to share in the pecuniary advantages of the invention (6).

While Greene's part in the invention of the cotton gin may never be certain, her experience, although in the end of the 18th century, significantly impacted women inventors in the 19th century. Her experience exemplified the basis for the emerging rhetoric and ideology of Jacksonian democracy which socially constructed a circumscribed politics of opportunity, one in which the legitimacy of women's experience as inventor was undermined and devalued. Women's relationship with technology was mediated by cultural barriers significantly defined by gender.

The annuals of patent history ring loud and strong the accomplishments erupting from half of the nation who were socialized to become cultural heroes as inventors. Unlike the names of Greene, Johnson, Stienhauer, Mather and Cook, exciting and spectacular inventions from male inventors became fused into the national fabric as sterling examples of the American character. Names and

inventions such as Eli Whitney, cotton gin (1793), Cyrus Hall McCormick, reaper (1831), Samuel F. B. Morse, electric telegraph (1844), and Samuel Colt's revolver (1835), continue to be canonized in our national litany of celebrated inventors and representative of the fruit of the Age of Jackson (Oliver 132; Pursell *Technology in America* 2-3).

It is not suggested that these famous inventors be debunked or expunged from our national canon, but rather expanded to include those women inventors who through their inventions characterize themselves as self-made women in the pursuit of national progress and economic gain. Other women inventors, too, who may not necessarily be contenders as cultural heroes in the age of Jackson, bear integration into the mainstream history of technology as contributors to America's emerging identity as a progressive industrialized democratic nation and as part of the enduring Jacksonian legacy. Not only do women inventors of this period merit recognition for their technological contributions, but they also bear recognition for the contributions in mediating gender power relations which significantly affected the development of technology.

For example, Cyrus Hall McCormick's patented his reaper machine in 1834 (Breeden 66). From the focus that has been heaped on this invention in the history of American technology, one gets a sense that his was "the" invention that characterized and embodied the technology of the Jacksonian era with its ability to replace human manual labor with profoundly efficient machinery. [6] In addition to the McCormick reaper's mechanical ability, the cultural impact of this invention seemed to "herald the dawn of American agricultural technology"

(McGaw 345). In reality, the McCormick reaper represents not a heralding of new American agricultural technology, but rather an individual contribution to the collective advancement of mechanized agriculture.

McCormick was not the first or only mechanized reaper invented. His invention was predated by others, the most famous being Obed Hussey's machine, which was very similar differing "mainly in the design of the knife" (Gies 190). Hussey and McCormick maintained an aggressive, hostile legal competition until the 1850s when Hussey lost his position as McCormick's chief rival (Gies 196). McCormick's success was not based on the superiority of his reaper, but rather he proved to be an exceptional businessman. He developed new aggressive selling techniques which included written guarantees for his machines, selling at a fixed, published rate on an installment plan, and a widespread and innovative advertising program (Breeden 70). The historical accuracy of his technological contribution is mired in legend, as his was not the first, best or only reaper which contributed to the revolutionary mechanization of agriculture. McCormick successfully mediated a dominant power relationship with technology even though he, in fact, did not meet the legendary criteria.

Actually both McCormick's and Hussey's reaper was predated by William Manning's 1831 reaper (Stanley 113). Manning's reaper, unlike Hussey's or McCormick's, draws very little attention in the history of technology despite the fact that he won an important legal case against McCormick with the aid of Abraham Lincoln as his attorney. His position as an inventor, though, like others was mediated by influences quite outside the realm of technical creativity. One

significant influence affecting his ability to mediate his position was the involvement of his wife in his inventive sphere. Mrs. William Manning is credited by some sources as the inventor of one of the earliest reapers. Although her husband took out the patent in his name, it was suggested by historian H. J. Mozans and suffragist Matilda Gage that Ann Harned Manning invented a mower and reaper as early as 1817-1818. Gage was personally acquainted with Ann Manning and wrote about her twice (Stanley 114). In 1883, Gage wrote,

> A third great American invention, the mower and reaper, owes its early perfection to Mrs. Ann Harned Manning, of Plainfield, New Jersey, who in 1817-18, perfected a system for the combined action of teeth and cutters, patented by her husband, William Henry Manning, as "a device for the combined action of teeth and cutters, whether in a transverse or revolving direction." Mrs. Manning also made other improvements, of which, not having been patented, she was robbed after her husband's death by a neighbor whose name appears in the list of patentees upon this machine. Mrs. Manning also invented a clover cleaner, which proved very lucrative to her husband, who took out the patent" (Gage *NAR* 484).

It is not surprising that Manning did not get a patent for the invention or that she has received virtually no recognition for her contribution. Such an invention falls well outside of the domestic coterie by its singularly agricultural nature. She, even less so than her husband and considerable less than Hussey or McCormick, did not have the financial, legal, or educational resources nor the social access to compete successfully with male inventors on the Jacksonian democratic stage.

As the Jacksonian decades closed, the paradox of nationally celebrating some inventions while simultaneously relegating others, took on greater scope and significance. The number of patents awarded to women inventors slowly rose and

gained real momentum in numbers alone by the 1850s (LWP). But it becomes increasingly clear that women inventors did not even place in the bottom rungs of canonized inventors because of their comparatively lower numbers or the nature of their inventions, but rather due to the relationship between technology and power in stratified societies. Despite all the loud oratory and great rhetorical platforms proclaiming America's unique brand of Jacksonian democracy where "no exclusive privileges of birth, no entailment of estates, no civil or political disqualification's" stands in anyone's way, Americans practiced the same old world forms of inequality that had consistently socialized women as inferior, dependent and, in this unique era of technological change, as antitechnocratic. It has been pointed out by historian, Edward Pessen, that the one great difference in form between old world European inequality and that in new world America was that "money rather than blood divided men into rigidly separated worlds." Women were divided even further as they historically have always had less money than men and, in this case, based on prejudicial gendered assumptions about their relationship with technology, they were judged incapable and inferior. (Pessen 28). Despite women sharing some of the same cultural conditions as abundance, mobility, and environmental conditions, the phenomena of the self-made man placed women inventors in a distinctly undemocratic position.

From the onset of the industrial revolution and even before, gendered assumptions about women's relationship with technology reinforced their dependent roles, and Jacksonian democracy perpetuated such assumptions. Women have traditionally been considered as consumers of limited kinds of

technology, especially domestic technology. The perception of their contributions as producers was even more limited. If women produced "appropriate" products or processes according to their relative role as mother, wife, daughter, or sister, such contributions supported their proscribed social roles and did not cause or encourage them to cross the social penumbra. In support of this standard, women's patent records, not only during the antebellum era but also after, show a predominance for many kinds of domestic technology, such as clothing, food processes, furniture, cleaning devices and processes, childcare products, reproductive technology and technologies to promote women's health (LWP). All of these contributions effectively improved domestic labor, and although many of these technologies successfully revolutionized the way both men and women lived, the inventions themselves were not considered as valuable or as important as mechanical inventions. And when women did invent mechanical inventions and/or things which clearly fell outside of domestic technology, they were considered in an inferior and subordinate light due to rigid gender boundaries.

Such new world prejudices were, ironically, part of the same Jacksonian legacy which celebrated Yankee ingenuity, which has been characterized by Gage, as "male yankedom" (Gage "Women as Inventor" 1870 Tract, 4 (hereinafter cited as Tract)). Values surrounding the celebration of Yankee ingenuity were politically charged and culturally restricted. A woman's support of Jacksonian democracy was not validated by her participation as inventor. She was not to be busy creating, building, or inventing new technology in order to support the expansion of the industrial horizons of America. Rather, a woman's supreme

contribution was succinctly epitomized in a prize winning essay published in 1851 in *The Ladies' Wreath* entitled "How May an American Woman Best Show Her Patriotism." The winner, Miss Elizabeth Wetherell, wrote that it wasn't through the vote, since that would only result in a "vast increase of confusion and expense without in the smallest degree affecting the result." Instead "a woman could best show her patriotism by staying at home, where she brings her influence to bear "upon the right side for the country's weal" " (Welter 39). While in this environment she could experience "natural refinement and closeness to God," which was a "blessed advantage of a quiet life." She would be at home with "her Bible and a well balanced mind" (Welter 39).

In her quiet life, the influence that she exerted on behalf of her "country's weal" during and after the Age of Jackson did not put her in motion with the other half of the population, which, according one historian, "throbbed and pulsed with energy." This energy was observed as "the relentless need to be better off. . . . [where] there are no limits within which the hopes of any class of society must be confined as in other countries." America was purportedly a country where "life consists in motion," but it was stagnating slow in recognition of women inventors regardless of whether they believed or not in the deeply entrenched democratic rhetoric that there were "no limits" to "any class" (Remini *Revolutionary* 14). Cursory recognition of the collective body of women inventors during the Age of Jackson remains embryonic. And even a superficial retrieval listing in the annals of the history of technology of such names and inventions as Diana H. Tuttle, spinning wheel heads (1824); Phoebe Collier, wheel-feelies, sawing (1826); Luna

Bishop, bellows (1831); and Margaret Gerrish, asclepias syriaca, manufacturing external fibers (1834) remains merely superficial (the only mention of these names appear in LWP, 1888).

The democratic limits which relegated women inventors in antebellum America persistently manifested a rhetorical guise of equal opportunity. Contradictions in values about men's and women's relationship to technology and an ensuing double standard caused tensions which added a distinctly difficult barrier for the few women who ventured into a life full of motion outside domestic confines during the Age of Jackson. Women's technical creative opportunities were severely limited by the gendered assumption that they were incapable of producing significant technological inventions. Cast as passive antitechnocratic consumers, the politics of equal opportunity extended a socialized justification to restrict women's movement during the inventive age. The "development of technology has been mediated by gender power relations" which have long been constructed by cultural values (Wajcman 163).

The central paradox regarding the national celebration of Yankee ingenuity worked against women inventors like a strong undertow. The excitement surrounding all the ideas, political rhetoric, and public gestures which touted invention as a nationally celebrated vocation, caused an undercurrent of simultaneous resistance and acceptance to ripple through the American populace. For those who had the adventurous spirit to enter the water, the currents of resistance and acceptance functioned as cultural boundaries which required specialized skills and resources to successfully navigate the treacherous waters.

And if one did not personally possess such skills or resources, they could be had with a little Yankee ingenuity, or so the myth flourished. Because of the very different social construction of technology's relationship with men and with women, equal access to such resources, such as money, education, and social roles, remained a part of the restrictive rhetorical pattern, not part of the celebration.

Yet, even though the course for women inventors presented a navigational challenge without precedent, the patent records testify that a few pursued the uncharted waters with determination, ingenuity, and ultimately, with a relative degree of success. Such was the case of Nancy M. Johnson (1795-1890) who patented the first ice cream crank freezer on September 9, 1843. The freezer had "three major parts: a tall tub, a slender cylinder with a close-fitting lid, and a dasher with a removable crank" (Funderburg 34). In the next 30 years, at least 70 additional ice cream freezer patents were issued, all of which were variations on Johnson's basic combination of a revolving freezer and dasher model. Johnson's name, though is rarely cited in the history of the ice cream industry or the history of technology. Rather, it was a patent issued to William G. Young in 1848 which is consistently cited as the first patented ice cream freezer in the traditional histories of the ice cream industry. [7]

Despite this oversight and the relatively little information we have about her and her invention, Johnson contributed a significant technology which helped to pave the way for a new and progressive industry, one that eventually developed new processes and contributed to the industrialization of America. The

wholesale ice cream industry was founded seven years later in 1851 under the direction of Jacob Fussell, a Baltimore milk dealer (Arbuckle 417). Her invention made ice cream more accessible to Americans by making it easier to make at home, better quality, and cheaper, thus readying American palettes for an industry that has never since faltered in its prosperity. This invention reflects the Jacksonian character embodied in the self-made woman and the spirit of Yankee ingenuity.

Prior to her invention, making ice cream was labor intensive work, requiring a good deal of expertise and was considered by most a luxury food. Although "cream ices" appeared to be popular since the Revolution based on advertisements, they were not something served frequently by average families (Burke 9-10). Ice cream was initially served by prominent Americans of noted upper class like Mrs. Alexander Hamilton and First Lady Dolly Madison (Frandsen 2). And even though ice cream was growing in popularity, the first truly American cookbook published in 1796 by Amelia Simmons, had no ice cream recipes. [8] In part, this was likely due to the difficulty of making ice cream. Within the next few years after Simmons' book, other cook books were published with a plethora of ice cream recipes and instruction on how to make ice cream, such as the following 1814 directive: "place the mixture in a pot, surrounded by ice and salt, inside a pail and alternately turn the pot and scrape the ice off the sides until the cream was the consistency of new butter" (Funderburg 31). This laborious process continued with no noticeable improvement over the next few decades as demonstrated in an 1837 edition of *Directions for Cookery;*

Being a System of the Art in Its Various Branches by Eliza Leslie, who advised, "Keep turning the freezer about by the handle till the cream is frozen, which it will generally be in two hours" (Funderburg 32).

Johnson's freezer represented a significant improvement over such time consuming processes because in her invention "the crank turned the dasher, moving the frozen particles from the wall of the cylinder toward the center, causing the cream mixture to freeze more evenly and giving it a smooth, fluffy texture." This was substantially less fatiguing than turning the freezer pot by hand (Funderburg 34).

Johnson did recognize a profit from her invention, but in retrospect the $1,500 that she and her husband sold her patent assignment rights for was grossly undervalued considering the large fortune amassed by individuals like Fussell who utilized such basic technology in the early days of the wholesale ice cream industry and the manufacturers of the freezer (Stanley 76). [9] She may have reaped other monetary benefits, but verification of such is still yet to be uncovered. Patent files indicate that she and her husband assigned her rights for $200 and "other considerations" to Isaac S. Williams and Samuel E. Riessier, manufacturers and importers of tin ware under the name of Williams and Company (Funderburg 35). What the "other considerations" may have been were not specified.

One is poignantly reminded of the limitations of her situation as a married woman, when she must do business and sell "her" rights in partnership with her husband. Her "instinct for freedom," as so eloquently stated earlier by Bancroft,

in her "social relations and public interest" regarding the business of invention apparently meet with other obstacles that are only hinted at but never clearly revealed. While waiting for a letter of acknowledgment from the patent office, she wrote a letter of complaint to the commissioner stating that, "I had some difficulty in obtaining your letter of acknowledgment from the post office in consequence of its having been directed to Mr. N.M. Johnson" (Patent Assignment File, Group 214, Liber R 365 qtd in Funderburg 35). These were her initials, not her husband's initials, which were W.R. Johnson. This suggests the patent office's assumption that the inventor, N.M. Johnson, was naturally a man. This invention fits appropriately within a women's domestic sphere as a food process and merited as such insufficient monetary value and even less recognition.

The identity of Nancy M. Johnson remains shrouded in her one and only patent record. Her maiden name, her status, her occupation, and her personal history remain unknown. Her invention and its reception in the 1840s is not completely obscured, but could hardly be considered as celebratory status despite its acknowledged ingenuity which inspired more than 70 others to patent ice cream freezers in the next three decades (Funderburg 35). Feminist historians argue that it is "social structure that undermines the legitimacy of women's experiences as innovators," which in turn "also structures society's reaction to women's creativity, making it insignificant or invisible" (McDaniel, Cummins, Beauchamp 2-3). Nineteenth century observation concurred by recognizing that, "Inventors must not only possess full freedom to exercise their powers, but there must also be a certain welcome and protection to their ideas" (Gage *NAR* 488).

And that welcome and protection "depends in large measure on the experience and values of males being perceived as the *only* valid frame of reference" (McDaniel, Cummins, Beauchamp 2-3). Although Johnson's invention of the ice cream freezer was a significant contribution in the industrialization of a very successful food processing industry, her invention is but a shadowy entry in both the history of technology and the history of the wholesale ice cream industry. As a food processing technology, the freezer was categorized as something within a women's domestic range of experiences, therefore, excluding it from the experience and values of the majority of males.

This is not to say that the argument is reduced to what is the most valid, agricultural technology or food processing technology. But it certainly raises questions and elicits further inquiry as to why the celebratory status is heaped upon one and excluded from the other. Why did Whitney and McCormick became names synonymous with the mechanization of farming and not one celebrated name comes to the historical forefront in early food processing technology? A restricted and limited frame of experiential reference based on biased gendered values, consequently placed such technology as less important by making it less visible. The legacy of Jacksonian democracy socially defined what was technologically significant and what was nationally visible in its celebration of the self-made man by its rhetorical fabrication of an egalitarian ideology. If the triumph of democracy is visible in the canonization of such distinguished inventors as Whitney, McCormick, Morse and Colt, its defeat is equally visible in

the silent shadows of such neglected inventors as Greene, Manning, Johnson, Stienhauer and Mather. [10]

It was not only the political rhetoric of the times which perpetuated the democratic myth that ours was a nation built on egalitarian virtues. The Jacksonian legacy was supported and further characterized by some of the contemporary writers of the day as well as some of the earliest American writers. Some writers, though, such as Charles Brockden Brown and Margaret Fuller challenged its mythical proportions. Others like Ralph Waldo Emerson reflected the tensions Americans felt in the national pursuit of progress. A dominant patriarchal social structure overshadowed this compelling democratic pursuit.

One of America's first professional authors, Charles Brockden Brown, published *Alcuin: A Dialogue* in 1798, which eventually consisted of four parts. It was reprinted later in a shorter version in the *Weekly Magazine* of Philadelphia as *The Rights of Women*, one of the earliest American writings on the subject (Clark 31). Brown's views on women's rights and capabilities were played out in a dialogue between the "priggish schoolmaster Alcuin and the widowed Mrs. Carter" (Clark 37). Although the dialogue did not specifically mention women inventors, it challenged the hypocritical basis of an egalitarian society which "makes the circumstance of sex a reason for excluding one half of mankind from all those paths which lead to usefulness and honour," which would certainly include women inventors (Brown 24). The words of the first Patent Act in 1790, to "promote the progress of Science and useful Arts" ring with an accusatory echo in Brown's writing. At the time of Alcuin's publication, the patent system had

been operating for eight years and a woman had yet to receive an American patent.

Mrs. Carter argued in favor of women's political and economic equality and baited Alcuin's less radical view of equality. Alcuin acknowledged and excused that without a doubt "there is abundance of injustice in the sentence; yet it is possible to misapprehend, and to overate the injury that flows from the established order of things" (Brown 24). The dialogue continues with Alcuin pondering that, "Perhaps this inequality is incurable" or in other words unavoidable because it is "rational." Alcuin is willing to concede that while he could admit to "the claims of the female sex to an equality with each other, we cannot allow them to be superior" (Brown 25). The collective voice of "we" and the controlling verbiage of "allow" reverberates with Jacksonian tenants of a democratic social structure which placed women in a subordinate and dependent role as passive consumers of technology which, consequently, affected how women inventors competed with their male counterparts.

One barrier which consistently mediated women's successful competition as inventors throughout the 19th century was the lack of equal education. It is with clear notice in this early work that such a calculated exclusion placed creative and intelligent women at a distinct disadvantage. Mrs. Carter developed her argument about why women were excluded from "all those paths which lead to usefulness and honour" and "equal opportunity" by pointing out "that, for some reason or other, the liberal professions, those which require most vigour of mind, greatest extent of knowledge, and most commerce with books and with

enlightened society are occupied only by men" (Brown 34). Alcuin admitted such facts, but saw no reason for "drawing mortifying inferences from them" (Brown 34). Mrs. Carter pointed out the mortifying inferences regarding her extremely limited education meant she could only "make a pie" and "cut out a gown," because "being of this sex is to be instructed in a manner different from those of another." She continued that because although there were "schools, and colleges, and public instructors . . . in all the abstruses sciences and learned languages," one must ask, "Are not women totally excluded from them?" (Brown 38).

Consistently, this lack of education excluded women inventors from such vital knowledge as chemistry, physics, advanced mathematics and other science related disciplines which support inventive creativity. Such exclusionary educational opportunities contributed to socializing women as less capable, especially in anything considered scientific, such as mechanical inventions.[11] This early reflection of women's inferior capabilities created a fertile bed of social inequity which underscored the tensions that preceded antebellum America and persisted throughout the 19th century.

Although the ink of the *Declaration of Independence* was barely dry, the tensions of social inequity were already festering when Brown wrote through the character of Mrs. Carter in the conclusion of Part II:

> I am tired of explaining this charming system of equality and independence. Let the black, the young, the poor, and the stranger, support their own claims. I am a woman. As such, I cannot celebrate the equity of that scheme of government which classes me with dogs and swine (Brown 59).

And although Mrs. Carter may have been tired of explaining "the charming system of equality and independence" to Alcuin, the argument was far from exhausted. It had only begun. Even during the heightened national celebration of democracy and the politics of opportunity in Jacksonian America, little was resolved in equalizing the classification of women inventors on a level par with male inventors. In reality, gendered assumptions about women's relationship with technology as subordinate, passive, and antitechnocratic stabilized with iron-like rigidity. Considering Mrs. Carter's classification of women with dogs and swine, the possibility of naming one famous dog or one famous women inventor during the first half of the 19th century shared the same potentiality. Persistently, now at the end of the 20th century, it remains far more likely that college students and educated adults can name more famous dogs than women inventors. [12]

Brown challenged the hypocritical democratic foundation of the United States by publicly debating that the distinction between men and women was based on the clearly undemocratic difference of opportunity (Clark 38-39). The threads of this argument were continually taken up by a host of early feminists including Francis Wright, Sarah Grimke, Lucy Chase, Elizabeth Cady Stanton and others.[13] Such arguments reflect how women were socialized as antitechnocrats by the impingement of equal opportunity and why the prototypical image of inventor was shaped and refined as male during the inventive age.

One of the most famous and influential 19th century feminists who wrote on the undemocratic state of women's opportunity was Margaret Fuller Ossoli. Her best known work, *Woman in the Nineteenth Century* (1845), was widely read

and sold out in a week after its first publication (Dickenson vii). Her high idealism was embedded with romantic values in her description of the female nature as "electric, vital, magnetic, full of life" and she consistently sought liberation through psychological means rather than political (Dickenson xxviii-xxix; 66-67). She was also acknowledged as a "shrewd judge of character" in regards to masculine nature (Violette 82; Dickenson 17-25). Born in Cambridgeport, Massachusetts, on May 23, 1810, Fuller lived her life of 40 years in the fullness of Jacksonian democracy (Miller xi-xxviii). She astutely recognized that during this time women lived in a relegated world where self-dependence among most women was "deprecated as a fault" (Dickenson 22). She elaborated on this conviction:

> I think women need, especially at this juncture, a much greater range of occupation than they have, to rouse their latent powers...I have urged upon the sex self-subsistence in its two forms of self-reliance and self-impulse, because I believe them to be the needed means of the present juncture (Dickenson 116,117).

This was critically true for women inventors. The ideas of self-reliance and self-impulse were circumspect to varying restrictive degrees as illustrated in the cases of Manning and Greene. Even though they lived in an age that trumpeted self-reliance as a national characteristic, their inventive ability functioned as latent powers because they were either not free to pursue their own patents due to economic, legal, or social restrictions or they chose not to do so, which also suggests an imposed personal restriction based on gender and/or sex. It remains forever unknown as to what kind of inventive abilities lay hidden or

dormant in these women due to repressive restrictions which limited their occupational opportunities, especially as inventors. The disparaging difference in opportunity is even more apparent when compared with the encouragement and support heaped upon both Whitney and McCormick throughout their entire lives and beyond. Fuller believed that women would be represented fairly only when "inward and outward freedom for woman as much as for man [was] acknowledged as a right, not yielded as a concession" (Dickenson 20).

Even when bestowed as a concession, women who pressed for inward and outward freedom and who utilized self-reliance and self-impulse in their pursuit of creative genius were "very commonly unhappy" Fuller noted. Women who possessed what Fuller termed "the electrical and magnetic element" were particularly proned to be repelled "more rudely" because "their quick impulses seem folly to those who do not discern the motives" (Dickenson 66-67). This bears unique application to some women inventors who claimed to have been motivated or inspired to invent by some divine intervention. In the antebellum scientific community there was an understood relationship between electrical and magnetic transference of ideas from the spiritual realm and appears to have been the premise of some of those who claimed a flash of genius when it came to inventing. [14] Regardless of motives, women inventors, like male inventors, possessed a measure of energy and creative genius which went mostly unrecognized and undeveloped in Jacksonian America. Fuller was particularly perspicacious when she observed that it was said of a women possessed with energy or creative genius that, "She has a masculine mind" (Dickenson 24). It

was not generally conceivable that women possessed the intellect or ability to produce something meriting creative genius. One 19th century author noted, "There are no women of genius; when they become geniuses they are men" (Bolton 511). Thus, if a women exhibited such intellect, she had abilities like a man or as good as a man.

Because of Fuller's own energy and creative genius, not as an inventor, but as "a woman, editor, essayist, political journalist and arts critic in an otherwise largely male domain," she was an intellectual superstar, a woman without parallel in her day. To some, she possessed a masculine mind steeped in the tenets of Jacksonian democracy. She understood the ideology of the American self-made man and how it represented people, specifically women, unequally. In her reflections of energy and creative ability, she provides keen insight into a monumental challenge women inventors faced.

Fuller did not advocate sweeping equal rights for women or make radical political demands like those which surfaced in Brown's work (Bartlett 105). Rather, she believed that women and men were different, but such different masculine and feminine traits were of equal worth (Bartlett 108). But she did not conceptualize that worth and value, such as in women's inventive contributions, was mediated by a social construction which undermined the legitimacy of women's experiences as innovators. She did not deem such contributions, like her own intellectual ones, as less valuable than male contributions and certainly never as virtually invisible (McDaniel, Cummins, Beauchamp 2).

To some, such as Ralph Waldo Emerson, Fuller's individualistic and self-reliant solutions to women's social disadvantage were visionary. He recognized that many did not appreciate her strong intellectual bearing when he wrote that, "crowds of vulgar people taunt her with want of position" (Porte *Journals* 429). [15] On the contrary, Emerson saw Fuller as "representing an interesting hour & group in American cultivation" (Porte *Journals* 429).

Emerson respected Fuller's sense of self as indicated in his journal entry after her death. He wrote, "she was the largest woman; & not a woman who wished to be a man . . . her confidence in herself was boundless, & was frankly expressed," July-August, 1850 (Porte *Journals* 414). No doubt, he recognized his own ideas about the individual in Fuller's application of individualism to women (Dickenson xx). Emerson celebrated the individual on many levels, but he especially, like Fuller, admired those Americans who exhibited inventive energy and creative ability. Unlike Fuller, though, he did not see such energy and ability stagnated and repressed because of gendered restrictives. He did not criticize the social structure which mediated technological power in a circumscribed patriarchal system, but rather celebrated the inventor along with the poet because of their respective ability to yield "us a new thought," one who "unlocks our chains, and admits us to a new scene (Emerson "The Poet" *Library of America* 463 (*Library of America* hereinafter cited as *LA)*). Emerson saw invention as producing a new scene of national industrial expansion.

Like others in Jacksonian America, Emerson admired the keen imaginations of those who directed America on a path of technological

advancement, and in them, he saw the emergence of an "independent national spirit" growing out of machine power" (Marx 234). Inventions such as the steamboat and railroad were able to "annihilate distance" and "like enormous shuttles, pattern the various threads of American life into one vast web" which contributed to a strong sense of national unity (Marx 234; Emerson "The Young American" *LA* 213).

Emerson believed that inventors helped to shape and create the character and substance of modern America. Like 19th century historian Thomas Hughes, Emerson saw "values of order, system and control embedded in machines" that were produced in a time of technological enthusiasm (Hughes 4). And in agreement with later historian and social critic, Lewis Mumford, he recognized that technology was both a shaper of, and shaped by, values. Technology was undeniably "value-ladened" (Hughes 5). But in time, Emerson's critical voice came to question the integrity of American values of order, system and control. As an eye witness to the tradeoffs of technology, he expressed serious concern about some of the consequences brought about by the unlocking of the "chains" and America's admittance to a "new scene." By the late 1860s, Emerson wrote, "The progress of invention is really a threat" (Porte *Journals* 452). He lived to see the invention of "deadlier weaponry" and observed the degradation of the industrial worker abused by an innovative, highly successful factory system (Emerson "Works and Days" *Centenary Edition* 163, 165 (*Centenary Edition* hereinafter cited as *CE*)). He eventually feared that progress, the fruit of invention, would exterminate us (Emerson "Fate" *LA* 958). He never reconciled

his celebration of invention with his criticism of it which reflects some of the basic tensions that shaped America during the "age of invention" (Hughes 7).

Inherent in that tension was the value-ladened ideology based on gendered assumptions about who could participate in America's technological mission and what constituted celebratory invention. Emerson observed that there were, "certain ideas...in the air. We are all impressionable, but some more than others, and these first express them. This explains the curious contemporaneousness of inventions and discoveries" (Emerson "Fate" *LA* 965). He correctly observed that there was something unique in this time compared to all preceding generations. But he ignored the part of that "curious contemporaneousness of inventions" which restricted and generally excluded half of the population from freely acting upon their inventive impressions even if they were the first to express such ideas. Women inventors such as Elizabeth Buckley sheet iron shovel (1828); Phebe Atwell, fur extraction from skins and manufacturing it in yarn (1834); Ethel H. Porter, straw cutting and fodder (1834); and Sarah Hammond, fireplace (1839), no doubt, heard and felt what ideas were "in the air" and regardless of whether they were impressionable and were the first to express such inventive impressions with or without a patent, they were not part of the 50 year legacy that Emerson noted nor mentioned in his celebratory litany (Emerson "Works and Days" *CE* 159). He wrote with characteristic national pride that "the inventions of the last fifty years counterpoise those of the fifty centuries before them" (Emerson "Works and Days" *CE* 158). Emerson lived during one of the most prolific periods of American male invention and the most restricted period for female inventors. His

contribution and support of that legacy remains saturated with gendered assumptions about the prototypical national image of inventor as male.

Like Brown and Fuller, Emerson's voice reveals how the American character was perceived, shaped, and idealized to either fit or reject the mold of the self-made man. And although his public voice is conspicuously silent on how women were socialized as antitechnocrats, his writings reflect the central gendered assumption about the inventor and inventions. Women were not inventors. The inventor was unquestionably male and the inventions were undeniably masculine.

Emerson projected invention as a national symbol of prosperity and success and recognized it as it was in progress, not merely from an historical perspective. With keen insight he wrote, "We anticipate a new era from the invention of a locomotive, or a balloon; the new engine brings with it the old checks...it is a symbol of our modern aims and endeavors" (Emerson "Nature II" *LA* 554). Those "modern aims and endeavors" cut a path to the standard American dream of economic self-sufficiency. The steamboat, railroad, sewing machine, power-loom, reaper, mowing machine, and gaslight reflected America's full store of prolific inventors (Emerson "Works and Days" *CE* 159). They held promise of emancipation and exhilaration which served as a fitting national symbol of expansion and progress. Emerson held that "a fascination resides in the symbol" and invention as a national symbol fascinated Emerson (Emerson "The Poet" *LA* 453).

That symbol holds further fascination, because it reflected America's values of order, system and control by its economically, socially, and legally excluding women inventors from equal participation or even marginal recognition as contributors to America's modern aims and endeavors. The promise of emancipation and exhilaration was not enough to raise women inventors up to an equally competitive playing field. Their invisibility was part of the intricate mesh of a socially determined relationship with technology.

Some male inventors and their inventions, too, were lost in the vast web of American progress. Emerson pondered on this selectivity, giving rise to issues of not only creative ability but also reception. He reflected,

> But now one wonders who did all this good. Look up the inventors. Each has his own knack; his genius is in veins and spots. But the great, equal, symmetrical brain, fed from a great heart, you shall not find. Everyone has more to hide than he has to show, or is lamed by his excellence ("Works and Days" *CE* 166).

The genius of the inventor, like the mother lode in a rich mine, surfaced in "veins and spots" leaving other space unproductive, possibly untapped. And sometimes the deposits that were mined were so rich that they became more valuable than the miner and were to be had at any cost. The knack and genius of Catherine Greene, Ann Harned Manning, and Nancy Johnson are representative of the untapped mother lode of women inventors during the Age of Jackson.

Perhaps, like Margaret Fuller, they were lamed by excellence. Their equal, symmetrical brains were hidden and submerged in a socially constructed system where the development of technology was mediated by gendered power

relations. Cultural values infused with democratic ideas, rhetoric, policies, and public gestures supported what Fuller termed "the great radical dualism." Male and female represented two sides of the same whole, a whole which constituted a national mission in pursuit of technological progress and scientific advancement.

Although women inventors responded to what was "in the air" with Yankee ingenuity and self-determination, the self-made woman embodied as inventor was not celebrated. Her submerged legacy is symptomatic of our cultural response to the development of technology. Technology is a human activity and as such, it is ladened with human value. During the Age of Jackson, gendered values contributed to the emergence of the prototypical inventor as male. The measurement of an inventor's worth was weighed on male criteria, experience, and value. As technology advanced at unprecedented speeds, how one mediated the power relationships was socially determined by gendered politics of opportunity. The role of the Jacksonian woman was idealized and conceptualized within the contextual roles of mother, wife, sister or in some capacity as a dependent helpmate. The pursuit of technological advancement in specified male dominated fields, such as agriculture, socialized women to respond and be perceived as antitechnocratic.

President Andrew Jackson's confidence that our constitution was no longer a doubtful experiment at the end of 50 years, reinforced his administration's democratic mantra of equality and justice across all lines. Like others, Jackson, undermined the significance of women inventors as producers in antebellum America. His celebration of the inventor and the self-made man

rendered the self-made woman inventor virtually invisible. As Emerson so prophetically waxed, invention became a symbol of our modern aims and endeavors. During the Age of Jackson, it was a national endeavor to submerge women inventors in the opaque guise of democratic rhetoric as antitechnocratic.

Chapter 3 - NOTES

[1] Historians refer to the "Age of Jackson" with various descriptors and time boundaries, "roughly bridging the years from the end of the War in 1812 to the coming of the Civil War" (Remini *Revolutionary* 3). For the purpose of this study, the reference to the Age of Jackson includes the 1820s through the 1840s, the decades when Andrew Jackson reckoned as a political force which characterized this period as "an age of change, an age of innovation, an age of reform" (Remini *Revolutionary* 3).

[2] According to historian, Irvin Wyllie, the term "self-made man" was first used by Henry Clay on February, 1832 , to a group of successful manufacturers. "Clay was defending the protective tariff in the Senate against charges of his Southern opponents that a tariff would widen opportunities and enable humble men to rise in the industrial sphere. He said, "In Kentucky, almost every manufactory known to me is in the hands of enterprising self-made men, who have whatever wealth they possess by patient and diligent labor" (10).

[3] "Recent scholarship has shown that the ideological gulf between the two parties was not so great as was once believed and that both parties appealed to similar middle-class constituencies. Furthermore, it is generally agreed today that both parties operated within a liberal democratic framework that accepted constitutional government and majority rule" (Miller xiii).

[4] Taken from Calvin Colton's *Junius Tract No. VII*, entitled "Labor and Capital". Colton was a Yale graduate who enjoyed an intellectual reputation and was associated with American Whiggery in the Jacksonian era. He wrote a series of ten *Junius Tracts* (1843-1844), which represent a codification of Whig positions. Tract No. VII emphasizes the centrality of the image of the self-made man in the Whig mythology (Rozwenc *Ideology* 346-347).

[5] Autumn Stanley provides a comprehensive discussion of the prevailing theories regarding Catherine Greene's involvement in the invention of the cotton gin in *Mothers and Daughters of Invention, Notes for a Revised History of Technology* in "Appendix A-2: Catherine Greene and the Cotton Gin." The Appendix provides a range of 19th and 20th sources which support the persistent controversy.

[6] For further context of the Cyrus McCormick's reaper see Chapter 7, "Cyrus Hall McCormick and the Mechanization of Agriculture" in Carroll Pursell's *Technology in America* and Ronald M. Fisher's contribution in *Those Inventive Americans*, edited by Robert L. Breeden, pp. 64-74.

[7] See Turnbow, Grover, et al. *The Ice Cream Industry*; Burke, A.D. *Practical Ice Cream Making and Practical Mix Tables*; Frandsen, J.H. and W.S. Arbuckle. *Ice Cream and Related Products*; and Arbuckle, W. S. *Ice Cream* which consistently do not credit Nancy Johnson as the inventor of the first ice cream freezer based on the principle of a combination of a revolving freezer and dasher. These sources either do not mention the first patent at all or mention it as attributed to William Young in 1848.

[8] "*American Cookery; or, the Art of Dressing Viands, Fish, Poultry and Vegetables, and the Best Modes of Making Pastes, Puffs, Pies, Tarts, Puddings, Custards and preserves, and All Kinds of Cakes, from the Imperial Plumb to Plain Cake* by Amelia Simmons, published in Connecticut in 1796, claimed the distinction of being the first truly American cookbook. Although Simmons borrowed a few recipes from British sources, she emphasized native American foods, such as buffalo steak, corn bread, wild turkey, pumpkin, cranberry sauce, papaws, and new England election cake. Simmons, who stated her recipes were for American women of all classes, did not include an ice cream recipe" (Funderburg 31).

[9] For a good historical overview of the wholesale ice cream industry and specifically its founder, Jacob Fussell, see Chapter 3, "Wholesalers and Heavyweights: 1850-1900" in Funderburg's *Chocolate, Strawberry and Vanilla: A History of American Ice Cream.*

[10] Christian Schussle's 1851 painting, *Men of Progress,* depicts 19 inventors, all male, with some of their notable patent models. Included in the artistic canonization are some inventors whose names alone speak their creative inventiveness: Cyrus Hall McCormick, Charles Goodyear, F.B. Morse, Charles Goodyear, Thomas Blanchard, Elias Howe, and Samuel Colt. But others in the painting are not generally as well known: James Bogardus, use of cast iron in construction; Henry Burden, horse shoe making machine; Isaiah Jennings, dentistry tools ; Jordan Lawrence Mott, a coal stove; Eliphalet Nott, a coal stove; John Ericsson, screw propeller; and Frederick Ellsworth Sickels, mechanisms for steam engines (Breeden 79). It is not surprising that women inventors were completely excluded as it expresses cultural values which symptomatically devalued women inventors position in American Progress. Appropriate female inclusions in this painting, should the title have been *People of Progress,* may have included: Emma Stienhauer, cook stove; Nancy Johnson, ice cream freezer; Sarah P. Mather, submarine telescope; Mary Ann B. Cook, sad iron; Tilly Flint, weighing scale; and Phoebe Collier, wheel-fellies, sawing.

[11] Augusta Genevieve Violette argues in her *Economic Feminism in American Literature Prior to 1848*, that Alcuin's response to Mrs. Carter's views

on women being excluded from college reflected the conventional attitude which considered American women as the least oppressed women in the world (41-42).

[12] This observation is based on personal teaching experience of the course *Introduction to Science & Technology* at Michigan State University (1996-1998). Students consistently were able to name numerous famous dogs and not one women inventor from any time period or of any nationality. The closest they came was Madame Currie, a scientist, not an inventor.

[13] For a good overview of some of the leading arguments from both the famous and not so famous early feminists, see Nancy Woloch's, *Early American Women: A Documentary History, 1600-1900* (1992); Ann Russo and Cheris Kramarae's, *The Radical Women's Press of the 1850s* (1991); and Linda Kerber and Jane De Hart-Mathews' *Women's America Refocusing the Past*, 2nd ed. (1987). Together these works include a wide range of reprinted essays, documents, tracts, speeches, correspondence, journals, personal narratives, and other documentation which sought not merely to "assert "women's rights" but also to redress "women's wrongs," and above all to renogotiate the contemporary rules of the game under which women and men interacted (Woloch xi),

[14] See the examples of Harriet Ruth Tracy and Elizabeth Hawks in Chapter 1 of this dissertation and Ann Braude's discussion in *Radical Spirits* of the connection between spiritualism and science. Braude cites the 1842 example of when F. B. Morse went to Congress to request $30,000 to construct an experimental telegraph linking Washington and Baltimore. He found little understanding of the principles of electricity and the Chairman was of the opinion to "require a scientific analysis to determine how far the magnetism of mesmerism was analogous to the magnetism to be employed in telegraphs" (4-5; 192-193).

[15] Nathaniel Hawthorne was one of the leading voices who discredited Fuller's intellectual contributions. He was joined by others such as Henry James and James Russell Lowell (Perry xvi, xxiv).

Chapter 4

THE CIVIL WAR: IMPETUS TO INVENTING WOMEN

Like other war periods, the Civil War era (1850-1870) sparked the inventive mind to produce at accelerated rates as verified by patent statistics. What women invented and the increased number of inventions by women marks this era as one of social flux in women's relationship to technological creativity. What they invented bears an imprint of social context, both historically and culturally. Gendered patterns of technological invention based on reception and diffusion were altered during the patriotically charged atmosphere before, during and after the Civil War. Unlike the previous Jacksonian Age of Democracy which touted Yankee ingenuity and the self-made man as national mantras while socializing half of the population as antitechnocrats, the Civil War consumed the entire populace in support of resolving the irrepressible conflict between the North and the South (Craven 2). The generation of women inventors who were swept up in this cataclysmic course responded with unprecedented inventive activity.

Since the inception of the US Patent Office in 1790 until 1850, just a little more than 30 patents were granted to women (LWP). But during the next two decades, at least 350 patents were issued to women. Consideration not only of the increased number of patents, but also the varied kinds of inventions during this

time reveals a shifting pattern in women's relationship with technology. Inventions by women related to war activities, such as a self-inflator for raising sunken vessels, planking for war vessels, a pyrotechnic flare and code system, an ambulance and a submarine telescope, provide fascinating evidence that women inventors significantly expanded their technological boundaries well outside of the domestic parameters. Such parameters limited women inventors to invent things relating to domestic functions rather than for industrial, scientific, or other application which fell outside of the proper social function of women as wife or mother. Embedded in this expanded relationship is the imprint of social context during a period when women struggled for increased accessibility to higher education, new job opportunities, and legal entitlement. The Civil War served as an impetus to inventing women not only by increased numbers of inventions and the variety of what was invented, but also by reshaping the paradigms of their relationship with technology which contributed to the propulsion of women into an era of heightened feminist consciousness.

The generation of women who experienced the Civil War lived during a time characterized by rapid growth and expansion, a growing development of sectionalism and an era marked by "democratic and humanitarian stirrings" (Craven 3, 4, 10). Both women and men were shaped by such national development, and in many instances, they were shaped differently. Women who were swept into the "irrepressible conflict" experienced all three of the above characteristics to varying degrees directly or indirectly. Some relocated with their families to wilderness territory in search of new opportunities (Massey 297-

303). Some witnessed first hand the growing tension between states rights advocates and unionists (Clinton 53-57). And many felt the affects of reform movements, particularly abolitionistism and women's rights (Massey 355-365; Russo & Kramarae 324).

Although still strongly connected to the domestic sphere as these changes rippled over the national landscape, the War forced many women to venture into new uncharted social territory. As more and more men were recruited for military service, by necessity for the sake of survival women integrated into the mainstream workforce outside of the home. [1] Like other wars, the demand for fighting men during the Civil War greatly affected the work force leaving women at home with little or no support. Many were forced to work in industrialized fields previously restricted to predominately male workers. Technology's relationship to the segregated world of women's employment broadened to include employment outside of the previous domestically confined domain of women. Increased numbers of women worked in factories, on farms in male capacities, and in urban environments.[2]

In the absence of fathers, husbands, and sons, women experienced increased access to technical, industrial, and business knowledge. In addition, a heightened sense of patriotic fervor motivated women to invent necessary and useful things in support of the war effort such as Clarissa Britain's ambulance (1863) and Mary J. Montgomery's war vessel (1864) By considering what women invented during the Civil War era and the increased numbers in previously male dominated categories such as war related and mechanical inventions, an

emerging pattern underscores the changing relationship with technology that women began to experience, one that challenged assumptions about their abilities and potential to participate in national technological development as more than mere consumers.

Women inventors especially participated in this development by resisting male construction of a distinct and inferior female patriotism. Resistance came in the form of increased inventive activity in areas clearly outside of their proper culturally proscribed roles as mother, wife, and passive dependent. Such prior social construction had systematically undermined and devalued their technological contributions, in part, sometimes due to the nature of the invention and/or simply the fact that it was invented by a women. This devaluation was based on gendered assumptions about women's limited and narrow interaction with technology, mostly defined in domestic terms. During the Civil War era discriminatory reception as experienced by antebellum women inventors was reshaped by nationalistic factors which produced a heightened degree of patriotism by men and women alike. Reception to women as inventors and what they invented was transformed from rigid rejection to moderate and conditional acceptance. Unyielding gendered assumptions about women and technology were relaxed into productive moldability, one which served to unify a country in crisis.

Changing patterns of reception were interwoven in a complex social system in which women gained credibility for their contributions on several fronts, technologically and otherwise. It became increasingly difficult for women's contributions to be submerged in a moiled system of patriarchal

dominance simply because they did not fit into an appropriate social category. Women were recognized as vital contributors in the war effort by both sides. A British journalist, George Augustus Sala, who observed the American people at war, wrote in his diary that "there was probably no conflict in history which was as much a "woman's war" as that of 1861-65." He noted that women in both camps were "the bitterest, most vengeful of politicians," "unanimous" in their "exasperation and implacability" (Massey 25).

Women experienced the impending storm by keeping abreast of campaign developments even though they were not allowed to vote. Southern women, particularly, had always been discouraged from any kind of political involvement previously as it was "considered extremely unladylike to meddle in politics" (Massey 26). But as the nation passed the point of no return, women from both sides understood implicitly that war was certain. [3] By 1860, "Southern women were avidly reading the newspapers and leaving their homes "to attend a speech or process," and "by November they were convinced that Lincoln's election would mean the complete destruction of their way of life" (Massey 26).

Likewise, Northern women were riveted to political developments. Following the attack on Fort Sumter, Sophronia Bucklin wrote in her Civil War memoir, *In Hospital and Camp*, that women responded with the "same patriotism" as the hundreds of thousands of men who responded to Lincoln's call for 75,000 militiamen (Leonard 3). Like American men, many women responded with action, not just words. But unlike most men, they were unable to respond as soldiers, although historical records indicate that approximately 400 women did

serve in this military capacity (Massey 79). What surfaces predominately in most traditional Civil War histories is women's response to the conflict on both sides as members of aid societies, relief organizations, and as nurses. In conjunction with this kind of war activity, women patented at least 36 inventions relating to medicine, hospitals, and general health improvements (LWP). [4] The reception to women participating in these kind of activities, even though outside of their normal functions as wives and mothers, was for the most part overwhelmingly supportive. Functioning in this capacity stretched the nurturing boundaries to include a national cause with the same kind of emotional and physical commitment that most women lent to their familial responsibilities.

The reception to women's political awakening and interest was meet with general support and approval by most men. In the "Introduction" to L.P. Bracket and Mary C. Vaughan's *Woman's Work in the Civil War* (1867), Henry W. Bellows commented:

> . . . Probably never in any war in any country, was there so universal and so specific an acquaintance on the part of both men and women, with the principles at issue, and the interests at stake. And of the two, the women were clearer and more united than the men, because their moral feelings and political instincts were not so much affected by selfishness and business, or party considerations ... Everywhere, well educated women were found fully able to understand and explain to their sisters, the public questions involved in the war. . . (57).

This kind of favorable public reception to women's political involvement during a period of heightened patriotism helped to shape and shift the boundaries that demarcated the proper narrow scope of women's lives. It allowed women to

challenge convention in a new and acceptable way. It also encouraged some to defy the conventional limitations in the name of patriotism. Such was the case with the shifting reception to some women inventors and their inventions.

Prior to the Civil War very few women patented their inventions, in part, because of the stigma of being labeled an inventor, a distinctly masculine occupation. Many women shared the same sentiment as Betsy Metcalf Baker, an early inventor of a process for straw braiding when she wrote that, "Many said I ought to get a patent; but I told them I did not wish to have my name sent to Congress" (Baker 60). In 1797 it seemed to Baker completely inappropriate for a woman to have her name before Congress for recognition as an inventor. Twelve more years passed before a women applied for a US patent. Reception to the very idea of woman as inventor was so negatively circumscribed and so masculine in its very concept that most women chose to not expose themselves to public ridicule and social censure. The War of 1812 motivated a very small percentage of women to patent inventions in support of the national crisis, especially the hat industry, as noted in Chapter 2 of this dissertation. But with the onset of the Civil War nearly 50 years later, the reception to women's inventions experienced increasingly more acceptance.

It was not that the idea or prototypical image of the inventor became more androgynous. It didn't, but rather remained decidedly male. What did undergo a conceptual change, though, was the development and application of technological innovations for the purpose of supporting a nation in crisis. This application fit into a masculine world view which reinforced economic and political survival

with the prospect of expansion through military strategy. [5] Technological innovations not only supported the War, but it was seen as vital to the victor. War has traditionally been a male domain throughout much of history, and, in this case, the reception to women participating in a male domain was viewed by the entire population as a form of noble and necessary patriotism. This shift in reception could be classed as part of the "grand convulsion in society" which rocked the very foundation of the American culture. [6] Women as producers of technology, especially technology which had some military application, whether mechanical or otherwise, reflected the shifting paradigms women inventors experienced which motivated some to apply their technical creativity to other than house and hearth. The experience of Martha Coston, inventor of pyrotechnic signal flares and night signals, exemplified how reception to women as inventors and their inventions shifted toward increased acceptance of women's inventions in a wider circle of technical activity.

Born in Baltimore, Maryland in 1826, Martha Hunt's life began as a model of conventionality. By the age of 21, she was a wife and mother of four (Coston 33). That was the beginning as well as the end of Coston's conventional life. She found herself at a critical juncture when her beloved husband, Benjamin Coston, an inventor of some promise who was assigned to a Washington, D.C. naval research lab, died after a short illness (Coston 23-25; 35-36). Within the next year, she lost her infant son and mother. She found herself virtually alone with three small dependent children. Adding further to her emotional desolation

and economic privation, shortly after her husband's death, she discovered that his business partners and relatives had bankrupted his estate (Coston 38).

Besides leaving his wife such a heavy burden, he also left her a valuable piece of his inventive genius as well as some useful political and social connections into Washington society that his position had afforded. Coston utilized all of these as opportunities to make a living for herself and family beyond expectations. She turned to invention and manufacturing as a means of support. Like other women inventors both before and after her, she was highly motivated by economic factors.

In November of 1847, Coston's dejection hit bottom as she contemplated her economic options as to either "to dig" or " to beg." She was sure she could do neither. What she did do was morosely rummage through an old box of her husband's papers which contained mostly inventions that were either unfinished or too expensive to produce. That was a turning point which led her down an unconventional occupational path. She wrote in her autobiography, *A Signal Success,* that it came to her "like an inspiration that perhaps in that same box I should find the means of retrieving my fallen fortunes" (Coston 38).

What she found was a large envelope containing papers and drawing plans for a signal to be "used at sea, at night, for the same purposes of communication that flags are used by day" (Coston 38). She was able to persuade the Navy to return her husband's prototype models, but as they were only in an early developmental stage, they didn't work. She focused on this incomplete idea for the next 10 years. Although the reception to the final invention was received

favorably, the process was fraught with the traditional obstacles that women inventors faced illustrating how their relationship with technology continued to be mediated by male values. She wrote,

> It would consume too much space, and weary my readers, for me to go into all the particulars of my efforts to perfect my husband's ideas. The men I employed and dismissed, the experiments I made myself, the frauds that were practised upon me, almost disheartened me; but despair I would not, and eagerly I treasured up each little step that was made in the right direction, the hints of naval officers, and the opinions of the different boards that gave the signals a trial (43-44).

Particularly, Coston's reference to the men she employed, the experiments she made herself and the frauds practiced upon her represent some what she considered the most trying of her obstacles which primarily resulted because of a lack of education or any legitimate prospect of acquiring the necessary education. Because she did not possess a knowledge of chemistry, scientific experimentation methodology or an understanding of business, she had to rely on those who had such knowledge, men. Based on gender alone, she felt she had been ignored, not taken seriously, or deceived.

Especially because Coston lacked the necessary knowledge in chemistry, she found it an exceedingly difficult and complex process to produce the desired three colors that she wanted for the flares. She was able to perfect a red and white one, but was stuck on producing a third color that would work with the standard maritime codes. "Blue I had my heart on," she later wrote, "in order to use the national colors, but I could not obtain it with equal strength and intensity to the others" (Coston 44).

As a woman, she experienced difficulty in finding a chemist to work with her. After watching a fireworks display in honor of Cyrus Field who had successfully sent a message to Queen Victoria on his Atlantic cable, she determined that "among the New York pyrotechnists I might find some one capable of helping me." Thus, she "opened communication with several of them, under a man's name, fearing they would not give heed to a woman, asking for a strong, clear, blue or green light, but not saying for what purpose" (Coston 45-46; Macdonald 19). She finally narrowed her collaboration down to working with one chemist which resulted in the successful creation of a third color, not her desired blue, but a strong bright green. It fit her other requirements, as well, that it be powerful, clear, distinct, clean and of uniform goodness when manufactured in large quantities (Coston 46).

She finally patented her invention in 1859, but not in her own name. She was clearly the true inventor since the inventor is the one who reduces to practice the idea, but it has been suggested that she deferred to her deceased husband in obtaining the patent as the administrix of his estate "because he had a well-established reputation that gave her special credibility---and respectability" (Macdonald 16). As a woman inventor, her credibility and respectability was suspect. But the successful reception of her invention significantly adjusted those parameters to make it more favorable for her to patent the 1871 improvement in her own name.

Her success was hard won, but it economically sustained her for the rest of her and her children's lives. Early on the Navy agreed to test the signals, which

proved highly successful. As a woman, though, she was not allowed to be present at the testing, but nevertheless, she was able to secure her first order for $6,000 worth of flares from the United States government. By the summer of 1859, she decided to take her signals to Europe, where over the next 15 year she successfully patented and marketed them in England, France, Holland, Austria, Denmark, Italy and Sweden (Coston 54, 60).

With the outbreak of the Civil War, Coston returned to the United States because she believed that the Coston Signals would prove to be a "valuable auxiliary" and that "the night would lose half its terrors at sea" if the signals were used by the Navy." True to her expectations, the really first successful utilization of the signals occurred during the Civil War. They proved vastly superior over the old Fresnal lanterns the Navy had previously used. That system consisted of three colored lanterns run up a pole, which were virtually indiscernible in anything but clear weather. In comparison, the Coston signal could be "discerned at a distance of from fifteen to twenty miles, and penetrating with a radiant glow of color the thickness of mist and fog (Coston 84, 101). The extensive use of the Coston Signal during the Civil War proved highly effective by enabling battleships to communicate strategic information over long distances. Coston wrote that she, "felt particularly thankful during the war that while the signals were made the means of capturing the enemy, they also played an important part in saving the lives of our own men" (102).

Coston not only contributed something of significant military value, but by persistent determination, creative strategies and shrewd business management,

she mediated a competitive vantage point. Successful aggressive marketing and manufacturing represented a significant inroad for other women inventors who would benefit from the relatively favorable reception and diffusion that her invention received both at home and abroad.

In country after country, she overcame the obstacles common to business negotiations, but with the added impediment of being a women without business experience, education, or status. Perhaps if she had been trying to patent and market an innovative corset or a domestic appliance, she might have had a somewhat different experience. But marketing and manufacturing a military device that involved advanced technology and implicated issues of national security during a period of national conflict, was truly far afield for a 19th century woman. Even today, one just has to imagine for a moment the probability of an American woman traveling alone to Europe to sell even a seemingly insignificant, but innovative, navel military technology to comprehend some of the insurmountable obstacles Coston experienced and recorded in her autobiography.

She reflected on gender discrimination she experienced in the following,

> We hear much of the chivalry of men towards women, but let me tell you, gentle reader, it vanishes like dew before the summer sun when one of us comes into competition with the manly sex...It was a most bitter thing to find in the lofty institution of our country, the Navy, men so small-minded that they begrudged a woman her success , though achieved after long years of struggle and patient industry (Coston 272).

While her success was begrudged, it was not totally denied. Although she did not get fair market value for her patent rights, she did realize a financial success from the total proceeds. She established a manufacturing firm to produce the signal and it apparently enjoyed a measure of success. Available records are very sketchy, but the Coston Signal Company was listed as surviving as late as the early 1970s in a Washington, D.C. directory. The Naval Historical Center has indicated they have no record of her or her company (personal correspondence June 27, 1997). But it is very possible that no one has actually pursued this investigation seriously or thoroughly to date.

What we do know from her autobiography is that she asked $40,000 for her patent rights from the Union Congress . She received $20,000. During the Civil War, Coston Manufacturing Company produced and supplied the signals at "cost price" which through wartime inflation and government ceilings meant that Coston was selling at a loss. She was promised remuneration in the future, but despite her many attempts, it never materialized (Coston 142). This was a repeated experience in most of her foreign business negotiations. She provides an especially insightful account of her business relationship with the French government who continually attempted to reproduce the "American recipe" by ordering shipments of the flares over a five year period, while refusing to negotiate for the purchase of the patent rights (Coston 154).

Still Coston's experience as a woman inventor merits recognition as one of marked successful reception and diffusion compared to the experiences of the 30 or so American women inventors who came before her. She was recognized with

favorable and credible public reception for her invention. The successful diffusion of her invention was merited in the economic success she finally achieved. Her experience and participation in military technical creativity represented how women's technological contributions crossed clearly demarcated gendered bounds during the Civil War.

Martha Coston did not change the image of inventor from male to female, but she did successfully mediate a competitive position as a women inventor. She accomplished this by participating as a producer of masculine technology which reinforced economic success and military advancement. She challenged and defied in many instances, a woman inventor's value in a male dominated social structure where technology was empowered and mediated by gendered relationships.

Her experience categorizes her as one of the earliest known professional woman inventors. While other previous women inventors may have relied on their inventive talents to sustain them economically and may have pursued invention as an occupation, there is no substantial documentation to prove that in patent or general historical records. As in the case of Coston, the number of patents does not necessarily determine if one has pursued invention as an occupation, but rather the successful cultural reception and economic diffusion of one or any number of inventions. This kind of historical documentation still remains illusive for the majority of women inventors.

But it is during the Civil War that we first see patent evidence of women who received multiple patents, suggesting a changing pattern of diffusion for

women's inventions due to an altered war-time social structure. Changes in business, industry and commerce surfaced in recognition of women's inventions in the commercial world, especially if they met pre-existing male criteria as to technological significance (i.e. outside of the domestic sphere). Along with Coston, both Mary J. Montgomery and Clarissa Britain fit the loosely emerging category of the first professional women inventors by the number and kinds of patents they patented during the Civil War era.

For example, Montgomery received four known patents, only two of which are recorded in the LWP in her name. Both of these were in 1864, one for an improved war vessel and one for an improvement in locomotive wheels. Later in 1866 she was assigned a patent from Richard Montgomery (relationship unknown) for an improved apparatus for punching corrugated metals. The fourth patent for a bridge was issued in 1868 jointly with Richard Montgomery. While this is not necessarily an impressive sum of patents, the inventions are all of a mechanical nature and particularly the first two, have some war-time application. They represent a diversity in potential application in transportation, clearly outside of the domestic field. The evidence of application remains obscure, but a few sources indicate that Montgomery did enjoy some kind of economic success, another criterion for a professional inventor. The Shaker *Manifesto* of July 1890 under "American Women Receiving Patents" noted that Mary J. Montgomery of N.Y., patented an improvement on locomotive wheels and has invented other devices out of which she has made considerable money" (164).

This information was later collaborated in a 1903 issue of *Scientific American* which called Montgomery the "one professional woman inventor in America" and made reference also that her inventions had made money for her (Stanley *Mothers* 502). This indication along with the mechanical nature of her inventions suggest that Montgomery received favorable recognition and profitable diffusion for her contributions which crossed gender lines.

The mechanical nature of her improvement in locomotive wheels was described by Ida Tarbell in her 1887 article, "Women as Inventors":

> The invention consists in substituting a curved corrugated beam to the periphery of the wheel instead of the usual fellies of wood or other materials, as in the iron wheels of locomotives, and in applying a tire of iron or steel with ribs or tongues fitting into the grooves formed by the curved corrugated beam. To give certain elasticity to the wheel, where this may be desirable, a sheet of India-rubber is introduced (356).

Based on this description, her next patent for an improved apparatus for punching corrugated metals seems to have a probable connection to the curved corrugated beam used in her locomotive wheels. And her previous invention of an "improved war-vessel, the parts applying to other structures for defense" also involved an innovative use of corrugated beams. The United States Patent Office official specification included the following description:

> ". . . an improvement in the nature and arrangement of the materials used as iron or steel clad armor in all kinds of vessels of war; and second, of an improved mode of planking the sides and bottom of ships or vessels of all kinds, and of applying planking to all other structures where corrugated beam-iron is used as ribs, beams, rafters, & c" (Letters Patent No. 41,167, dated January 5, 1864).

These inventions suggest some kind of relationship with the manufacture of corrugated iron materials and the transportation industry. But in what capacity she was connected to these industries is unknown at this time. Likewise, her personal profile remains unknown other than that she was from New York. Unlike Coston, she left no written record of her life's accomplishments, nor did anyone else. It seems apparent that Richard, her possible co-inventor, was a relative, but not necessarily her husband as she was referred to as "miss" or by her full first and last name with no marital title in the few afore mentioned references. What she did for a living, what her family connections were, what her educational status was, and virtually all important and significant biographical information remains historically obscure.

Her connection to the transportation industry merits further investigation. From 1860 to 1870 it has been estimated that in trades and transportation, "there was a 7.3 per cent increase in women employed" (Massey 152). While this is not one of the most dramatic increases in women's employment in new fields, it does indicate significant new opportunities in a previously restricted field of employment. [7] The nature of Montgomery's inventions suggest that she was able to cross technological gender boundaries because she was part of that 7.3 per cent who experienced expanded opportunities during the Civil War in trades and transportation. Montgomery and Coston, along with hundreds of other women, utilized such opportunities to become successful inventors.

War-time opportunities were more diverse for women inventors specifically and, in general, for women who sought employment in what was once

considered a man's world. As women's social position changed within the context of the Civil War, many had to reevaluate conditions women experienced as wage earners. It is estimated that female wage earners increased by 60 per cent between 1860 and 1870, ushering about 300,000 women into the work force who might never have sought jobs before (Massey 151; Kessler-Harris 75-76).

Although women's employment opportunities and interactions in business broadened to include options previously considered improper for women's participation, many of these new employment opportunities proved to be short lived without any permanent positive changes in broadening women's employment opportunity after the War was over. They were "last hired, first fired, least paid," according to feminist historian Gerda Lerner (Lerner, *Female Experience*, 273). But for women inventors, changing opportunities fueled them to invent in new directions, and this trend continued to increase consistently after the War was over. Through exposure to dominate forms of business structure, innovative and established systems of commerce and, most importantly, industrial manufacturing development, women inventors began to carve out new fields of inventive activity which led to sustained and increased production in post-Civil War America.

According to women's labor historian, Alice Kessler-Harris, "A variety of factors pulled and pushed women into the work force, and individual women manipulated and structured their lives in direct response to their own reference groups as well as in dim recognition of a larger social ideology" (Kessler-Harris 108). Like other women in the burgeoning work force, women inventors were

pulled and pushed by the prospect of economic profitability. Some invented things relating to their new forms of employment. And in their jobs, many women found new social relationships with other working women, some of which would later surface in organized solidarity in women's unions. From these early enclaves of working women, especially those working in the industrial sectors, women inventors began to sense a changing social ideology. Reception to their inventions was increasingly more favorable and economic diffusion more successful. A new respect and credibility loomed ahead for women inventors. It pushed and pulled them into new and successful arenas of technical creativity.

Their newly expanded occupational opportunities supported untapped industrial creativity on two premises. First, many 19th century famous basic inventions were invented by men who had little or no technical knowledge and who invented things outside of their occupational field. Instead of acquired technical knowledge these inventors brought an outside practical knowledge which facilitated a fresh and unhampered outlook on the problem (Rossman *Industrial* 144). [8] This theory supports a seeming contradiction of how women's increased inventive activity was possible without technical experience or education. Most women did not have prior technical knowledge or any kind of career experience which would have integrated them into the work force had it not been for the War. They were initially ignorant of inside business traditions, standard theories of operation and lacked direct practical mechanical experience and education. Given the widespread variety of women's inventions during the Civil War era, being previously outside of the workforce paradoxically proved to

be a stimulus for increased industrial creativity. Dr. Joseph Rossman, lawyer, chemical engineer, U.S. Patent Examiner, author and Doctor of Psychology, maintains that even in the 20th century about half of all inventors invent outside of their given occupation because of the absence of prior preconceived knowledge which limits and stagnates new thought (*Industrial* 144-147).

The other half "usually confine their inventions to their specific occupation" because, "their job is to improve what is already being used and consumed . . . they are motivated primarily for economic reasons" (146). This second premise of inventing for economic motivation was a standard motivation for women even prior to the Civil War. This premise, in addition to the theory that the other half invent outside of their occupation because of innovative insight, both support why this first significant wave of women's increased inventive activity occurred during the Civil War era, a period which underwent an alteration of the division of the labor force, promoting new opportunity and access for women inventors.

Industrial development and the pursuit of technological advancement was an acknowledged social ideology in previous generations, one that severely circumscribed women's participation as producers. But against the backdrop of the Civil War, this ideology elicited a direct response from more than 350 women inventors with increased favorable reception from traditional male sectors. Women inventors were part of emerging work force patterns which introduced a "changing set of economic realities intersected with conventional expectations of women's roles, sometimes mocking cherished beliefs, other times reinforcing

them - - bending here and twisting there" which ultimately produced a fertile bed of technological creativity among women (Kessler-Harris 109).

Such increased and varied technical creativity was due, in part, to the bending and twisting of conventionally defined sex roles which catapulted women into new forms of employment. Nineteenth century historian and author, Helen Campbell, wrote in her 1893 expanded prize monograph for the American Economic Association, *Women Wage Earners*, that ,

> Up to the time of the Civil War, aside from factory employments, the trades open to women were limited, and the majority of their occupations were still carried on at home, or with but few in numbers, as in dressmaking-establishments, millinery, and the like. With the new conditions brought about at this time, and the vast number of women thrown upon their own resources, came the flocking into trades for which there had been no training, and which had been considered as the exclusive property of men. A surplus of untrained workers at once appeared, and this and general financial depression brought the wage to its lowest terms; but when this had in part ended, the trades still remained open. At the close of the war some hundred were regarded as practicable. Ten years later the number had more than doubled, and to-day we find over four hundred occupations; while as new inventions arise, the number of possibilities in this direction steadily increases (101-102).

In opposition to Kessler-Harris' observation about declining employment opportunities after the war, Campbell suggests that the alteration of the division of labor and the changing composition of the work force continued to present expanded employment opportunities afterward. It is of interest to note her observation here that new technology expanded further possibilities for women's employment. This idea functioned conversely for women inventors as more

overcame gendered assumptions about women's technological capabilities and patented their inventions. The more exposure they got to new industries and other professional secular environments, the more motivation and inspiration they had to invent. They experienced first hand the mechanical and practical needs of industrializing America. As Rossman substantiated, the psychology of the inventor leads half to produce innovations which enhance and improve their own employment. Such increased job opportunities significantly expanded the range of women inventor's technical creativity into fields once relegated as exclusively male, and in some cases, may have secured improved working conditions for themselves and co-workers by their technological contributions. [9]

Employment accessibility and opportunity expanded traditional forms of women's employment and "opened a few unusual opportunities in less traditional businesses and professions" (Rable 129). For example, traditionally women were involved in benevolent associations in antebellum years. For the most part, this work was not wage earning employment, but consisted of volunteer sewing circles, church societies, and town meetings (Young 68). During the War this kind of volunteerism increased dramatically for both Southern and Northern women. They supported aid and relief organizations by organizing, administering, and producing badly needed supplies such as bandages, articles of clothing, food packages, and medicine (Young 69-71; Culpepper 245-250). [10]

Before the War, some women had also worked as nurses and teachers, but the War witnessed an increased number of women entering in these professions with an expanded range of opportunity and an increased level of social status

(Faust 82-88;92-113; Clinton 97-113). Others had previously worked in factories, and likewise, the number of factory operatives increased during the war years, especially in the sewing and textile factories and in arsenals (Massey 142-149).

Still other women increasingly entered into those formerly considered "unusual and less traditional" lines of work. Such lines of work included actresses, dancers, lecturers, soldiers, spies, traders, dealers, sales clerks, government workers, and prostitution and other illegal activities (Massey 78-86; 131-133, 150-151, 253-255, 262-263). More women also worked in what might be termed entrepreneurial fields due to the absence of the men who formerly operated such businesses. Accounts include female lumber mill managers, lumber inspectors, ferry operators and steamboat captains, ship builders, teamsters, light house keepers, metal manufactures, pawnbrokers, bankers, brokers, and morticians (Rebel 129; Penny 214-233, 405, 486; Massey 152; Culpepper 273).

Wage earning women were part of an emerging work force pattern which included some elements common to all women in varying degrees. Large numbers of women entered the work force for the first time because of new economic realities. They also began to have less children, consequently shrinking the size of the average household. [11] In addition, changes in household technology accompanied the changed family composition and the increased numbers of women working outside of the home. As these technologies became more widely available, they caused a decrease in household production. Women

began to buy things like soap, candles, clothing, and some food items that they used to produce in the home (Kessler-Harris 109-111). Commercial workforces began to produce what was previously home production. Women participated in the increased production as well as consumption of these products. All of these realities contributed to re-shaping of conventional standards, making it more and more acceptable for women to seek employment outside of the home. Prior to the Civil War,

> ". . . women divided themselves into those who did and those who did not leave their homes to engage in wage labor. After the war, daughters of impoverished southern farmers took their places in the urban labor force, as did black women. And genteel widows, North and South, broke through barriers that had discouraged well-educated and affluent women from seeking jobs... A neat pattern of urban and industrial expansion from east to west shattered into explosive fragments--showering factories, offices, and opportunities over the map" (Kessler-Harris 108).

Industrial and urban expansion also contributed to the rise in the number of women inventors and in the expanded range of their inventions. As opportunities opened up for female wage earners, women were exposed to new factory, office, manufacturing and trade environments, many of them in the earliest stages of mechanization. Along with the male work force, increasing numbers of women experienced first hand the pressing need to improve production and efficiency. In addition, many women personally experienced the devastation and primitive conditions of war (Culpepper 167-177). An atmosphere stimulated by accelerated technological development pulsed on both sides of the Mason-Dixon line. For the first time in American history, the

demand for greater manufacturing productivity included women inventors as significant and valuable contributors.

Not only do the numbers jump significantly after 1850, but also the kinds of inventions that women are patenting increase significantly. According to the 1888 patent office census of women inventors prior to 1850, two thirds of the 30 patents could be categorized as domestic, including such items as corsets, stoves, bellows, a fire place, broom brushes and a sad iron. The remaining third of patents were industrial and/or manufacturing applications. Most notably, several of these pertained to the straw hat industry during and after the War of 1812 as discussed in Chapter 2.

Between 1850 and 1870, the 350 women's patents still included a predominance of domestic inventions, but with a tremendous increase in variety. There were still, of course, numerous corsets, but additionally there were many different kinds of clothing items, including shoe soles, stocking supporters, ladies hoods and headdresses, hoop skirts, military caps, clasps for boots, shoes and belts, and collars to name just a few (LWP).

Beyond clothing, domestic inventions included more than a dozen child care related items for the first time, such as bottles, a baby jumper, toys and children's furniture. Food related inventions also included increased innovations with things like a process for fruit extracts, manufacture of vinegar, a method of preserving eggs and a process for manufacturing cheese. Numerous medical, health, and hospital aides appear for the first time on the list which include a variety of medicinal compounds, including one for the cure of cholera and an

improved nitrated mercurial ointment. Other examples under this categorization included a medicine-spoon and bottle-stopper combined, an invalid chair, an ambulance, a hospital bed and several specific women's health aides such as pessaries and mammiform breast-protectors (LWP).

A number of unusual and curious miscellaneous inventions also appeared on the list in this 20 year span which do not fall clearly into a domestic category or any other well defined category. A sample of the range of these inventions offers insight regarding the divergent kinds of things women were inventing. Such inventions included a corpse preserver, composition fuel, an extension traveling bag, sunshades for horses, low water indicators, fire alarm thermometers, and photography innovations (LWP).

Perhaps most significant, though, was the increased variety of mechanical and industrial inventions. These technological innovations fell clearly outside of any domestic application and suggest a period of social flux in women's relationship with technology and an increasingly positive reception toward such changing perimeters. They exemplify not only an expansion of a pre-existing category, but many of them denote new fields of technical creativity altogether for women inventors. The following represents a sample of some of the more than 65 industrial and mechanical inventions women produced during the Civil War era: reaping and mowing machines, plows, improved locomotive wheels, a war vessel, furnace for smelting ores, machine for weaving cords or coverings around cords, braiding and spinning machines, tatting shuttles, a plastic composition, apparatus for punching corrugated metals, machines for weaving hair for wigs, & etc.,

fluting machines, construction method for screw-propellers, porous porcelain, machine for cutting wax for artificial flowers, improvement in desulphurizing ores, improved material for packings and bearings, a paper feeding machine, and a mode of preventing the heating of axles or journals (LWP).

Women also invented mechanized domestic technologies including nearly 20 improvements to the sewing machine, numerous washing machines and a dish washing machine. Sewing machine innovations were especially valuable to the war effort, as clothing was essential equipment for the military. It has been estimated that the North experienced a real advantage on this front with the invention and utilization of the sewing machine innovations in the already extensive ready-made clothing industry. "The output of sewing machines doubled between 1860 and 1864. With a sewing machine, shirts could be made twelve times as rapidly as by hand" (Oliver 281; Gies 278).

Beyond the obvious technological value of their contributions, it is significant that women invented more prolifically and with a much wider scope of application during the Civil War than ever before. It suggests shifting boundaries in the relationship between women and technology which developed through an increased knowledge base and more freedom in social choice to pursue occupations previously restricted to women's participation. The War encouraged women's participation in active and powerful roles because of the need for a productive work force. Women inventors brought desperately needed new technology to the front line on more than just the battle field. Their inventions fortified sagging economic resources. They did not challenge, but integrated and

supported, the masculine world view wherein economic and political survival was intrinsically connected to military strategy resulting in favorable reception of their patriotic and valuable inventions in support of the cause.

Because of this prevailing cultural reception, women's mechanized and/or industrial inventions were considered more valuable. As in the case of Martha Coston, who although faced discriminatory obstacles that male inventors did not face, she experienced profitable success. If she had invented and marketed an improved window sash, mincing knife, or dust pan, her story, like the inventors of those devices, would have perhaps not merited the same notoriety or value. [12] Even though all inventions require knowledge, whether practically or professionally acquired, and all inventing activity requires choices about tools, processes, and marketing, mechanical and industrial inventions have culturally been deemed more valuable based on a gendered system that reinforces male values as superior, especially during war-time. Inventions like the pyrotechnic flare and code system, improved planking for war vessels, screw propeller construction (used in early submarines), reaping and mowing machines and other agricultural and industrial types of inventions fit into an established area of technical activity, in which significance was evaluated on gendered criteria.

The economic and technological significance of these inventions went hand-in-hand with the changing cultural significance of women's place in Civil War society. Campbell, believed that "the United States Census for 1860" showed the "first really definite statements as to the occupations of women and children" because in preceding years "no such needs as those of the mother

country pressed upon us" (96). The "blankness of this period" persisted because not many occupations were open to women, generally not enough to merit serious national occupational censuses. But the demands of the War shaped the needs of the mother country, and they outweighed the needs of preserving a male dominated work force.

Dr. Emily Blackwell, one of the first women physicians in America, commented on the dearth of opportunity for higher work for women in the early national period. She wrote,

> Women were hindered at every turn by endless restraint in endless minor detail of habit, custom tradition, etc... Most women who have been engaged in any new departure would testify that the difficulties of the undertaking lay far more in these artificial hindrances and burdens than in their own health, or in the nature of the work itself" (Campbell 97).

The cultural barriers women inventors faced in antebellum America were artificial in the sense that they had no merit or basis in fact. But they created very real hindrances and burdens based on gendered assumptions that women were either inferior or incapable altogether to "work" with machines or in any capacity which placed one outside of the protective confines of the home. Particularly on point is the astute observation of historian Witold Rybczynski. He noted that,

> ". . . the relationship between technological innovation and economics is hardly one of cause and effect. Just as technology is not governed by an internal imperative, neither is it ruled by a narrow set of economic conditions. This is not surprising if one considers that the application of technology ultimately involves society as a whole, and that technology is not just a constraint on culture, it is itself a part of culture" (221).

In agreement with Rybczynski, women inventors were not ruled or restricted by economic conditions alone. Their inventions, particularly during the Civil War era, became a cultural constituency that pressed the existing limits of women's narrow relationship with technology.

A suggested corollary surfaces between the expanded employment opportunity and the increased types of inventions. In 40 years of women's inventive history between 1809-1849 compared to the 20 years between 1850 and 1870, we see a dramatic increase in patenting activity which corresponds to a period of increased employment opportunity. Many women were entering the work force for the first time, and, correspondingly, we see many first time occurrences of specific kinds of inventions by women. A speculative correlation is prompted between these employment types and patented inventions from 1850 - 1870 as illustrated in the following brief sample:

Employment	**Patented Inventions**
mortician	Mary E. Mott, corpse preserver, May, 1868
hospital, aid societies	Clarissa Britain, ambulance, August, 1863; Sarah Hussey, hospital table, May, 1865; Lucy Broad, improved disinfectant, Sept, 1866; Hannah Conway, hospital bed, Feb, 1868
lumber industry	Rebecca Sherwood, improvement in reducing straw and other fibrous substances for the manufacture of paper-pulp, Dec, 1864
shipping/railroad transportation	Mary J. Montgomery, war-vessel, Jan, 1864 & locomotive wheels, May, 1864;

	Temperance P. Edson, inflator for raising sunken vessels, 1865; Henrietta Vansittart, method of screw propeller construction, May, 1896
steel & Iron manufacture	Eliza Jane Hall, furnace for smelting ores, Mar, 1864; Elizabeth Burns, improvement in desulphurizing ores, 1870
machine manufacture	Mary Carpenter, ironing and fluting machine, 1862; Catherine Corbet, fluting machines, Apr, 1869; Mary J. McColl, machine for cutting wax for artificial flowers, Feb, 1870
printing industry	Margaret Knight, paper feeding machines, Nov, 1870
misc. manufacture	Mary Hurley, needles for canning chairs, July, 1866; Nannie Hunter, improvement in manufacture of soap, Oct, 1867;Catherine E. Howard, manufacture of artificial flowers, Mar, 1869; Eliza D. Murfey, May, 1870, material for packing journals and bearings

This correlation suggests as women expanded their fields of employment in expanded range of industrial capacities, increased numbers began participating as producers (inventors), not just consumers. The socio-economic conditions surrounding the Civil War marked a period of increased inventive activity through increased employment opportunities and shifting standards of women's roles. This reflects a social imprint "that the application of technology ultimately involves society as a whole, and that technology is not just a constraint on culture" (Rybczynski 221). What women invented during the Civil War began to

challenge the gendered assumption that women: (1) could not invent and (2) if they did, it had to be something in the domestic field.

Although the assumption was challenged, it was not dispelled. Persistently, the general perception remained the men were the most capable, therefore, important inventors, and the image of the inventor was not altered to include a female dimension. Even though women were functioning in productive industrial roles, they continued to be seen and perceived as consumers. For example, women who participated as producers in the iron and steel industry, such as inventors Eliza Jane Hull (#41,989, improved furnace for smelting ores, 1864), Elizabeth Burns,(#100,497, improvement in desulphurizing ores, 1870), and ironmaster, Rebecca W. Lukens, left evidence of their legacy and involvement in the burgeoning steel and iron industry. Hull and Burns left patent records and Lukens left biographical and business records.

In the case of Rebecca W. Lukens, by her death in 1861, she was known as a successful ironmaster "whose achievements had mounted with the years, whose progress had been identified with the progress of her times" (Stern 248). [13] She wrote that "the manufacture of iron is not a mere local or individual interest, but is of national importance, . . . affording a supply of a chief element of progress in time of peace, and an important engine of defense in time of war" (Stern 250). In her life's work as owner and operator of Brandywine Mill in Coatesville, Pennsylvania, she acknowledged that application of technology and her relationship with such was molded by cultural factors, such as a spirit of national progress and a patriotic duty of defense. What relationship to the iron

and steel industry inventors Hull and Burn's experienced is unknown at this time. Only their patent records provide evidence of their contributions.

But again neither Luken's life experience, or Hull's or Burn's contributions, significantly changed the perception of women's relationship to the steel and iron industry. In John Oliver's standard History of American Technology (1956), in his discussion "On the Eve of the Civil War" he notes the following regarding the steel and iron industry:

> The improvements and refinements in iron technology brought the use of steel within the reach of every one, even the ladies. A new process for tempering a cheaper grade of steel was invented which provided steel hoops of light weight, great toughness, and elasticity, in the crinoline age, enabling the women from families of limited income to be dressed in the height of fashion. The output of tempered wire for crinoline skirts amounted to several tons annually (269).

Oliver seems amazed that "even the ladies" had something to do with new iron technology. How wonderful, he seems to say, that it served to make it more easy and economical to conform to fashion dictates, possibly placing women at the height of fashion! The persistence of women's perceived narrow relationship with technology did not abate during the Civil War era with their increased inventive activity, their expanded employment opportunities or changing social roles. Rather, the perception that men produce and women consume persisted and has been consistently reinforced through standard 20th century histories of technology.

Perhaps what might dispel such persistent misconceptions and remedy the bias in which most histories of technology are presented is the missing data, the

elusive biographical data, in the above corollary between women's employment types and inventive activity. What circumstances, family connections or business relationships placed them in their field of inventive activity and in their traditional or non-traditional employment? We have some biography on Lukens from her own writing and from a good collection of business records. [14] But she was not an inventor, although she did share some kinship with women inventors in that she was a woman of significant accomplishment in a male dominated technological progressive industry. We do not know, though, what Clarissa Britain was engaged in professionally that compelled her to invent an ambulance for battlefield use? Or did Mary Mott, inventor of a corpse preserver, in fact, work as a mortician? Was her family engaged in the undertaking business? Did she "set-up" business as an itinerant mortician at the edge of battlefields? (Bowen 79) Was Temperance Edson working with the military in some official or unofficial capacity when she invented a system for raising sunken vessels? Did she have a salvage business or some personal stake in a sunken ship?

Like the biographical recovery of these three women inventors, most women inventors biographies are in the earliest stages of documentation, if at all. They have yet to be given serious historical attention or scholarly credibility that such investigation merits. The value of such an undertaking has been noted by historian, Judith McGaw, in her review of the only three book length treatments of women inventors. [15] She encourages scholars to pursue biographical scholarship of women inventors, because,

> New work on great women could benefit more than these books have done from the example set by the many fine studies of technology's great men. One elementary lesson of that literature is that creativity is far too complex and idiosyncratic and, indeed, still too poorly understood for the superficial study of numerous cases to yield much insight. There is good reason why biography has predominated in this area of scholarship (*Inventors* 225).

McGaw clearly sees the merits that women inventors' biographies would have in "challenging the popular conviction that women did not invent," but, on the other hand, she does not make the distinction between male and female inventors biographies when she notes that biographies have "the added advantage of being a highly accessible form of historical writing" (225). For women inventors, particularly 19th century women, accessibility to biographical data is the uncommon exception (i.e. Martha Coston's autobiography). But the pursuit of that highly illusive information is due critical scholarly attention by future historians as it would, no doubt, yield valuable insight into "how the gender system has influenced who invents" (225). The potential of such a rich resource would be immense in placing women inventors into historical context, as in the subject at hand, the Civil War.

For example, the few biographical details we have in placing Britain's ambulance in context of the historical context of the Civil War, pose more questions than answers at this point. But they do reinforce the potential that such information would surely lend insight into women inventors relationship with technology and the gender valued system in which they were evaluated. Britain's life holds particular promise of shedding light on how the gender system has

influenced women's inventive activity as she is one who might be classed as a professional inventor with seven known patents to her name. [16]

Her ambulance, her second patent dated August 11, 1863, holds particular interest in understanding the social context that promoted its invention, its war-time application and its manufacturing history. Was she involved in a relief organization that put her in close proximity to a battlefield, witnessing first-hand the need for such a vehicle? Or was she employed in some vehicle-related occupation or in the geographic region where such manufacturing was centered? All of these questions pose valid possibilities based on the available sources.

For example, Clarissa Britain was known to have been head of the Niles Female Seminary in Michigan in 1843 (*History of Berrien and Van Buren Counties* 268). The school was advertised in the *Niles Republican* in 1843 as place that "parents wishing to give their daughters an education, can find no more institution more desirable, or place them under a person better qualified for the duty." At some point (date unknown), she left her position at Niles Female Seminary and moved to South Carolina to teach (Macdonald 19). Was it her occupation as a teacher that caught her behind Confederate lines when the fighting broke out? If so, she couldn't have picked a more volatile state to witness the erupting of war between the states as South Carolina was the first state to secede on December 20, 1860, and the first to experience attack at Fort Sumter on April 12, 1861 (Garraty 249, 253). She may have witnessed the movement of wounded men from the battlefield, like the following anonymous woman, who described

her work at Stoneman's Station in a letter from the Chicago Historical Society collection.

> I am very tired, as until last night, I have not laid on a bed or undressed myself for six nights. . . we took possession of a little old house in the field with the ambulances. As the battle had commenced we wrote a note to the Medical Director of the 5th Corp, telling him we were there with supplies. Soon came an "orderly" bringing a note, requesting to have a supper ready as soon as possible for an ambulance train containing about eighty wounded men . . . (Culpepper 254).

Was it her brother's death in 1862 that prompted her to come back to Michigan where she handled his affairs as administrix of his estate? And possibly enroute, did she witness such an ambulance train, noting their primitive and inefficient design as captured in some surviving Civil War photographs? [17] What, when, and why she was in South Carolina or in what other way geographically or occupational she was connected to the war, would certainly yield valuable information in accessing the social context of her inventive activity.

The purpose of her invention is clearly in support of the war effort and demonstrates that she had some specific knowledge about the need to get the wounded quickly and efficiently off the battlefield to a place of safe treatment. In her patent specification to the United States Patent Office she related, in part, that,

> This invention relates to certain new and useful improvements in ambulances for the removal of the wounded from the field of battle to safe quarters, where they may receive immediate surgical aid.
>
> The invention has for its object the construction of a safe, cheap, and comfortable ambulance which will admit of being taken apart and packed in a very small compass for

> convenient transportation, and which may be easily erected again when occasion requires, the whole arrangement being adapted to the wants and necessities which arise in the transportation of the wounded about the field, and to hospitals which may be remote therefrom, all as will be hereinafter described (No. 39,460 dated August 11, 1863).

After a thorough mechanical description, the official patent specification concludes with the defense by Britain that,

> I have obtained a means whereby I am enabled to erect a frame in a common wagon-body in a few minutes which will serve as a comfortable support for stretchers; and these stretchers, with the wounded lying upon them, can be placed in this frame and conveyed from the battlefield to the hospital to receive surgical succor. It is not proposed that the wagons themselves should be brought upon the field, but they should be left in the immediate vicinity in a secure place... (No. 39460).

Like the woman at Stoneman's Station, Britain was more than simply aware of military strategy involving the removal of the wounded from the battlefield. Some experience, whether as an astute eye-witness, in some capacity as a relief worker, or something quite unpredictable, motivated her to invent something clearly outside of a domestic categorization. She was not, perhaps, content to tend and nurse the wounded as thousands of women did, but she sought a technological solution to improve their medical care. She was not ruled or restricted by economic conditions alone, but experienced the war in a cultural context.

What Britain did back in Michigan during the War is equally unclear. We do know that she was born in 1813 to a rather politically prominent family in St. Joseph, Michigan. Her father, General Calvin Britain was one of the pioneer settlers who originally plaited St. Joseph in 1827. He later served as President of

the village offices in 1835 and from 1832-1835 he served as a member of the legislative council of Michigan Territory. He died in 1840. Her brother, Calvin, was a Representative in Michigan Legislature in 1847, 1850, and 1851 and the next year served as the Lieutenant-Governor of Michigan in 1852-53 (History of Berrien and Van Buren Counties 148, 149; 312). He died in 1862. There is no mention of her mother (Myers 9/16/96). As a single women, it can be assumed that these family connections afforded her some measure of affluence and elevated social status in her local community, but it is not clear if they afforded her any financial security.

After 1862, she appears not to have any male relatives who might have supported her and the need to support herself at the age of 49, may have been what compelled her to a invent so prolifically in the next two years. Her first patent for a floor warmer was taken out on March 10, 1863 and her last patent for lamp burners was granted on September 27, 1864, totaling seven patents altogether. If she continued in the teaching profession or went on to some other occupation during or after this period of inventive activity is unknown. The corollary between her employment and inventions remains unsubstantiated.

According to historian Ann Macdonald, "since assignment files at the National Archives yield no evidence of transactions for the sale of rights to any of her seven patents, one can assume that Britain never benefited financially from her ingenuity" (20-21). But to date, it has not been possible to verify this source, and if Britain's probate records are recovered, a very different story would be revealed if she was, in fact, receiving any patent royalties. Suspicion of

Macdonald's assumption arises, in other part, because of Britain's geographic relocation. Her last listed address in handling her deceased brother's affairs was dated January 28, 1867, which stated that she lived in Kenosha County, Wisconsin (Myers 9/16/96). It raises the question that such a move may not have been coincidental due to the fact that Kenosha was a transportation manufacturing center and was the home to such firms as Bain Wagons, Mitchell Wagons, American Motors and the Nash Motor Company, who later manufactured the first motorized ambulance. This would be a logical place for an inventor of an ambulance to do extended business.

It is also of interest that Cordilla Harvey of Kenosha, WI, started the first federal hospitals during the Civil War to transport men off the front lines and care for them at remote hospitals. Was Britain in any way connected with Harvey or the transportation manufacturing business in Kenosha? Comprehensive biographical research would surely bring to light some of these missing pieces. Such evidence would certainly help to place women inventors like Clarissa Britain in a larger social context explaining if and how women's participation in technology was accepted and rejected based on gendered values. And as McGaw suggested, accurate biographical data would challenge the persistent conviction that women did not invent.

Woman inventors such as Britain, Coston and Montgomery, along with 350 other women did, in fact, invent a wide variety of things during the Civil War era. The Civil War provided a springboard from which many women leaped beyond the circumscribed woman's sphere into that heretofore reserved for men

(Massey 367). Increased employment opportunities expanded women's social roles and provided access to technological development. They functioned as significant producers of Civil War technology, not just as consumers. This proved to be a time of accelerated technological development, especially in the northern and eastern states, and has been considered by some to have been a "turning point in many technological advances. It was the first struggle in which science and machinery played a dominant part, and it was the first time that technological innovations and improvements were applied on a large scale in a major war" (Oliver 276). What and how much women invented during this time period successfully challenged the assumption that they were incapable of producing significant technological advances across diverse inventive categories.

Women continued to invent predominantly in the domestic field, but they consistently contributed inventions over an increased technological range, far afield from their normal conventional domestic activities. Due to the preponderance of domestic inventions, though, these continued to overshadow women's mechanical and industrial inventive capabilities. Increased numbers and types of invention did not significantly change the prototypical image of inventor as male but rather, the emergence of women inventors in fuller numbers with expanded capabilities began to change the reception to women as inventors. Earlier unyielding gendered assumptions about women and technology began to change, shaping and carving out expanded social roles for women. Women inventors joined the ranks of women who supported the war effort in ways previously considered socially unacceptable.

These subtle social changes, fueled by a heightened sense of patriotism, marked a time of "beginnings and not fulfillment" (Massey 23). Both Northern and Southern women realized and accepted that they lived in a man's world and did not at this time challenge that social order. The women's movement would not gain serious support or momentum until almost a generation later. But those women who lived through the Civil War era "shared their men's principles and prejudices" and responded to the battle call with newly forged social tools (Massey 24). Their unprecedented activity in both traditional and untraditional roles produced the first generation of women inventors, who, like others, challenged and defied convention to enlarge women's social, economic and political roles. Much of this development transpired under the emotional guise of fervent patriotism which reinforced a masculine viewpoint of economic and political survival. Military strategy demanded technological innovation with the clear understanding that technological dominance would be a decisive element in winning. And it was (Oliver 276). This sentiment is exemplified in the words of Secretary of War Edwin M. Stanton when he said, "The reaper is to the North what slavery is to the South . . . Without McCormick's invention I fear the North could not win and the Union would dismembered" (Gies 280). It wasn't just advancement in agriculture, though, that turned the technological tides in favor of the North. Advancements in food preservation and packaging, textile production, clothing manufacture, transportation, medical and surgical equipment, machine tools and engine improvements, in addition to the obvious fire arms and other

military developments, also played a pivotal part in the victory (Oliver 269-274; Gies 278-290)

This need for stimulated accelerated technological development went hand-in-hand with increased manufacturing demands. Such war-time circumstances forced a re-ordering of the social prescription which insisted that women join the labor force outside of the home in new capacities. As employment opportunities slowly expanded, the social landscape took on new shape, contorting old conventional standards where women were limited by domestic boundaries.

Their function as inventors and their inventions merited increased recognition with notable public national recognition for the first time in the Philadelphia Centennial of 1876 and later in the Chicago Colombian Exposition of 1893 where women inventors exhibited separately in the Women's Buildings (See Chapter 6). What women invented during the Civil War and their increased number of inventions bears the imprint of social context as all invention and innovation occur in a social context . Our technology is a symptom of our culture, not vice versa, and reflects the human preoccupations of its time (Rybczynski 222-223). From 1850-1870 our country was preoccupied with the Civil War. Technological advancement was not only a means to an end, but was then, and remains now, a complex human activity involving cultural and social precepts as well as intellectual and mechanical principles. Women inventors responded with unprecedented inventive activity which set the pace for future women inventors during the rest of the 19th century.

This accelerated pace of inventive activity melded with other social changes which benefited women inventors as women collectively demanded higher education, participated in forming women's clubs and professional organizations, and in the movement for legal entitlement (Culpepper 391-393). Technological progress after the Civil War continued to witness exciting and dynamic inventions such as the telephone, electric lightbulb, and automobile, and women continued to contribute their inventive talents on these new technological frontiers. The Civil War reshaped the paradigms of the scope of women's inventive activity and contributed to their emergence in the national technological scene. Women inventors during this time forever bear the imprint of that momentous social drama.

Chapter 4 - NOTES

[1] For a comprehensive view of Civil War women and their expanding work opportunities outside of the home, see Jeanie Attie's article "Warwork and the Crisis of Domesticity in the North" in *Divided Houses*, Clinton Silber.

[2] L.P. Brockett's and Mary C. Vaughan *Woman's Work In the Civil War: A Record of Heroism, Patriotism and Patience* (1867), George C. Rable's Civil Wars: Women and the Crisis of Southern Nationalism, Chapter 13, "The Janus-Faced Women of the New South", and Marilyn Mayer Culpepper's, *Trials and Triumphs: Women of the American Civil War* , Chapters 7 and 8, "Much to Do - Part I" and "Much to Do - Part II" provide solid documentation for the conclusion that women systematically moved out of the home and into formerly male occupied lines of work in order to support themselves and their families while their men were away fighting.

[3] According to Civil War historian, Kenneth M. Stampp, "1857 was probably the year when the North and South reached the political point of no return---when it became well nigh impossible to head off a violent resolution of the difference between them" (viii). It proved to be year of dramatic tension punctuated by such momentous events as the Panic of 1857, the Dred Scott case, and the Lecompton Constitution.

[4] According to the LWP from 1850 - 1870, the following medicine/hospital inventions were patented by women: 2 bandages; 5 abdominal supporters; 1 vapor bath, 1 disinfectant; 1 corpse preserver; 17 various medical compounds; 1 ambulance; 1 eye water; 1 drinking cup for the sick; 1 hospital table; 4 hospital beds; 1 medicine spoon and stopper.

[5] See Susan C. Bourque and Kay B. Warren's article "Technology, Gender, and Development" for a contextual discussion of the "Feminization of Technology" and "Appropriate Technology."

[6] Caroline Eliot Kasson referred to the many social changes produced by the Civil War in women's world as "a grand convulsion in society." Kasson was in Washington D.C. in 1861 and observed and "recorded the innumerable social changes which took place in the capital throughout the war" in her memoirs, *An Iowa Woman in Washington* (Massey 242, 245).

[7] According to historian Mary Elizabeth Massey, the greatest increase of women workers was a 33.4 per cent increase in "personal services," which

included many former slaves or recently arrived immigrants not listed in 1860. Women employed in industry rose by 16.5 percent, making the 7.3 per cent in trades and transportation considerably less in overall comparison (Massey 151-152).

[8] Dr. Joseph Rossman cites the following examples of important 19th century inventions by men who had very little technical knowledge in the field in which they invented: "Richard Arkwright, the inventor of the spinning-frame, was a barber; Edmund Cartwright, the inventor of the power-loom, was a clergyman; James Watt, the inventor of the improved steam-engine, was a maker of scientific instruments; Robert Fulton, famed for his steamboat, was a portrait painter; Eli Whitney, the inventor of the cotton-gin, was a lawyer; Morse, the inventor of the telegraph was a landscape painter; Bell, who is identified with the telephone, was a teacher of deaf-mutes; J. and W. Hyatt, inventors of celluloid, were printers; William Armstrong, the inventor of the hydraulic engine, was a lawyer. What these men did have in common was "an intense urge to contrive...a decided bent towards mechanics...as well as the capacity for drudgerous detail and prolonged intense effort (143). While these characteristics are cast in masculine imagery, when gendered assumptions are set aside, they have distinct application in the lives of women inventors.

[9] Inventions especially related to industrial safety issues suggests this precept (i.e. Harriet Tracy, safety elevator; Harriet D. T. Wilson, fire escape; Augusta M. Rodgers, fire-prevention devices for railroads; Eleanor A. McMann, safe guards for sleeping-car births; Maria Beasley, life rafts (Stanley 447-449,487-488, 495).

[10] Women began to organize with incredible speed and efficiency from the spring of 1861 and throughout the War. Historian Glenda Riley notes that by the "end of 1861, there were approximately 20,000 women's aides societies in the United States and the Confederacy." The following examples illustrate their activity: "Organized in 1862, the Weldon, Pennsylvania, society contributed $17,000 in goods in one year. In one month in 1863, the Center Ridge, Alabama, group sent "422 shirts, 551 pairs of drawers, 80 pairs of socks, 3 pairs of gloves, 6 boxes and a bale of hospital stores 128 pounds of tapioca and $18 for hospital use" (122). Records of other relief societies and sanitary commissions are characterized by strong community support and industrious productivity. See L.P. Brockett and Mary Vaughan's, *Woman's Work in the Civil War* (1867) for details regarding women's "contributions, toils and sacrifices...to minister relief and consolation to our wounded and suffering heroes" in which he claims that "two million and three hundred thousand volunteers" participated in relief organizations (56).

[11] "Aggregate figures reveal both a decline in the birth rate and a startling reduction in the number of small children for whom women cared toward the

latter part of the century. ... Between 1860 and 1890 the number of children under five per 1,000 women dropped nearly a third" (Kessler-Harris 110).

[12] See Martha Coston's *A Signal Success* for detailed accounts of various awards and medals given to the signal around the world: 1873, Vienna, Austria; 1875, Chili, Santiago de Chili; 1876, U.S. Centennial at Philadelphia; 1886, International Exhibition for Navigation, Commerce, and Manufactures, Liverpool, England.

[13] Rebecca Lukens was the first American woman to own and run an iron plate rolling mill. She began operation of the nearly bankrupt Brandywine Mill in 1825 at the age of 31 when her husband died (237). Due to litigation problems and property right issues, the mill was not legally hers until 1853. She turned the company around financially and continually stayed abreast of the latest technological developments which kept the company going throughout the 19th and 20th century. Her estate was worth over $100,000 upon her death. She was proud of her life's accomplishment that she had "built a very superior mill, though a plain one and our character for making boiler iron stood first in the market" (Stern 249). Her contributions to the steel and iron industry are profiled in Madeleine Stern's, *We the Women Career First of Nineteenth Century America* .

[14] The resources include an unpublished autobiography, personal correspondence, litigation records and extensive papers of the Lukens Steel Co. at the Eleutherian Mills Historical. Library in Wilmington, DE (*Notable American Women*, 1607-1950, 442-443).

[15] McGraw's Review Essay in *Technology and Culture* focuses on Ann Macdonald's, *Feminine Ingenuity,* Ethlie Ann Vare and Greg Ptack's *Mothers of Invention* and Autumn Stanley's *Mothers and Daughters of Invention* as the only three book length texts on women inventors. Only two of the texts, though, Stanley's and Macdonald's, have historical merit and credible scholarship ("Inventors" 215). Vare's is riddled with factual errors and lacks credible scholarly documentation.

[16] Clarissa Britain's patents:

#37,851	floor warmer	Mar. 10, 1863
#39,460	Improvement in ambulances	Aug. 11, 1863
#40,157	Improvement in boilers	Oct. 6, 1863
#41,274	Improved lantern dinner pail	Jan. 19, 1864
#43,087	Improvement in vegetable boiler	June 14, 1864
#43,088	Improved dish drainer	June 14, 1864
#43,393	Improvement in lamp burners	Sept. 27, 1864

[17] John Bowen's *Civil War Days, Everyday Life During the War Between the States* (1987) includes good photographic history, including one photograph depicting "horse-drawn ambulances of the 57th New York Infantry, 1864" (79).

Chapter 5

NATIONAL RECONSTRUCTION VS. GENDER CONSTRUCTION

Following the Civil War, the nation entered into a period of national reconstruction designated as a time for economic, political, and social healing. Antebellum life was not to be restored, but a new united nation was to emerge reflecting the hard won ideologies of the victor. The Civil War had touched the lives of all Americans "with the most intense fire in the nation's history, sweeping from battlefield to governmental halls, into communities and homes" (Paludan 376). As the fires of war smoldered and went out during the spring of 1865, new fires of contention were already kindled. Peoples lives continued to be shaped by forces the war had unleashed. Four million slaves were freed and slavery was no longer an issue. But freedom did not eliminate racism. Rather, it remained a powerful force in the new nation and continually factored into the relationship between freedom and equality (Paludan 382, 389). Neither did freedom spread across gender boundaries, but rather the quest for freedom for American women continued to ignite fires fanned by flames of inequality. This quest profoundly affected the status, opportunity, and success of women inventors.

With other post-war women, women inventors journeyed into new territory as the nation tried to unify and rebuild itself into a technologically

progressive world power. The foundation for economic growth had been laid by prewar industrialization and improved technological resources which developed throughout the War. Also tools of finance, business, and industry were successfully mobilized and honed during the war. Afterwards, they continued to grow and expand, supplying the country with transcontinental railroads, advanced communication systems, improved agricultural machinery and processes, an improved factory system, and new banking and educational systems. All of these efforts at national reconstruction significantly affected gender construction. But unlike national construction with its lofty aims of unifying a divided and weak country, the construction of gender during post Civil War America was intent on solidifying division.

The division between the sexes was more rigidly defined than ever. The ideals of true womanhood continued to focus on wife and mother, but at a level of elevated status. [1] After the War, many espoused conformity to the ideal woman as dependent, submissive, fragile, and intellectually inferior but still with superior spirituality as the source of her strength. These ideas influenced conventional standards of behavior and attitude to a great degree despite the reality that women had expanded their domestic boundaries during the war to include a broader secular environment. In the midst of this ideological endeavor to return women to their pre-war social status, others countered with a somewhat different set of ideals which historian Frances Cogan refers to as "Real Womanhood" which stressed "physical fitness and health for its models of young

women with its concomitant belief in the spiritual dimensions of health" (Cogan 26). The ideals included demands for extended or higher education, right reasons for marriage, women's duties toward home and family, and attitudes toward employment. Cogan asserts that this ideal both emerged and finally disappeared because of the dual and sometimes incompatible "emphasis on marriage as the norm and active duties" (26). Both sets of cultural standards stem from the same basic premise, that woman was at her best when she took care of home, husband, and children in an exemplary manner. But for many, conventional standards had been forever altered due to their war-time experience. Resistance to reinforcing pre-war gender construction and instituting new standards which elevated the roles of wife and mother to new heights met with opposition from a collective group of women around the country.

For some women, standards had shifted to such a degree during the War that it was neither desirable nor possible for them to return to pre-war status. Women from both sides amply demonstrated that they could perform very capably, even admirably, in jobs, positions, and social contacts outside of the home without the direction of a male head of household. During the War, women challenged spatial boundaries in an unprecedented manner by refusing to accept the idea that war was "no place for women." Instead, they made the war their place by creating positions for themselves and "adjusting their prewar patterns of behavior to fit public, wartime circumstances." Like men, "women declared themselves citizens and patriots who had a right to participate actively." And they participated during the war in "numbers too large and in ways too

unconventional" to ever go back to prewar status (Leonard 198). Women inventors joined the ranks of women who had expanded the private sphere of the home and moved out into public sectors where previously only men had functioned or women had functioned under circumscribed circumstances. Women inventors, like other groups of professional women, were part of the,

> Generations of women after the war [who] would grow up in the context of a revised gender system that reflected the impact of the Civil War by assuming their capacity for and allowing them broader access to professional labor . . . (Leonard 196-197).

With their increased inventive activity after the War, professional inventors such as Clarissa Britain, Mary Walton, Margaret Knight, Amanda Theodosia Jones, Helen Augusta Blanchard, and others, helped to realign social perimeters defining women's relationship with technology and challenged the persistent notion that women did not invent.

The professionalization of women inventors was duly noted by Charlotte Smith, a 19th century public advocate for women inventors specifically and women laborers in general. One of her most important contributions was a short lived journal, *The Woman Inventor*. Although only two issues were published (April & June, 1891), they reveal interesting social context and attitudes about women inventors as a collective group as well as specific names and categories verifying the continued upswing in women's inventive activity.

Despite the success of several women inventors, their status was never recognized in the same light as their male counterparts. A professional woman inventor did not fit the mold of the ideal women. She was generally single and

without children or widowed with dependent children. She invented for her livelihood. Her inventions were often mechanical, mostly commercial, and achieved a standard of technical sophistication with manufacturing potential. She rarely received the same kind of public recognition for her accomplishments as did male inventors. She was considered an oddity and made to feel deviant for pursing unnatural priorities even if her inventions were domestic (Glazer and Slater 6-7). Regardless of the level of simplicity or the practical application in the home, the woman inventor was not categorized as even an ethereal domestic entity. Conventional standards did not elevate a woman in the machine shop, the business world, or the scientific community. Social forces worked to idealize a woman only in the home where her relationship with technology was narrowly defined within a domestic context. This perception continued to undermine the emergence of a female dimension to the concept of inventor. Yet in the face of this seemingly stagnate social climate, women's inventive activity continued to increase and a small number of professional women inventors emerged during the last quarter of the 19th century.

Neither national reconstruction or new gender construction reinvented the prototypical inventor as anything but male, but shifting gender boundaries after the War connected women inventors inextricably to the "woman question" and more significantly, to the answer. Construction of gender patterns which affected women inventors were significantly impacted by developments in the women's movement, increased access and higher levels of education, and the emergence of women's science clubs and societies.

As the century progressed, the women's movement took on new shape and gathered velocity. The momentum of the movement supported a national social reconstruction which demanded a new construction of gender, one that simultaneously resisted and reinforced previously established ideals of womanhood, but agreed that women's basic rights were in desperate need of reform. Women's rights leader, Elizabeth Cady Stanton, in an undated "Speech on Reconstruction" eloquently summed up the basis on which women demanded a new construction of gender:

> Our Fathers declared all men equal, then placed the power in the hands of the few . . . They declared taxation without representation tyranny then taxed all these disfranchised classes. . . From the baptism of this second revolution, with a century of added experience shall we repeat the blunder of the Fathers & build again on the old foundation whose corner stone is class & caste[?] (Venet 151).

The inequity and hypocrisy of the old national order based on "class & caste" was distinctly mediated by sex, and for many women it was no longer tolerable. When the Fourteenth Amendment passed in 1866 enfranchising black men, but not women, the "blunder of the Fathers" darkly foreshadowed the future. Stanton expressed the foreboding that the Fourteenth Amendment generated among women when she predicted, "If that word 'male' be inserted it will take us a century at least to get it out" (Riley 126). Outrage accompanied this overwhelming sense of apprehension as illustrated in the words of reformer Frances Gage when she wrote,

> Can any one tell us why the great advocates of Human Equality . . . forget that when they were a weak party and needed all the womanly strength of the nation to help them

> on, they always united the words 'without regard to sex, race, or color?' Who ever hears of sex now from any of the champions of freedom!" (Riley 126).

Champions of women's freedom did not surface among the new body of lawmakers or the newly organized government but from women themselves. But it would be the second decade of the 20th century until women's rights would experience any significant victory. In the postwar period, demands for new gender construction emerged in two distinct camps. Many women struggled to maintain the changed status quo of women's enlarged sphere while others worked toward returning to their prewar domestic status. [2] The status of women inventors benefited from the former and suffered from the later. During the War, women's experiences revealed "the enormous and varied pressures they exerted on the Victorian gender system . . . , pressures that led to shifts and adjustments at particular points, and that met with rigid intractability at others" (Leonard 197). Women inventors joined those who shifted and adjusted boundaries which opened new doors for women in the professions and in public life. But their contributions, along with other women who entered into the public work force, did not bring about the "demise of the gender system's fundamental structure--its organization around the basic concept of gender boundaries and limits" (Leonard 201). That basic concept was defended and protected with "rigid intractability."

After the War, the idealization of woman reached new heights and found strong entrenchment not only in male consensus but in one of two main branches of the woman's movement which reinforced woman's role as wife and mother. [3] Lucy Stone and Henry Ward Beecher were imminently connected with the

American Woman Suffrage Association (AWSA), which called for women to fulfill the definition of womanhood with expanded application of piety, purity, submissiveness and domesticity (Welter 21; Venet 16-17). Stone argued that women's unique attributes such as compassion, nurturance, and a better-developed sense of morality required representation in the political process and legal structure. She advocated marriage and motherhood like most women, but demanded reform in the contractual legality of the institution. She boldly defied convention when she married Henry Blackwell in 1855 by keeping her family name and entering into a well-publicized marriage contract with Blackwell. Her views about marriage reform were revealed in her marriage contract:

> ". . . no sanction of, nor promise of voluntary obedience to such of the present laws of marriage, as refuse to recognize the wife as an independent, rational being, while they confer upon the husband an injurious and unnatural superiority, inventing him with legal powers which no honorable man would exercise, and which no man should possess" (Riley 115; Kessler-Harris 185).

Stone wanted equality between the sexes to be legislated in marriage. The AWSA differed from its opposition by not advocating the vote as the way to obtaining legal entitlement. This was a main cause in the split in the women's movement in 1869 (Kraditor 3-4).

The other faction of the women's rights movement , the National Woman Suffrage Association (NWSA), was headed by Elizabeth Cady Stanton and Susan B. Anthony. They uncompromisingly advocated the vote, reformed divorce laws and property rights, equal employment and wage standards, and national legislation to protect sexual equality (Paludan 387; Kessler-Harris 95-97; Riley

114-115). They believed that equality lay in political participation which meant throwing off all the constraints of gender stereotyping. The NWSA believed women were strong, intelligent, and independent and should have the right to freely enter into legal contracts, hold any kind and amount of property, and be able compete for fair and equal wages. Stanton disdained the idea of woman's sphere and Anthony believed that the vote was the only way for women to achieve such participation. She felt that, "suffrage involves every basic principle of republican government, all our social, civil, religious, educational, and political rights" (Riley 114).

This split lasted until 1890 when the two factions merged into the National American Woman Suffrage Association (Kraditor 4). But a far greater chasm lay between women's movements as a collective whole and women who did not organize at all. Women who did not support the women's movement for equality premised their life style on pre-war gender conventions wherein women generally worked in a narrowly defined domestic segment as submissive and dependent individuals. For women inventors, this social ferment created an atmosphere where their creativity, especially if it had an industrial application, was still suspect. But on another level, they benefited from the tumultuous atmosphere as gradually attitudes about women and technology were positively shaped and molded by increased opportunities for higher education and the emergence of women's scientific clubs and societies. These developments supported increased inventive activity and the emergence of more professional women inventors with

inventions that demonstrated a consistent level of technological sophistication and economic potential.

For women inventors, access and opportunity to formal higher education would eventually improve their abilities, intellectual range, and professional standards. But even before they began to benefit from an enlarged scientific educational system, the growing acceptance and status of educated scientific women provided a more favorable social climate in which women contributed technologically significant inventions. Through increased and improved higher education, women gradually gained recognition, credibility, and status in the larger scientific community. A summary of the increased opportunities for higher education beginning in the 1870s suggests that more women were admitted to higher learning institutions with increased opportunities for a wider range of degrees (Degler 310-311). For women inventors that meant access to chemistry, physics, and advanced mathematics. How many women inventors actually obtained such degrees remains an important research focus for future study. Such information would help to verify and quantify that the development in women's education increasingly supported women entering into the scientific during the last quarter of the 19th century. What is clear at this time, though, is that some women inventors recognized the need for advanced education and often were at a disadvantage without it.

Change in the educational system slowly evolved. Continually opposition to women's advanced education became a mission to many of its opponents who demonstrated rigorous hostility with their argumentation. Very gradually women

were accepted into institutions of higher learning and new women's colleges were opened. [4] Their presence and their success in such institutions and in previously restricted programs, such as science and mathematics, challenged the social malaise which considered women incapable of advanced scientific comprehension and accomplishment. Although liberal arts curriculums expanded and some of the more influential women's colleges patterned their science curriculum after male counterparts, after the Civil War a "curious dialectic of opportunity and constraint" permeated the missions and philosophical underpinnings of the leading female educational institutions (Rury 3; Horowitz 28; Eschbach 62). [5] The increased educational opportunities did not automatically mean increased job or career opportunities. While women could avail themselves to higher education (particularly if you were white and middle or upper class), the educational goal for most women was still to become a better wife and mother. After the War, this posed an enduring paradox which prevented accelerated social advancement in education for most women, which especially affected women inventors. The persistent opposition to women's education supported by social convention attempted to keep women exclusively in the domestic realm, but yet steadily increasing educational opportunities provided access for more and more women to enter colleges and universities.

The traditional goal of women's education solely for the enhancement of their domestic calling originated in the earliest of women's educational institutions and persisted throughout the century. Early female schools were generally called seminaries rather than academies, colleges or universities. [6] It

has been generally summed up that "boys were taught to read and write" at academies and "girls to read and sew" at seminaries (Marks 91). During the 1840s women were considered educated if they acquired a proficiency in "embroidery, tapestry, singing, and versifying" (Marks 96). And although women's education expanded throughout the 19th century, domestic curriculums remained central in women's education.

For example, the 1854 *Catalogue of the Wheeling Female Seminary* listed under "Terms" the tuition for specific courses. Music (with the use of instrument) was $18 per session; modern languages, painting or drawing was $10 per session; embroidery, fancy needle work or plain sewing was $5.00 per session; and vocal music and chemical or philosophical lectures were $2 per session. If the value of the course was equated with the cost, music was far more important than lectures in chemistry or philosophy. For women with any aspirations in scientific fields, these early seminaries offered no advanced education and even less encouragement to pursue a science orientated education.. For women inventors, this meant not only was scientific or mechanical instruction unavailable, but standard educational values for women devalued the sciences. It was clear that music was far more valuable for a woman to master than chemistry or philosophy. The social acceptance of what was appropriate for women to study had as much an effect on women inventors as what was actually studied. Even if she was not able to obtain any scientific credentials but had a natural affinity for learning such or had acquired such knowledge in a private and unconventional way, the fact that she was knowledgeable in the sciences and industrial arts was

enough to caste shadowy suspicion on her abilities, accomplishments, and her very character.

An astute educator, Sarah Emily Davies (1830-1921) who was the founder of Girton (1869), the first of the Cambridge and Oxford women's colleges, wrote in 1866 that, "The educational question depends, as we have seen, on the larger question of women's place in the social order" (Davies viii, 30). Women inventors place in the social order would eventually benefit from increased educational opportunities, but not for at least another generation. Dual significance gradually surfaced in access to higher education and in expanded curriculums during the late 19th century. But generally from female seminaries to women's universities, persistent and dominant domestic goals functioned as social as well as educational obstacles for scientifically inclined women.

It is interesting to reflect on inventor, Clarissa's Britain's seminary experience. As the head mistress of Niles Female Seminary in the 1840s, it would seem likely that we might find evidence of training beyond preparation for teaching and Republican motherhood. She was engaged in this occupation right before she started inventing and given the nature of her inventions, she would have experienced first-hand the need for some mechanical vocational education and/or basic scientific principles. (See Notes 16, Chapter 4). The value of such training strikes one as essential as her first patent for a floor warmer was returned to her (after it was already patented) with the figures "bottom-upward" which she lamented making the invention "utterly worthless" (Macdonald 20). But this seminary was a finishing school where young women could refine their manners,

improve home management skills and preparation for domestic life. She advertised that "parents wishing to give their daughters an education can find no institution more desirable, or place them under a person better qualified for the duty" (Macdonald 19). A person qualified as an inventor was certainly not the message she wanted to advertise. But her upstanding family and community reputation were attributes which would attract parents who wanted their daughters to receive a proper seminary education.

At this point in women's education, the option of entering a college for the purpose of learning a profession other than teacher or motherhood was simply not an option. As Mary Lyon, founder of Mt. Holyoke in 1837, promised, women "came to receive "a new direction," one "to enlist them permanently in the cause of benevolence" (Horowitz 25). But that new direction was really just a broadening of the old traditions. For Mt. Holyoke students that benevolence was centered in evangelicalism, domestic work, or teaching (Horowitz 27). The unusual woman who wished to enter the sciences was not permitted to enroll in men's colleges where such a curriculum might be offered and women's seminaries did not yet provide such education.

Even the Vassar Female College which offered an enlightened and expanded curriculum for women, placed a persistent emphasis on domestic education. It was strongly supported in the 1865 Vassar *Prospectus* under the heading of "Domestic Education" where students were reminded that,

> The household is, by common consent, woman's peculiar province. In the majority of cases, it is the only one in which she performs an independent and dominant part.

> The art of administering its various economies, therefore, is among the least dispensable of her acquisitions; nor can any one hope to be recognized as a thoroughly accomplished woman, who is not an accomplished housekeeper (Rothman & Rothman 16).

In the same *Prospectus*, under the heading of "Professional Education," students were offered four options: teaching, telegraphing, phonographic reporting and book-keeping. These were offered as a "few unexpended resources for special professional training." They were considered "incidental aids" which "however, will be cheerfully rendered" (Rothman & Rothman 23). If Vassar and other major women's educational institutions were influenced by deep-seated social persuasions that considered an educated woman was one who was an accomplished housekeeper, and professional training was merely incidentally, than it is not surprising that even as a head mistress of a female seminary and a woman with inventive potential, Britain did not offer a science curriculum which might have provided inventors with even the rudimentary training in mechanical skills or scientific knowledge.

Formal education in itself did not factor into the equation which produced a successful 19th century woman inventor. More important was the eventual social development that awarded credibility and status to an educated women who mastered fields outside of domestic education, especially in science. But persistent concepts of prestige and professionalism were constructed which reshaped "science" to make it seem even more masculine regardless of a woman's intellectual achievements (Rossiter 73). To some degree, those concepts are still prejudicial barriers to women scientists today. When women in science

finally gained a modicum of credibility, elevated status and respect, education itself became important to women inventors. But this did not occur during the 19th century and, even for successful professional inventors like Britain who had educational credentials, mechanical and scientific education remained self-taught or facilitated by a male relative or friend.

Such was the case of Mary Walton of New York who patented locomotive and other chimneys in 1879 and in 1881 patented a system for deadening the noise of elevated railroads. She was able to obtain some sort of technical education as is attested to by her own vague words and the technical nature of her inventions which is documented by several of her contemporaries. Her first invention, a type of smoke-burner, consumed all smoke from a fire, furnace, or locomotive, as well as certain kinds of dust and destroyed offensive air born factory odors (Stanley *Mothers* 489). Walton also received an English patent for this invention where British officials hailed this invention as "one of the greatest inventions of the age" (Smith, *WI* /1 4). Her second invention was described by journalist, Ida Tarbell as consisting of,

> . . . certain combinations of the rail, the longitudinal guards, and the cross-ties with flooring and partitions, thus forming enclosures for bedding the rails in sand or like materials, which smothers the noise, and when the sand is covered with asphalt the includes parts are protected from the weather (356).

Further recognition of the invention's sophistication came from the first edition of *The Woman Inventor,* April, 1891, where it was explained that,

> The most noted machinists and inventors of the country had given their attention to the subject without being able to

> furnish a solution, when, but, a woman's brain did the work, and her appliance, proving perfectly successful was adopted by the elevated roads (4).

Walton sold the rights to the Metropolitan Railroad and in 1891 it was still reported that she was "reaping the rewards of a happy thought" (*Woman's Journal*, 8/22/1891; Macdonald 150). But how she gained the knowledge, particularly in engineering and physics, is only hinted at by her own incomplete statement as recorded in the Lexington, KY, *Weekly Transcript*, Aug. 28, 1884, where she noted that: "My father had no sons, and believed in educating his daughters. He spared no pains or expense to this end" (Stanley *Mothers* 489). What those pains and expenses were is unknown at this time, but certainly suggests that she was permitted some sort of advanced education and that she proved herself very capable in her field. Her inventive activity takes place about 30 years after Britain's, indicating that some women eventually acquired educational support for their inventive activity.

Both Britain's and Walton's educational experiences are representative of the trend in women's education from the 1840s through the 1890s. [7] During the first half of the century, most women's higher education was focused on maternal duties and homemaking. Other forms of advanced education, especially in the sciences and mechanical arts, were generally self-taught or done through a private association with a male relative or friend. Anything beyond domestic education was subject to heated debates about the physical and moral dangers women would encounter if they pursued higher education. The paradox surfaces, despite the

persistent opposition to women's education, that after the Civil War woman's access to colleges progressed steadily between 1870 and 1900.

The continually barrage of opposition took a variety of forms. Prominent physicians, such as Dr. Henry Maudsley, a noted English "mental specialist," and Dr. Edward H. Clarke, a professor of Harvard Medical School, wrote respectively on this two-fold danger of mental and physical dangers (Newman 57; Eschbach 83-84). Both were widely read and influenced popular thinking about the fear that strenuous study would "unsex" a woman" which Maudsley said "may be a monstrosity--something which having ceased to be a woman is yet not a man" in his 1874 article *Sex in Mind and Education* (Eshbach 84; Newman 77-86). Clarke wrote a respected treatise entitled *Sex in Education; Or, A Fair Chance for the Girls* (1873) in which he "concluded that a young woman could not exert the mental effort required to win an equal education and "retain uninjured health and a future secure from neuralgia, uterine disease, hysteria, and other derangements of the nervous system" "(Eshbach 83; Hobbs 62-63). Both Maudsley and Clarke's professional status and claims of scientific evidence did much to support the fear that "woman might forsake their infants for quadratic equations" (Woody 138). For women inventors, this kind of reasoning was particularly damaging as they were already considered far afield from their domestic station in life.

It was also argued that because women's brains were thought to be smaller than a man's, that an equal education was "useless, ineffectual, and stressful" (Eschbach 85-86; Marks 90). [8] These kinds arguments persisted throughout the remaining years of the 19th century. Added to these arguments

were also consistent cultural constraints which valued women's education as less important than men's education (Solomon 61). The "quest for knowledge, vocation, and identity apart from family" was considered by some as a direct affront to the sanctity of marriage and motherhood. Rigorous study was another way which reinforced "the differences between men's and women's lives; no woman could forget that she was in a man's world" (Solomon xix).

For women inventors, this was a two-fold cultural barrier to their inventive pursuits and identity as inventor. A women who was well educated, especially in the sciences, and who worked in a male dominated professional field, like invention, carried a double stigma of being unfeminine which conveyed negative character value. In an 1883 *North American Review* article, "University Education for Women," author W. Le Conte Stevens wrote concerning women who pursued higher education:

> In bursting unnatural bonds they were compelled to trample upon the exacting but unwritten laws embodied in the etiquette of their time. To be "unfeminine" is to violate a conception of womanly propriety . . . (25).

Later in the article, he explained what such a conception of womanly propriety meant:

> They are expected to make home attractive, to administer domestic economy with system and accuracy, to preserve the health of their children, and train these up with intelligence, . . . but it is assumed that they will be made coarse and unfit for home life by learning more than the traditional school-girl's allowance (31).

Stevens argued, though, that it was "difficult" and "unjust" to mark out a limit of knowledge beyond which a woman was forbidden to pass based on a "mere

arbitrary prescription" (29). For women inventors, that arbitrary prescription particularly influenced how people responded to the need for scientific and mechanical education, knowledge which clearly went beyond the traditional school-girl's allowance. Tarbell commented that one of the reasons why so few patents were taken out by women was because "all training in handling tools is withheld from girls." As evidence, she recorded a comment by a female manager in a large paper-mill,

> Girls are so entirely and totally ignorant of practical mechanics that it is about as astonishing a feat for them to originate any invention as would have been for Noah to have invented a steam-engine for his ark" (357).

Women inventors had to contend with this double-edged cultural barrier in their attempts to be successful, particularly in obtaining the necessary education and training to support their inventive activities. A few exceptional women were born with gifted talents, such as Margaret Knight. And a few, such as Mary Walton, were able to acquire adequate education from unconventional sources. But for most others, like Martha Coston who had to correspond with a chemist for ten years under a man's name to get the right color for her signal flare, the lack of education posed difficult and costly obstacles.

Even for those with seemingly exceptional understanding of scientific and mechanical knowledge, their level of expertise was often suspect. Even though they had the necessary know-how to invent mechanically sophisticated things, they lacked the formal credentials that placed them in serious professional circles where talented male inventors found themselves. Unlike their male counterparts,

after a few successful inventions, those women who considered invention as a profession, still did not gain entrance into the mainstream scientific community. For some male inventors, such as Thomas Edison, even if they lacked formal education, the nature and success of their inventions allowed entrance into inner networks where experimentation and invention was the focus and one gained acceptance by virtue of success (Pretzer118-122). But for women inventors, cultural perceptions of the inventor as male presented persistent obstacles for them. Consequently, educational credentials became even more important to women in the sciences. For 19th century women inventors, both cultural perceptions and access to advanced science education were slow to change, but the eventually change worked toward elevated status, improved credibility and increased recognition.

For Margaret E. Knight (1838-1914), both cultural acceptance and lack of credible education posed obstacles in her career as an inventor. Despite both of these formidable obstacles, she remains one of the most famous and success professional woman inventors during the 19th century and early 20th century. Because of her numerous inventions, she was called a "woman Edison" in the *Framingham Evening News* obituary of October 13, 1914 (Lovett 340). The exact number of inventions has been widely recorded as anywhere from 22 to 89 (Lovett 340; Macdonald 51; Stanley 524). Current sources estimate that the most likely figure is somewhere between 22 and 27. The inflated figures may be exaggerated based on her unpatented inventions as well as patented ones, patents in which she had a part but were taken out in another's name, or patents that she

may have participated as co-inventor and were listed as such but were not included in the LWP or any other lists (Stanley *Mothers* 522). Another factor for such inflated figures may have been her popular reputation as a female Edison. It is certain, though, that she patented at least 22 inventions in her own name. Her inventions fell into three major categories: " 1) the paper bag industry, 2) the shoe-manufacturing industry, and 3) rotary engines" (Stanley *Mothers* 524). [9]

Her accomplishments were particularly remarkable because she lacked any formal training or advanced education. Her first invention at 12 years of age was a shuttle restraining device. While in a cotton textile mill in Manchester, New Hampshire (possibly Amoskeag Manufacturing Company) she witnessed an accident "when a broken thread snagged a moving shuttle and pulled it off the machine," injuring a girl with its steel tip. She invented a device that would automatically stop the machine when a thread broke (Stanley *Mothers* 522; Lovett 339; Macdonald 51). There are conflicting accounts as to the exact nature of this mechanism, but there is no doubt as to its usefulness and importance. What other inventions Knight may have patented after that and until 1870 when she took out her first patent at the age of 32 remains unknown, but she apparently worked at improving her mechanical skills and inventive abilities during this time. Her efforts were not supported by any advanced education, but rather by her special innate talents, personal ambition and motivation, and employment experience which she later described.

Her lack of education fueled persistent skepticism and doubt about her abilities to produce complex mechanical inventions. An interview which

appeared originally in *the Woman's Journal*, entitled "A Lady in a Machine-Shop," December 21, 1872, and later quoted by Phebe A. Hanaford in her 1882 publication, *Daughters of America or Women of the Century,* provides insight into the kinds of obstacles that Knight had to contend with when she manufactured her machine for folding paper bags:

> The workmen employed were at first skeptical as to her mechanical ability; but she cured them of this by going daily, and working among them, -- detecting mistakes, and improving plans, with a keener eye than any man in the works (Hanaford 632).

Respect for her mechanical abilities was hard won and something she continually had to defend. Later in the same interview, Knighted responded to the question of how a woman could "ever do any thing in machinery" based on her own personal experience:

> It is only following out nature. As a child, I never cared for things that girls usually do; dolls never possessed any charms for me. I couldn't see the sense of coddling bits of porcelain with senseless faces: the only things I wanted were a jack-knife, a gimlet, and pieces of wood. My friends were horrified. I was called a tomboy; but that made very little impression on me. I sighed sometimes, because I was not like other girls; but wisely concluded that I couldn't help it, and sought further consolation from my tools. I was always making things for my brothers: did they want any thing in the line of playthings, they always said, "Mattie will make them for us." I was famous for my kites; and my sleds were the envy and admiration of all the boys in town. I'm not surprised at what I've done. I'm only sorry I couldn't have had a good a chance as a boy, and have been put to my trade regularly (Hanaford 633).

Hanaford, commenting on Knight's experience, stated that "she knows as much about machinery as though she had made it a study all her life. It is a

genuine gift" (633). The fact was that she had indeed made it a study all of her life, from childhood until death. But she never had the advantage of studying it formally, consequently she never acquired the credentials which the public would acknowledge as a lifetime of study. It was noted by a *New York Times* writer that at 70 years of age she was still working 20 hours a day on a new invention (Stanley *Mothers* 525). She pursued mechanical knowledge without the benefit of any advanced education. Her educational background has not been documented as her biography has yet to be written. It is a logical assumption, though, that because she went to work early, possibly even before the New Hampshire cotton mill, her formal education was minimal.

Knight's comment that she was sorry she didn't have as good a chance as a boy and was not put to her trade regularly illustrates that even for gifted inventors, the lack of education posed frustrating limitations. This was not an accidental chance or a mere coincidence of some sort, but rather an important gender constructed component which devalued women's place in the scientific community and stigmatized their abilities as less proficient than men. Commenting on this "chance" in *Woman's Journal* of August 22, 1891, author May Wright Sewall wrote in "The Education of Girls" that,

> It cannot be properly said that girls have an equal chance for education with boys especially for the higher education, until society regards a young women who poses as a mere family and society ornament with the same contempt with which it now regards the young man who values himself solely for his decorative qualities.

For women inventors, contempt arose from their occupational pursuit as inventors, which on every level lacked the usual female ornamentation and cultural propriety expected of women. Particularly the few women inventors, like Knight, who became public figures and acquired reputations as professional inventors had to combat the social barriers which prevented girls and women just a good a chance as boys and men in obtaining an advanced education. The need for cultural acceptance of women inventors and increased educational opportunities was noted by Notre Dame theologian John Augustine Zahm, who wrote *Women in Science* under the pseudonym H. J. Mozans in 1913, noted that,

> An instructive fact touching woman's inventive achievements is that her fullest success is coincident with her enlarged opportunities for education, and began with the breaking down of the prejudices which so long existed against her having anything to do with the development of the mechanical or industrial arts (349).

Zahm commented specifically on Knight as a case in point that even after she had demonstrated he skill as an inventor, she encountered skepticism by workmen in the manufacturing plant where her machines were produced. "They questioned her ability to superintend her own work, and it was only her persistency and remarkable competency that ultimately converted their incredulity into respect and admiration" (350).

Her "persistency and remarkable competency" helped her defend her invention in other circles as well. When Knight learned that a Mr. Charles F. Annan had patented a machine suspiciously like her paper bag machine before she did, she hired a Washington attorney and filed an interference suit despite

Annan's claim of priority of invention. "Annan insinuated that Knight could not possibly have designed the machine herself and attributed it to the model maker" (Macdonald 53). Much to Annan's dismay, to say the least, her successful defense ultimately rested in her superior mechanical knowledge and her ability to prove that she was the one who had reduced the idea to practice.

She submitted abundant testimony in a variety of forms such as eyewitnesses in the character of Mr. Stanbury, her former employer, and Eliza McFarland, with whom Knight had boarded in 1867. She also submitted a number of diary entries which she considered so private that she requested the magistrate read them in private only. These entries provided carefully dated notations and an "impressive array of proof, from genesis to manufacture" (Macdonald 54). Included as other evidence were numerous design drawings and patterns, paper bags made from experimental models, four photographs of the original iron machine, cogs from the wooden model and her own personal testimony. The Patent Commissioner judged that, "

> Miss Knight...had introduced voluminous testimony, and has stated fully the history of her invention from its first inception down to the present time. From her own statement, which is abundantly corroborated by other witnesses, it appears that she conceived the idea of the invention in February 1867 (*Decisions of the Commissioner of Patents*, 1871, 35).

Still, the defense hammered away at what they presumed to be her weakness, her mechanical inability. After one such assault, she fired back,

> I have from my earliest recollection been connected in some way with machinery. I have worked in manufacturing departments where both wood and iron

> machinery was used for the purpose of manufacturing different kinds of articles and goods (Patent Interference Case #272; Macdonald 53-54).

Her credentials were on-the-job experience and gifted mechanical ability. If she had had the same chance as a boy, she would have had education, too. Education, even now, carries not only increased knowledge, but heightened status and credibility.

At this point in her life, unlike most women inventors, Knight had vital support in her defense which helped her overcome her lack of education -- money. Her defense cost her $100 a day, plus expenses, for sixteen days of depositions (Macdonald 52). For most women, this barrier was the difference not only between winning and losing, but between filing and not filing a lawsuit. In this respect Knight may also be categorized as a professional inventor because she was able to manufacture and make a profit from her inventions. Unfortunately, she was not as gifted in business as in invention, as indicated in her personal estate of less than $300 upon her death. Her profits have not been thoroughly documented at this time, but what is known suggests that at times during her life her financial success was substantial (Macdonald 55-56; Stanley *Mothers* 522; Smith *WI* / 1, 4).

The final decision of the Patent Commissioner sided in Knight's favor, giving her the benefit of the doubt in regards to the time lapse between conceiving the invention in 1867 and not applying for patent until 1870. The decision was based, in part, on the fact that she was not a man and, therefore, her "inexperience in business, as well as the embarrassments to which her sex subjected Miss

Knight" might have arguably delayed her application (Macdonald 55). The judgment also supported that,

> Knight's diligence at the time when Annan secured his patent, as well as for two years before, was certainly of the most notable character; and, considering her little practical acquaintance with machinery, her success in overcoming the many difficulties encountered is a matter of great surpass. Her diligence at the period named must be regarded as sufficient to constitute a defense against Annan's patent, and consequently entitles her to the protection she now seeks, unless she has forfeited her rights by subsequent laces (*Decision of the Commissioner of Patents*, 1871, 38).

Particularly after having given "voluminous testimony" as to her mechanical expertise, Knight surely must have experienced "a great surprise " of her own to have her skills evaluated as having derived from "little practical acquaintance with machinery." Her victory was tempered with the deep seated cultural bias that women possessed inferior abilities, even in the face of overwhelming evidence. Despite the obstacles, her inventive contributions stand as a tribute to her legacy as a successful professional inventor. She served as a role model to other women who aspired to the role of professional inventor.

For Britain, Walton, and Knight, educational credentials remained illusive in their lifetime. But by the close of the century, women had made a significant cultural inroad into the educational system. In the June 23, 1900, issue of the *Women's Journal* under the article "Progress in Women's Education" it was concluded that, "Women can take the same academic rank as men, and they wish to do so. They can work with men, and they do equally good work alone. Where capacity and will are joined, there is no limit to possible advance" (193). Progress

was in process, but educational opportunities for women remained circumscribed throughout the 19th century by social dictates that reinforced women's domestic position. The social climate which addressed the "larger question of women's place in the social order" persistently opposed women in higher education. Yet, paradoxically between 1870 and 1900, women's access to colleges progressed steadily (Davies 30; Glazer and Slater 5; Degler 310-315; Rossiter 1-28).

Women inventors place in the social order was affected not only by the developments in women's education and the advancement of women's rights but also by their participation in women's clubs and societies. An emerging community of women inventors was fortified by women's efforts to support one another in scientific endeavors through women's clubs and societies. [10] This development suggests that women's own attitudes were instrumental in carving out new constructions of gender which integrated their contributions and abilities into larger scientific communities. Women interested in science and technology began to network and participate in the socialization of their scientific professions thereby challenging the status quo of their former position as incapable and inferior in anything outside of the domestic realm (Glazer and Slater 124).

American men had been participating in such societies and clubs since the early republican period, such as Benjamin Franklin's Junto club. That club constructed a social network for intelligent, scientific, and business minded community men. Although the original Junto Club was considered a literary club, its purpose was expanded when Franklin recommended that each member "should

endeavor to form a subordinate Club." The purpose of which he outlined in his *Autobiography* as,

> The Advantages propos'd were the Improvement of so many more young Citizens by the use of our Institutions; Our better Acquaintance with the general Sentiments of the Inhabitants on any Occasion, as the Junto-Member might propose what Queries we should desire, and was to report to Junto what pass'd in his separate Club; the Promotion of our particular interests in Business by more extensive Recommendations; and the increase of our Influence in public Affairs & our Power of doing good. . . (Franklin 112)

The Junto Club facilitated business opportunities, stimulated scientific ideas, and provided a prestigious community presence for professional men. [11] Women, of course, were not allowed membership.

It was not until the last half of the 19th century that they were allowed membership into a select few clubs, and then generally with a limited membership. Exclusion by males has frequently been cited as the "precipitating factor in the coalescing of women's groups" (Blair xiii). And in the case of club membership, such exclusion eventually led women to form their own clubs (Kohlstedt, *Formation* 103; Blair 7-13). The rise and development of such clubs after the Civil War in the 1860s coincided with the enlarged educational opportunities and the emergence of women in the professional sciences which included increased numbers of professional women inventors (Croly 54; Woody 453; Blair 13). [12]

Membership in women's clubs and societies, like in men's clubs, facilitated networking, stimulation of intellectual ideas and a form of socialization

for professional women. Although most early women's clubs were organized as study clubs with a literary focus, a few clubs were organized as amateur science clubs. [13] In the face of pervasive stereotypes about intellectual women, and especially women in the sciences, women's organizations that acknowledged a scientific focus were few. Arguments from Darwin and Francis Galton perpetuated the idea that "in evolution woman had been "the loser in the intellectual race as regards acquisition, origination and judgment" (Romanes 385). That bias was echoed by an editor when he suggested that,

> "If an educated woman was a curiosity, a woman scientist was nothing less than peculiar; thus, if "an unfortunate female should happen to possess a lurking fondness for any special scientific pursuit she is careful (if of any social position) to hide it as she would some deformity" "(Kohlstedt, *"Periphery"* 90).

Like female scientists, women inventors found themselves a curiosity, peculiar and a social deformity (Rossiter xv; Glazer and Slater 7; Gage *Tract* 21). They were not alone with their scientific interests, and like women scientists, did not find a wide array of clubs to join which would support their "acquisition, origination and judgment" concerning scientific subject matter.

Very little scholarship has been done on 19th century women's science clubs, and even less on women inventors organizations. [14] A few societies did foster an ongoing interest in science, such as the Dana Society of Natural History of the Albany Female Academy, the Chautauqua Literary and Scientific Study Circles, and the Society for the Encouragement of Study at Home, but their development has yet to be thoroughly documented (Kohlstedt, "Periphery" 91-

95). These clubs primarily stressed self-development rather than creating pathways into the larger professional scientific community. For example, the Dana Society of Natural History stated that their purpose was "to awaken in ourselves and in others a growing interest in the study of nature, and increase our knowledge of the natural sciences in both their practical and scientific bearings" (Kohlstedt, "Periphery" 91). Kohlstedt notes that these club members were educated and active, but dedicated first to private study and socializing. Evidence suggests that members had little contact with practicing research scientists, and it is unknown whether women interested in research or advanced training benefited from club membership (Kohlstedt, "Periphery" 92; Rossiter 75).

There would have been an obvious attraction for women inventors if such clubs did in fact facilitate research and connections to the larger scientific community. Future research on membership and professional relationships among women inventors and the scientific community will be invaluable in understanding the social context in which women invented during the second half of the 19th century. Coupled with the advancements in education and the emergence of even a few scientific clubs, a social climate was fermenting in which women inventors would eventually gain status, credibility, and recognition (Martin 2).

Like the few science clubs, women's clubs in general were interested in self-development. An early club, Friends in Council (1866), organized to establish "within their circle of acquaintance such a nucleus of thought as would attract and gather about it those who valued the world of thought and who were

zealous for self-improvement" (Croly 54). For women inventors, this kind of club association and general attitude among women would eventually provide an important stimulation to their inventive activity. To be able to converse with other women about invention ideas would not only spawn possible solutions, but also help to create an established identity as inventor. Although several women were participating on a professional inventive level, very few called themselves inventor. Like woman scientist then, woman inventor was a contradiction in terms (Rossiter xv).

It was not until the late 19th century that women benefited from an organization dedicated exclusively to women inventors. During the 1890s, a brief and short lived movement to organize women inventors was spearheaded by Charlotte Smith. In 1882 she became the president of the Women's National Labor League (WNLL) which was formed by women clerks in government departments. Many women found government work as clerks during the War, which continued afterwards (*The Revolution*, April 16, 1868) . Notably, women clerks were hired in the patent office affording Smith's general interest in labor reform to include women inventors specifically (Massey 9). A year later the WNLL joined the larger organization of the Knights of Labor. During the same time period, Smith was invited as a convention delegate to the American Federation of Labor where she admonished members to form women's unions (Foner 189, 213-214). In 1891 she shifted her general interest and energy in women's labor issues to specific support of women inventors through the

publication, *The Woman Inventor,* and the establishment of a women inventors organization.

In the first of two issues of *The Woman Inventor*, printed as April, 1890, but the actual date was 1891, she announced that "under the auspices of the Women's National Industrial League of America. . . a new department, whose object it is to promote and encourage the interest of female inventors of the world" had been organized (3). This department was formed to support those women who possessed the genius and capability of the best male inventors, but who lacked the encouragement of an interest. The department would provide this interest in order "to develop in the women, especially of America, the tact, the skill, the genius, the capability and the interest in mechanical and other arts, from which they have been heretofore practically ostracized" (3). Like other women's clubs such as the Fortnightly of Chicago whose purpose was "to enlarge the mental horizon as well as the knowledge of our members," the purpose of Smith's group was to develop their "genius by encouraging one another" (Martin 1; Smith *WI* / 1 3).

In the next and last issue of the *Woman Inventor*, June ,1891, Smith announced the resolve that a "mutual aid and protective association be formed to consist of women inventors and all other women, who wish to enter the inventive field" (2). This announcement was made under the article heading "Help! Practical Help!!" The editor said that this new association was formed in response to all the many letters received from women inventors who cried for help to such a degree as never contemplated before. They told of their,

> . . . vicissitudes, their disappointments and especially of the great lack of the necessary information for their guidance to reach the successful termination of their inventions. . . not a few tell us of men's inhumanity to woman, by defrauding them of their well earned compensation, namely by the piracy of their patents! (2).

Under another article in the same issue, "Women Inventors' Mutual Aid and Protective Association of the United States of America," the officers and committees were named, the objections of the group were clearly set out, the Terms, and the Rights and Advantages to Members were listed (4). The officers were Mrs. Charlotte Smith as President, Martha J. Coston, as Vice-President (inventor of the pyrotechnic flare), Miss Marion Foster as Treasurer and Mrs. Caroline Hall as Secretary. The following committees with appointed officers were organized: Committee on Woman's Inventions; Committee on Woman's Industrial Advancement: World's Fair of the Inventors' Department; Committee on Literature; Committee on Arts and Sciences; and Committee on National and International Copyrights and Trade Marks. Membership was $5 a year or $50 for life.

The Rights and Advantages to Members were particularly revealing as to what kind of help inventors most needed and the kind of ambition women inventors entertained. It was published that,

> The object of this Association is to obtain mutual aid and protection to women inventors. Competent attorneys have been engaged to look after the legal interests; able draughts, men and correct model workers have been procured. In the bureau for foreign correspondence and for the translation into Spanish, French, German, Russian and Italian languages competent persons have been engaged (4).

In addition, patent attorneys in foreign countries were in correspondence with the organization, efforts were made to secure copyrights in foreign countries, and a special department for the registration of trademarks was established. The Rights and Advantages to Members were also carefully spelled out in detail. Among other things, membership meant free access to information on how to obtain a patent, drawings, specifications and models at the lowest possible rates; free legal advice as to procedures in foreign countries; the Association would negotiate the sale of patents, make arrangement for the manufacture of patented articles, put them on the market for a moderate royalty and urge the reduction of patent fees charged by the Government (4).

All of this sounded like the beginnings of a well organized club with a narrow and specific focus. Unlike other earlier women's clubs and societies, the purpose here was not only for self-improvement. Rather, women were seeking an active network that would assist them in the manufacturing and business side of patenting, aiding them to integrate into the mainstream community of invention and commerce. They came together not only for intellectual stimulation, as indicated by the kinds of committees that were organized, but they also came together collectively to engage more successfully in the professional field of invention.

Unfortunately, there is no evidence that this group survived or even got off the ground. It is difficult to speculate what went wrong. Was some outside force set in opposition to it from the onset? Was there a lack of support by women themselves? Did Charlotte Smith abandoned the project for other interests or lack

of funding? A biography of Charlotte Smith, now in progress by Autumn Stanley, will, no doubt, shed some light on these questions.

Although we may never know exactly why the society did not flourish, it is intriguing to theorize about what might have happened to this group and how it might have affected the progress of women inventors of the 20th century. Encouragement and interest in an invention are essential elements for most successful inventors. The U.S. Department of Labor acknowledged that it was "a well recognized fact that the creative spirit flourishes in an atmosphere of friendly faith and languishes when environed by indifference, unbelief, or hostility." (*Bulletin of the Women's Bureau*, No. 28, 1923, 5). If 19th century women inventors had had some kind of organizational encouragement and interest, their inventive contributions would have benefited on several levels. Women inventors, like their male counterparts, would have stood to benefit immensely from an organization dedicated to supporting their inventive ambitions. In the same *Bulletin* the results of such encouragement were succinctly acknowledge by the U.S. Department of Labor:

> If a lack of popular interest in achievement along specific lines of creative research retards the advancement of men to whom custom opens all research facilities, it is not to be expected that women will be uninfluenced by the traditional and prevailing lack of faith in women's creative abilities. Such a lack of faith not only discourages and retards creative effort in women as it does in men but it also creates in women a timidity about applying at all for patents on such inventions and discoveries as they do achieve, and fosters a tendency to the pass the creative suggestions on to their male relatives, who, with the greater self-confidence born of freedom from restricting customs,

> perfect the inventions or complete the discoveries and secure the patents (5).

The one and only known society for women inventors in the 19th century did not achieve its vital purpose of creating and maintaining a "popular interest in achievement" by women inventors as did some male societies such as the Association of Inventors and Manufactures (Smith *WI* / 2 1). The club movement in the United States had the potential to encourage and advance the work of women inventors. But the record of such achievement remains vague, despite at least one seemingly solid effort by Charlotte Smith. Something happened which prevented the organization from functioning for any length of measurable time. "So far as we know the association flickered briefly and disappeared" (Stanley "Champion" 26). Likewise, the publication *The Woman Inventor* published only two issues and sank into historical oblivion. Nothing of its kind has ever been published since.

But what is significant about *The Woman Inventor* and the Women Inventors' Mutual Aid and Protective Association is in its conceptualization and the fact that it existed at all. By virtue of the public nature of both, women inventors gained recognition and, like other women's groups, a measure of autonomy, identity, and competitive encouragement. Unlike male inventors, they did not gain any measurable advancement by their association. An organization like the Women Inventors' Mutual Aid and Protective Association would not have even been possible during the early postwar years when women's clubs were just beginning to form and when women's educational opportunities were just

beginning to open up. During that time women inventors were also just beginning to increase in numbers, and there was not even one woman who was yet considered a professional inventor.

But by the end of the century, several women had made their mark as professional inventors. They pursued invention as a career, had multiple patents, had successfully manufactured their inventions and had made a living by their inventive activity. They were generally unmarried and by their lifestyles, showed support of women's rights. The need for a collective identity had reached a new plateau, one which was addressed by Smith, but never successfully remedied. Individual women experienced personal identity as inventor, but the prevailing public image and identity of inventor as male did not change. A pattern of segregated employment and under-recognition persisted, as exemplified in the case of Margaret Knight. Still, the contributions of women inventors slowly worked toward an increased level of status and credibility.

As already discussed, women such as Margaret Knight, Martha Coston, Mary Walton, and Clarissa Britain all experienced invention at a professional level. In addition, other notable woman like Helen Augusta Blanchard (28 patents), Amanda Theodosia Jones (14 patents), Maria Beasly (15 patents), Mary P. Carpenter (13 patents) and several others, should also be included as 19th century professional women inventors (LWP). [15] All of these women made significant contributions specializing in machines despite the fact that none have ever been recognized in the history of American technology. In addition to having multiple patents, they share similar criteria and suggest a developing

pattern of a successful woman inventor during reconstruction and afterwards. Professional women inventors slowly emerged in the same climate of social fermentation in which women's rights were openly challenged, women's opportunities for higher education expanded, and women organized clubs and societies for social, intellectual, and professional support. What women inventors had in common with these other groups of women was that generally they were all actively constructing new boundaries for women, be it social status, legal entitlement, political rights, educational opportunities, or sexual equality. Specifically, women inventors actively mediated the relationship between women and technology. Far reaching consequences which established fair employment standards, competitive business opportunity, and elevated social status evolved from their contributions and re-defined the relationship between women and technology in the late 19th century.

The shifting of such boundaries in the relationship between women and technology is exemplified by the experiences of Helen Augusta Blanchard (1840-1822). Like Knight, Coston, Walton, and Britain, Blanchard was not married. [16] She patented at least 28 inventions between 1873 and 1915, mostly relating to the sewing machine. Most of her inventions were mechanical, mostly commercial, and most of them were actually used in the industries for which she intended them (Stanley *Mothers* 517). Her experience, like other women who took up invention as a profession, arose out of economic need. Her father, Nathaniel Blanchard, one of Portland, Maine's best known shipbuilders and owner of packet steamers, lost his fortune in the panic of 1866. After his death, Blanchard, at the age of 30,

borrowed money for her first patent fee and embarked on a successful career as an inventor (Smith *WI* / 1; Macdonald 60; Reynolds 5).

Her inventions and manufacturing efforts proved technologically innovative and financially lucrative, particularly in connection with the sewing machine. What should rank as one of her most recognized inventions was the zigzag sewing machine, but credit is generally given to the Singer Company who mass produced it for industrial purposes after the original patent expired (Stanley *Mothers* 516). In 1876 she established the Blanchard Over-Seam Company, wherein "she applied her powers to the intricacies of machinery" and "by the results of her inventions" she "achieved a signal success" (Williard and Livermore 97; Logan 889). Several other successful inventions and businesses enabled her to eventually buy back her family property which had been lost years earlier (Stanley *Mothers* 516; Macdonald 60). Her success as an inventor was noted by Smith in *The Woman Inventor*, adding public recognition to her personal identify as a professional inventor (Smith *WI* / 1 1). She was lauded as "a benefactor of her sex" who never lost her qualities of "gentleness, dignity and modesty" (Willard and Livermore 97).

Blanchard clearly fit the criteria as a professional inventor. As such, her drive and ambition would have benefited tremendously from a professional association or club where women inventors might have networked, engaged in a stimulating intellectual atmosphere and socialized in a business capacity. In addition to being an inventor, she was noted as a benefactor of her sex . This dual identity profiles her as a good candidate for club membership. By the nature

of their associations and the desire to organize, club women organized to prove "to themselves their intellectual capability and interest and to the public their continued commitment to women's "proper" role" (Martin 3). Blanchard's accomplishments identify with the club mission. But if she was a member of the Women Inventors' Mutual Aid and Protective Association, it remains unknown as no membership lists have surfaced. What records we do have of her accomplishments, though, do testify to her categorization as a professional inventor.

Another woman, Amanda Theodosia Jones, should also be categorized as a professional inventor. She would certainly have benefited in more than one way from club membership due to her multiple career paths. Her education from a normal school qualified her as a teacher. She received no further higher education though which would have prepared her for her remarkably diverse multiple careers. In addition to being a teacher, she was a published poet and writer, an editor, a spiritualist, an inventor, factory owner and a manufacturer. She patented a total of 14 inventions from 1873-1914. One of her most notably inventions was a vacuum process of preserving food. Although she had no specific education or employment experience in this field, she did claim a special source of knowledge for the idea. In her autobiography, *A Psychic Autobiography*, she explained how her unseen spiritual mentor, "Dr. Andrews" encouraged her:

> Now, I confess this seemed so far from what I most desired, I never dreamt [the message] was for me. Since I, in very truth, was no inventor. No flounce of mine had ever brushed a Patent Office door-jamb, or caught in court house palings. Then one night, the voice spoke again: "Friends,

> do you know there is a way of canning fruit without cooking it?" (297-298).

In 1873, with the help of her cousin, Professor Leroy Cooley, five patents were issued in regard to her invention of vacuum food processing: "two to Jones alone, one to Jones and Cooley jointly, two to Cooley alone with one of these assigned to Jones" (Stanley *Mothers* 93). In addition to several other inventions (3 for an oil burner), she patented two more related vacuum process inventions in 1905 and established 2 companies utilizing her process. In 1890, Jones established the Woman's Canning and Preserving Company in Chicago "to manufacture, sell and deal in canned, bottled or otherwise preserved foods of all kinds; to acquire, purchase or control letters-patents. . . relating to methods, processes, machinery, apparatus and devices for preserving foods of all kinds" (Macdonald 67-68). It was almost entirely a female enterprise including its officers, employees and stockholders (McHenry 214; Wilson 285). She told her employees:

> This is a woman's industry. No man will vote our stock, transact our business, pronounce on women's wages, supervise our power. Give men whatever work is suitable, but keep the governing power. This is a business training school for working women. . . .Her is a mission; let it be fulfilled (Macdonald 69).

The company prospered at first with its popular lunch tongues and fruit preserves, which were advertised as products all put up by "competent women." Jones subsequently opened plants in Aurora, Illinois and Montello, Wisconsin. But after three years, she lost the support of her officers and left the company in bitter disillusionment. The company lasted until 1921 when it was involuntarily dissolved (Wilson 285; Stanley *Mothers* 93; Macdonald 68-69). After this she

once again turned her attention to her earlier patented oil burner, a liquid fuel burner used in furnaces and boilers in oil fields (1880). She took out three more patents consisting of valves and other refinements to the oil burner (1904, 1912, 1914) (McHenry 214).

Although Jones did not participate in suffrage activities, her support of women's rights, like other spiritualists, was consistent and often deemed radical. She wore her hair mannishly short, shared in the view that marriage was a "perilous adventure," and was determined to succeed as a women in a man's world of both invention and business (Wilson 285; Braude 2-3, 121; Macdonald 68-69). In her unique position as inventor, spiritualist, business owner, and writer, her life's work advocated social reform for women, especially for professional women who attempted to integrate in the business of inventing, a male domain which continued to be reinforced and structured by gendered prescription throughout the 19th century. Jones would have shared in Charlotte Smith's vision for her "Woman Inventor" which was "to encourage and help by advice all who enter the field of the Inventor . . . to assist women who have the talent for inventions, but not the means to carry out their labor to a successful end" (Smith *WI* /2 3). In Smith's "co-operative inventors association," Jones would surely have found encouragement and support for her inventions and their industrial application. Like Blanchard, though, there is virtually no evidence beyond probability that Jones was involved in the brief movement to organize women inventors.

The movement to organize women inventors, although brief, was part of a patterned trend after the Civil War wherein women began to demand personal identity and public recognition as inventors. After the War, a small group of women turned to inventing as a profession for the first time. Their efforts were meet with unabashed inequality in segregated employment practices, opportunities for higher education, and a reinforced gender construction which solidified women's domesticity and demoralized those who challenged that status quo by assuming professional masculine roles such as inventor. The majority of women who chose a professional path remained single and acknowledged that the goals of marriage and career were mutually exclusive. The stigma had far reaching social repercussions for women inventors as this was "an era when a woman who appeared to fail at motherhood was thought to be not only incompetent, but also immoral." By pursing a career, especially one in an exclusively male field such as invention, women were "made to feel deviant for pursing . . . an unnatural set of priorities" (Glazer and Slater 6-7). But in the face of extreme opposition, amazingly increasing numbers of women pursued professional goals.

For many women, the War had irrevocably changed their collective and individual passivity toward outright sexual discrimination which deemed them as less capable and less intelligent than their male counterparts (Martin 121-122). After the War, when party leaders informed women that "this is the Negro's hour" and that "women must wait for their rights," a heightened incentive fueled the women's movement in their demands for equal rights and opportunities

(Kraditor 3). Women's rights leaders sensed the foreboding implication of the passing of the Fourteenth Amendment which enfranchised black men but left out all women. The weight of the insertion of the one word, "male" into the United States Constitution for the first time in this amendment was a dark and oppressive omen. For the small emerging number of professional women inventors, inequities surfaced in limited opportunities in education, employment, and business practice. For the thousands of women inventing at lesser levels, such inequities often spelled defeat. Despite such formidable obstacles, between January 1, 1865, and December 31,1900, over 600,000 patents were issued to women (Merrit 246). By their increased number of patents and the diverse range of these patents, women inventors supported women's rights providing solid evidence that women were capable and intelligent, strong and independent.

Women's patents also provided evidence that abilities, intellectual range and professional standards warranted educational support. If they were able to invent things like a machine for folding paper bags, locomotive chimneys, the zigzag sewing machine, vacuum food processing, barrel making machines, steam generators, steam boilers, machine for raising sunken vessels, and thousands of other sophisticated and useful inventions without education, their potential for inventing important and valuable inventions in the future with appropriate education had no limits.

Although documentation is currently unavailable as to how many women inventors received a higher education, they benefited from the developments that gradually increased access and opportunity even if they personally did not gain

advanced educational credentials. Formal education did not assuage the concepts of prestige and professionalism which made science, including invention, more masculine than ever. But as more and more women successfully challenged the prevailing negative attitudes about women and higher education by entering universities and colleges in increased numbers, a more favorable social climate developed in which educated women gained recognition, credibility and status. This development, more than obtaining an actual education, positively affected women inventors.

In the face of volatile opposition which warned that educated women would become "un-sexed" and that a woman pursuing higher education would suffer irreparable physical and emotional damage, women refused to be deterred from seeking higher educational opportunities. Their determination gradually created career pathways into fields previously considered male bastions. The paradox unfurled throughout the remaining years of the 19th century wherein women made steady advances in education and the professions despite the fact that most Americans considered educated women a threat rather than an asset to society (Rossiter 3).

Historian Gerda Lerner observed that because women were shut out of institutions of higher learning for so long, they developed "their own social networks in order for their thoughts, ideas and work to find audiences and resonance" (12). The emergence of the women's club movement was just such a development. Critics claimed that women's clubs were one more manifestation of gender disorder, like the women's movement and the demand for higher

education. And, in truth, it did draw attention to the state of disorderly and discriminatory construction of gender. Historian Karen Blair asserts that clubs flourished because they afforded women a more complete, and, therefore, a more authentic self-expression during a time when such had been effectively thwarted by prevailing conventions. For many women, joining a club offered a chance to "escape into larger cultural and intellectual arenas" (xii, xiii). For women inventors, again, it was not the actual participation as members (like actually getting an advanced education), but rather the social atmosphere that clubs created that supported women who wanted to enlarge their "mental horizons" (Martin 1).

Women were encouraged to be "zealous for self-improvement" and to cultivate the stirrings of "intellectual independence--an awareness of and confidence in themselves and in their sex which they had not been able to accomplish alone" (Martin 3). Women inventors attempt to organize at the club level is evidenced in Charlotte Smith's short lived Women Inventors' Mutual Aid and Protective Association. From all appearances, this club did not make any significant long lasting impact on the position of women inventors. But in its very conception, it did reveal women inventors desire for autonomy and for placement into the larger scientific and technological community. The brief pages of *The Woman Inventor* suggests an organized movement which called for legal, political, educational and social reform on behalf of women inventors. Although it seemed to come to naught, evidence that it even developed to embryonic fruition points out the existence of a community of women inventors. This is an

affront to the standard histories of technology which continue to treat women inventors as invisible, non-entities in the development of American technology. Like members of other clubs in the late 19th century, women inventors reached a new plateau which demanded both a personal identity and public autonomy. The atmosphere in which the women's club movements originated and developed, helped to create a group consciousness among women inventors which in turned encouraged a small number to turn to invention as a profession for the first time in American history.

For women inventors, like other post-war women, their accomplishments during the War provided momentum to propel them into a period of reconstruction of their own. That momentum was sustained by gradual progress toward women's rights, advancements in higher education, and a developing sense of autonomy in the club movement atmosphere. As the century came to a close, the activity of women inventors continued on a steady upward swing. The image of inventor as male still had not changed, but what had changed was the atmosphere in which women inventors could more freely pursue their ambitions. An emerging group of professional women inventors were part of the post-war generation who grew up in a context of a gender system under re-construction (Leonard 196-197). With more than 600,000 patents to their credit from 1865-1900, women inventors met the 20th century with increased status, credibility, and recognition.

Although the image of inventor remained intractably male, women inventors like Britain, Coston, Walton, Knight, Blanchard, and Jones amply

demonstrated that women, in fact, did invent with the same "fire of genius" as male inventors (Heyn 1-2). Even though the national period of reconstruction was officially concluded, the construction of gender remained in progress. Women had a long way to go before they even began to approach the platform of equal rights. Despite the undeniable fact that women did invent useful and valuable inventions, women's inventive ability remained limited and circumscribed by cultural conditions. Charlotte Smith believed that the only thing women inventors lacked was equal opportunity. She reflected that,

> Where but a few shinning lights have come to the surface in the Patent Office as inventors a hundred thousand women could have become successful inventors had they the opportunities--opportunities to develop their inventive genius (*WI* / 2 4).

Women inventor's opportunities for increased credibility, status and recognition were just beginning to shine by the end of the 19th century. Equal rights, access to higher education and a redefined social position would gradually evolve during the 20th century, and with them a burgeoning community of professional women inventors.

Chapter 5 - NOTES

[1] Barbara Welter's classic *Dimity Convictions* elaborates on the Cult of True Womanhood in Chapter Two. The attributes of True Womanhood, she wrote, "could be divided into four cardinal virtues--piety, purity, submissiveness and domesticity. Put them together and they spelled mother, daughter, sister, wife--woman" (21).

[2] Historian Ann Macdonald utilizes this theory in her discussion of "After the War: Inventing within Woman's Sphere," pp. 24-47.

[3] See Philip Shaw Paludan's "Conclusion" in *A People's Contest* for a succinct summary of the two opposing groups divided between Elisabeth Cady Stanton and Susan B. Anthony on one side with a more radical platform demanding the vote, divorce law reform and national legislation to protect sexual equality and Lucy Stone on the other hand reinforcing more traditional women's roles which elevated and protected women's rights in the home. Also see Aileen S. Kraditor's *The Ideas of the Woman's suffrage Movement*, Chapter One; Glenda Riley's, *Inventing the American Woman* , pages 112-116;

[4] For a comprehensive discussion of the development of women's education in 19th century America see Helen Lefkowitz Horowitz's *Alma Mater;* Barbara Miller Solomon's *In the Company of Educated Women*; Thomas Woody's *A History of Women's Education in the United States*; Louise Michele Newman's *Men's Ideas/Women's Realities: Popular Science 1870-1915*; and Catherine Hobbs' *Nineteenth-Century Women Learn to Write.*

[5] Women's early 19th century educational institutions were called seminaries which replaced the earlier word, academy, used in reference to male institutions because the word "seminary" was thought to denote a certain seriousness which supported their two-fold mission of professional preparation: training women for "teaching and the Republican motherhood" (Horowitz 11).

[6] Elizabeth Seymour Eschbach's, *The Higher Education of Women in England and America 1865-1920,* cites that with the opening of Vassar in 1865 the idea of creating a woman's college "like a man's" became attractive. And in 1871 when Smith College was chartered, its founder, Sophia Smith "heartily endorsed the ideal of equal educational opportunity for women and in her will left her fortune for the establishment of an institution "with the design to furnish for my own sex means and facilities for education equal to those which are afforded now in our colleges to young men" (62). But although some institutions set their sites on such ideals, the reality tended to fall considerably short of its mark

because not many women had received adequate preparation to meet the demands of a rigorous course immediately upon entering college.

[7] During the first half of the 19th century, especially during the 1830s and 1840s, female seminaries advocated "a special program for women to strengthen their sense of maternal duties and provide them with practical training in homemaking." Gradually in the "1840s and 1850s, the first female institutions to call themselves colleges appeared with the explicit goal of providing women with an education similar to that offered by men colleges" (Newman 54-56). After the Civil War, many higher education institutions began to admit women, especially state universities. For a comprehensive discussion of women's educational opportunities and lack thereof in the 19th century see *Men's Ideas/Women's Realities, Popular Science, 1870-1915*, by Louise Michele Newman.

[8] Dr. William Hammond, a New York neurologist attempted to prove that women had smaller brains in a series of articles published in Popular Science Monthly. A public debate ensued with a counter from feminist Helen Hamilton Gardner and another neurologist, Dr. Edward Spitzer, who refuted Hammond's ideas in the article, "Sex in Brain." Gardner argued that the size difference was minimal in most individuals and there was no established connection between size and intelligence (Eschbach 85).

[9] Some of Knight's most important mechanical inventions include:

#109,224	Impr. in Paper-feeding Machines	1870
#116,842	Impr. in Paper-bag Machines	1871
#306,692	Clasp	1884
#311,662	Spit	1885
#436,358	Sole Cutting Machine	1890
#436-359	Machine for Cutting Soles	1890
#521,413	Reel	1894
#524,278	Feeding Attachment for Sole-Cutting Machine	1894
#716,903	Compound Rotary Engine	1902
#717,869	Rotary Engine	1904
#720,818	Rotary Engine	1904
#743,293	Automatic Tool for Boring or Planing Convex or Cylindrical Surfaces	1904
#1,105,761	Resilient Wheel	1912

(Macdonald 390).

[10] See Sally Gregory Kohlstedt "In from the Periphery: American Women in Science, 830-1880," in which women who organized and participated in women's clubs and societies are discussed in the context of "group coordinators" who "formed study or research groups which reinforced their conviction that scientific

investigation was appropriate for women" (*SIGNS*, Autumn 1978, Vol. 4, No. 1, pp. 81-96).

[11] See *The Autobiography and Other Writings* by Benjamin Franklin for a comprehensive account of how the Junto Club facilitated Franklin's successful business ventures, scientific experiments, and public service.

[12] In the 1840s some women began to create their own scientific organizations, which slowly attracted more and more members, but most were mainly interested in private learning, mutual growth, and contributions to local education and conservation instead of publishing new findings and seeking recognition or prestige (Rossiter 75).

[13] In 1868 the influential New England Woman's Club (NEWC) was founded "to be a centre of rest and social convenience for women in active philanthropic employments and for sympathetic intercourse" (Croly 38). It was organized to create opportunities for intellectual stimulation and supported educational reform for women, especially in the professions. Furthermore, "It was not to be purely literary, charitable, philanthropic, educational, reformatory, political, religious, not recreative, yet it was to partake of all the qualities in combination. It was to be a voluntary associating of kindred spirits, drawn together by no ties of family, neighborhood, or church" (Croly 37).

Another club with similar influence was simultaneous founded in New York City, Sorosis. Founder, Jane Cunningham Croly, the single most important figure in the woman's club movement wrote an expansive work, *The History of the Woman's Club Movement in America* (1898)). A comprehensive history of the NEWC and Sorosis is included in her work as well a thorough consideration of the roots of women's difficulties in society. Her work documents the tremendous impact and force of women's clubs during the late 19th century . See also Karen Blair's *The Clubwoman as Feminist: True Womanhood Redefined, 1868-1914*, Chapter 2..

[14] There are several good historical sources for women's clubs in general, such as Karen Blair's *The Clubwoman Feminist* , *The History of the Woman's Club Movement in America* by Jennie June Croly, *High Tea At Halekulania* by Margit Misangyi Watts, and *The Sound of Our Own Voices: Women's Study Clubs 1860-1910* by Theodora Penny Martin. But regarding women's science clubs specifically, there has been minimal research and very little published. The brief work of Sally Gregory Kohlstedt "In from the Periphery: American Women in Science, 1830-1880" provides several good leads for future scholarship and some insight into why so little has been written.

[15] Autumn Stanley in *Mothers and Daughters of Invention: Notes for a Revised History of Technology* provides a chart of "Thirteen 19th-Century U.S. Professional Women Inventors (Specializing in Machines)." In addition to those

listed in this chart, elsewhere in her work she includes: Eliza Alexander, 7 patents; Ella Gaillard 15 patents; Harriet Hosmer, 7 patents; Mary J. Montgomery, 4 patents; Mary S., 53 patents; Emily Tassey, 5 patents; Harriet Tracy, 17 patents, and Bertha Lamme "who held no patents in her own name, but worked on a corporate innovation team (Westinghouse) for 12 years; the numbers of important motors and generators she helped design could arguably equal the total patents received (or applied for) by her brother Benjamin Lamme and other teammates during those years" (501, 40).

[16] Carl Degler in *At Odds: Women and the Family in America from the Revolution to the Present* , comments on the conscious choice women made to remain single, particularly when they aspired to professional goals. He observed that the conflict between women's aspirations and marriage was more obvious "among those women who were graduating from the new women's colleges and coeducational universities during the last half of the century" (160-165). See also Penina Migdal Glazer and Miriam Slater's *Unequal Colleagues: The Entrance of Women into the Professions, 1890-1940*, (57-64).

Chapter 6

AMERICAN PROGRESS: CELEBRATED OR RELEGATED?

The Philadelphia Centennial of 1876 and the World's Columbian Exposition in Chicago of 1893 offer "significant social and cultural artifacts that reveal much about the times and places that produced them" (Segal 125). Although women had exhibited at previous American fairs, the Philadelphia Centennial was the first time "there was a separate building devoted exclusively to the wide-ranging products of women's thought and labor" (Trescott 102). Included in both the Philadelphia and Chicago women's buildings was a separate exhibit for women inventors. Unlike other women's exhibitions of the past where traditional women's work was marginally represented, the Philadelphia Centennial and the Chicago Columbian expositions encouraged women to focus on industrial interests. What inventions women exhibited, how their presence was mediated, and how the public responded to their presence and their inventions were functions of time, place, and resources. In addition, the cultural value assigned to women's technological contributions in 1876 and 1893 provide insight into how women's relationship with technology had expanded during the last quarter of the nineteenth century. The responses to women inventors and their inventions at both expositions serve as cultural indexes, reflecting a social pulse which measured changing values and persistent assumptions about women inventors.

Insightful cultural responses were expressed through a variety of mediums,

including women's own fair publications, leading scientific journals, and general media coverage. The *New Century for Women,* a weekly newspaper published by women during the Philadelphia Centennial, was dedicated to the "industrial interests of women" and to "advancing the prosperity and extending the opportunities of women-workers" (May 13, 1876). The journal was also published as a defense to "so much sneering upon the character of some of the work exhibited and so much good advice lavished on the women in regard to the folly of their trying to make a separate exhibit." The Women's Executive Committee decided that "it would be well to say a few words on the subject" in order to set the record straight and to distinguish women's accomplishments with positive values (May 13, 1876).

The New Century, written by women about women, merits comparison to the highly respected *Scientific American* edited by Alfred Ely Beach and Orson Desaix Munn. The prospectus that was published with the first issue of *Scientific American* pledged,

> ". . . to furnish the intelligent and liberal working-men, and those who delight in the development of those beauties of Nature, which consist in the laws of Mechanics, Chemistry, and other branches of natural Philosophy--with a paper that will instruct while it diverts or amuses them" (Shenton 5).

Since the *Scientific American's* first edition in 1845, the editors enthusiastically endorsed the American penchant for invention and believed it was "the unique aptitude of Americans for inventions that set them off from other peoples" (Shenton 6). During the Centennial exposition, the editors published the *Scientific American Supplement* with the original express purpose to describe and illustrate interesting exhibits at the exposition. It continued after the exposition as the technical supplement to *Scientific American*

(Shenton 6, 7). In its review of the Women's Pavilion in the 1876 Philadelphia Centennial, however, women's technological contributions were viewed with a distinct bias, one that barely credited women as sharing in the afore mentioned "scientific delights." It was evident that a domesticated characterization of women inventors persisted.

This characterization was a point of continual friction between women inventors and public reception to their inventions. This focus serves as a comparative basis to the reactions recorded 17 years later at the 1893 Chicago's World Columbian Exposition Woman's Building when a noticeable change in media perception occurred. A correspondent for the North Dakota newspaper, *Fargo Argus* reported that women's achievements as represented in the Woman's Building in 1893 "form an object lesson in the history of woman's intellectual development, and present an unanswerable argument to those who have been wont to deny her ability to excel in any line of work outside of light fancy work or household drudgery" (Shaw 61). In the case of women inventors, this was especially true. In support, there was a substantial increase in the number of women inventors who exhibited in Chicago and in the number of awards which recognized their contributions. In Philadelphia, 79 women exhibited and won 14 awards and in Chicago, 335 women exhibited and won at least 33 awards (Stanley *Mothers* 760). [1] The 17 year interim between the expositions showed an increased measure of recognition of women's inventions and created an embryonic public image of the woman inventor which continued to develop with the explosive technological advances of the 20th century.

The atmosphere in which women's technological innovations were recognized at these two world class expositions reflected the patriarchal struggle to maintain cultural control over women's relationship with technology which was intent on keeping women restricted to domestic technology. Social convention did not relinquish its constricting dictates that placed the ideal woman exclusively in the home, but cultural standards did show evidence of change as the 19th century drew to a close. As American technology advanced, women's relationship to it showed movement out the strictly domestic realm and into selective industrial fields. Men and women continued to be socialized to view gender as an ideological construct which dictated the proper relationship each sex should have with technology, but these constructs, like the fairs themselves, focused on progressive ideals revolving around technological advancement.

A primary purpose of America's first national expositions was to proclaim America's technological superiority which presented a paradoxical culture clash between men's and women's "appropriate" relationship with technology. Both the Centennial and the Columbian expositions provided a public platform for women inventors which made it undeniable that they had expanded their relationship with technology. Particularly in the Philadelphia Exposition, the resistance to expanding such boundaries was overt on one hand while encouraged on the other hand. Both fair administrations could claim that *even* American women participated in America's quest to achieve and maintain international technological superiority. By the Chicago Columbian exposition, the resistance to women's participation as technological contributors surfaced distinctly as a subtle undercurrent. For women inventors, this meant that they experienced increased access to exhibit space, increased respect, and an emerging atmosphere where women

might participate in technical activity on a new expanded level beyond hearth and home. As Henry Nash Smith pointed out, by 1893 the World's Columbian Exposition provided "something like a mark of punctuation in American cultural history" and one might add, in the history of American women inventors (xvii). By the close of the Columbian Exposition, women inventors had left an indelible imprint on the history of American technology.

Prior to the Centennial Exposition in 1876, women inventors remained virtually invisible in the progressive technological scene. Although they had shown a dramatic increase in the number of patents during the Civil War and the Reconstruction era, their contributions were barely recognized by the larger public, and even less celebrated. Efforts to be included in the 1876 Centennial Exposition demonstrated women's determination to prove that the "woman's sphere is as much of the world as she can move in" and "that the woman's kingdom is not only within four walls, but without . . ." (*New Century,* May 13, 1876).

Women participated in the 1876 Centennial not just out of "pure patriotism," but as "intelligent observers of this country's record in its centennial year" they sensed that, "never before had American women such activity and purpose; never before did they feel such a sense of responsibility, such a knowledge of awakening power" (*New Century*, May 13, 1876) Yet, their activity and purpose was continually devalued because, "custom, society, and the laws of corporations present[ed] each so many obstacles in the way of self-supporting women" that women's accomplishments, particularly inventions, were viewed with lesser credibility and significance than their male counterparts (*New Century*, May 13, 1876). The power of voice, presence, and representation in an

international cultural arena was not to be missed, though, by either the Women's Executive Committee in Philadelphia in 1876 or by the Board of Lady Managers in Chicago in 1893. President of the Board of Lady Managers, Bertha Palmer, felt an ideological kinship with the Women's Executive Committee regarding the responsibility to "clear away any misconceptions as to the value of inventions and industries of women. . . [and to] present a complete picture of the condition of women in every country of the world. . . particularly of those who are breadwinners" (Greenhalgh 178).

Misconceptions, though, were the rule rather than the exception. And in some measure, they were not without valid merit, especially in review of the Woman's Pavilion in Philadelphia. Misconceptions about women's abilities, especially regarding technology, were perpetrated by design. The minimal size of the Woman's Pavilion, the lack of time to put the exhibits together, and the complete lack of funding certainly worked toward the misconception that women were less productive in areas outside of the home. What *The New Century* acknowledged as a "poverty of exhibits in some branches of industry" was "due greatly to the fact that women of limited resources make up the majority of those who have achieved any success in either science or art" (Aug 19, 1876). The dilemma of limited resources plagued the women organizers from the outset in 1871 when plans for the Philadelphia Centennial Exhibition began.

Plans included what Congress deemed appropriate and what American powers wanted the world to see as,

> ". . . its progress in those arts which benefit mankind, in comparison with those of older nations . . . The centennial anniversary of the Declaration of Independence seemed an opportune time to celebrate the nation's achievements and its contributions to the arts and sciences of the world" (Miller, L 3).

The Centennial Exhibition was to feature the latest developments in both machinery and arts in the two dominate buildings, an art gallery, Memorial Hall, and industrial machinery in the Machinery Building (Miller, L. 3-6). The attempt to exhibit America's accomplishments in the fine arts was overshadowed by America's technological wonders. The 1870s introduced an array of innovative technology: a workable typewriter, the sewing machine, developments in refining, mining, civil engineering, the Bessemer steel-making process, the development of transcontinental railroads, the telegraph and the telephone to name just a few (Nugent 4; Gies 6-8). And although women inventors had contributed to many of the major industrial fields and had actively participated in the nation's industrial progress, the inclusion of their contributions and other women to the Centennial Exhibition was an afterthought (Stanley *Mothers* 501;886-897). Elizabeth Cady Stanton quipped, that "it was too much like the afterthought that "theologians claim woman herself to have been" "(Macdonald 77; Weinmann 4).

No women were included on the original Centennial Board, which was organized to raise money, initiate exhibit plans and supervise the exhibition administration. After a year's work in February of 1873, the organizers realized that they had,

> . . . failed to arouse all the interest necessary to carry the undertaking to a successful issue, and they therefore had invited thirteen ladies, in memory of the thirteen colonial States, to cooperate with them in the endeavor to create popular enthusiasm and to add to the subscriptions for Centennial stock (Gillespie 270).

They recognized the fund-raising talents among a host of women who had established successful fund raising reputations during the Civil War and thereafter in their club and community activities. Consequently, the Women's Centennial Committee was formed

with Elizabeth Duane Gillespie, great granddaughter of Benjamin Franklin, as head. Her administrative abilities were well established through her involvement in the Philadelphia Sanitary Fair of 1874. She accepted the position on one condition, that women be allowed exhibit space in the Main Exhibition Hall "to give the mass of women, who were laboring by the needle and obtaining only a scanty subsistence, the opportunity to see what women were capable of attaining unto in other and higher branches of industry" (Gillespie 282). At the annual meeting in May of 1873, the Centennial Commission agreed to this condition and promised "ample space" (Gillespie 282; Weinmann 1-2; Brown, D. 139).

Gillespie's experience and enthusiasm earned her the reputation of "imperial wizard, the arch-tycoon" of the Centennial Exhibition (Brown 139). Women's Centennial Committees were formed in almost every state. Stock subscriptions for the exhibition were sold nationally. Centennial teas were held where tea was auctioned at premium prices and tickets sold for as much as $50. For one such "Centennial Tea" in Boston, Ralph Waldo Emerson wrote a poem for delivery, with all the proceeds going to the Exhibition. The Women's Executive obtained permission to have Martha Washington medals made at the United States mint which were sold with great success along with other souvenirs (Gillespie 306). By June of 1875, Gillespie's efforts had netted over $93,000, which she turned over to the Fair's Board of Finance. All were confident that plans for women's exhibits were well under way (Weimann 2, Brown D, 140).

But on June 11, 1875, Gillespie wrote that the "cup of hope was dashed from our lips" by two letters she received. One was from Mr. Goshorn, the Director-General of the

Exhibition, which explained that there was no space, after all, for the women's exhibit because of the "demands that have been made by foreign countries for space" and suggested that they might build a "worthy and attractive" building of their own. The second letter was from Mr. Cochran, the Chairman of the Committee on Grounds, Plans and Buildings, who expressed sorrow that there was no money in the coffers to contribute towards the women's building. He suggested that if they could come up with "say, thirty thousand dollars" they could construct a building "two hundred feet by two hundred feet, covering one acre. . .at a prominent position on the grounds" (Gillespie 311-313; Weinmann 2).

Gillespie later wrote that she never forgot "the utter misery of those first moments, for the women of the whole country were working not only from patriotic motives, but with the hope that through this Exhibition their own abilities would be recognized and their works carried beyond needle and thread" (Gillespie 313; Weinmann 2). All hope, though, was not lost. Gillespie was "encouraged" by the Centennial Committee's advice to, "Get up a side show for yourselves, pay for it yourselves, and be - - happy" (Weinmann 4).

And while never happy with the arrangement and never acquiescing to women's accomplishments as a side show, Gillespie put her anger to productive use and raised the necessary $30,000. By October construction finally began, with H. J. Schwarzmann as architect, the same individual who designed Memorial Hall (*Illustrated History* 1877, 656). This experience, Gillespie claimed, was their "first great mistake" of not employing a woman architect, a mistake which was duly noted by the Lady Board of

Managers of the Columbian Exposition when they commissioned a female architect for the Women's Building (Gillespie 315; Weinmann 3).

The structure was the smallest on the grounds, 208 feet by 208 feet (Norton Charles B, 42). [2] It housed 600 exhibits, a library, art gallery, kindergarten annex, and the offices of *The New Century for Women* (Weinmann 3). The wooden building, considered to be of modern style, was built in the shape of a cross, with wings extended outwards on four sides, surmounted by arched roofs. The many windows were lavishly decorated with gingerbread. A cupola with a high flagstaff at the center, topped the building. The exterior was painted a light bluish gray color and the interior was in the "softest shade of light blue." The building was described as very pretty, attractive, tasteful, graceful, and one of the handsomest edifices connected with the Exhibition (*Illustrated History* 1877, 654-656). By design, the building was embedded with values which placed women on an ornamental pedestal. By design, the building was not masculine, bold, nor massive. It was distinctly feminine, domestic and submissive in its presence to all the other exhibition buildings.

Historian Helen Lefkowitz Horowitz makes the following observation regarding design and experience: "No meanings intrinsically inhere in associational schemes or in buildings. A culture invests both with significance" (xviii). The Woman's Pavilion was richly invested as a significant cultural and social artifact which reflected values associated with virtuous femininity and traditional womanhood. For example, women were considered to be spiritual pillars as suggested in the overall building shape of a cross. They were considered the weaker sex, fragile, pure, and delicate, as evinced in the lavishly intricate gingerbread and multiple windows. The soft and airy colors of the

building emitted a sense of peace, harmony, and welcome, not aggressive, demanding, or confrontational. The design of the Woman's Pavilion was imbued with the virtues of the ideal woman: domestic and submissive. Regardless of what was housed therein or what the declared objective was, the building was invested with cultural significance which placed women in a protected, domestic, and "very pretty" place -- like the ideal home. This investiture worked toward devaluing anything exhibited in the building which challenged these cultural standards, which meant inparticularly a portion of women's industrial and mechanical inventions.

The ever vigilant patriarchal Centennial Committee had the building erected on "Belmont Avenue, across from the United States Government building, in front of which was a pair of enormous cannon pointed straight at the pavilion." The symbolism cannot be missed regarding government's attitude toward women's organized activity (Brown D, 141; Weinmann 3; *Illustrated History* 1877, 654). The declared object of the women's department was "to exhibit the highest types of women's work, and, if possible, to enlarge the sphere of her usefulness and profit in the future" (Norton, F. 92). This mission sent up the red flag to the male vestige of business and industry. Profit margins were threatened by a formidable portion of the population-- industrial minded women.

The Woman's Pavilion opened on May 10, 1876, along with all the rest of the exhibition buildings, despite the continual doubt of the male commissioners who predicted that the building could not possibly be completed by opening day (Brown, D. 140). More than 186,672 visitors poured in the first day to tour the first American fair of real international importance in commemoration of one hundred years of independent American history (Weinmann 1; Rydell 10). What they saw reflected the strengths,

weakness and values of American culture. The exhibition was not to be just a holiday, but "a great school of instruction" where people viewed the past with the purpose of future self-improvement. The attitudes and values exemplified in the diverse exhibits were meant to educate and mold tomorrow's citizens. It was meant to be "a working model of an American Mecca," designed to celebrate material progress, to sound a call for culture, and to emphasize order and harmony among diverse peoples" (Rydell 11; Morgan 55).

For women inventors, the Woman's Pavilion proved to be an American Mecca, but with a much different agenda than the rest of the exhibition. As a whole, the Woman's Pavilion presented a showcase of women's struggle for equality. From the planning stages where women struggled for inclusion, a sobering July 4th celebration, a memorable November 7th election day, and through to the closing addresses in mid-November, what women exhibited, particularly inventors, and how their presence was mediated reflected the persistent assumption that women's place was in the home, her intellect was inferior, and her technological capabilities were limited (Weinmann 4; Rydell 110). Women's relationship with technology was shaped and circumscribed by autocratic social convictions.

The limitations, more than the accomplishments, of the Woman's Pavilion were widely and unanimously recognized. The reasons for its shortcomings, though, were not so unanimously recognized and register the complexity of the cultural indexes prevailing at the time. The women's department contended that, "We live in a country and an age of experiment; the American woman is herself an experiment in the face of social laws in the old world." And they saw the Woman's Pavilion as a laboratory where her

accomplishments could be studied and evaluated by all, especially "to show woman as a worker. To separate her work, to admit the distinction of sex, and to do its share in pointing out to her the avenues of remunerative labor "(*New Century*, May 13, 1876). Gillespie pointed out that the women's exhibits were aimed " to give to the mass of women who were laboring by the needle and obtaining only a scanty subsistence, the opportunity to see what women were capable of attaining unto in other and higher branches of industry" (Gillespie 282; Warner in Trescott 109).

One of the most promising "higher branches of industry" open to women was invention (Warner 103). But to the disappointment of many, most of the women's inventions at the Centennial were characterized as domestic in nature. Why this factor constituted a disappointment is a revealing cultural index. The disappointment was not voiced because the inventions were considered technologically insignificant, although such evaluation still persists today. [3] Or was the commentary offered because the exhibited inventions had little marketability, because many proved to be financially lucrative. But for women, the disappointment lay in not demonstrating the true scope of their accomplishments beyond "the four walls" and their capabilities in "higher branches of industry." For others, disappointment was based on the seemingly paltriness of the exhibit, which was taken as evidence that women simple were incapable of doing anything except domestic activity and work.

Even from sources that had traditionally supported women's inventive activity, the invention exhibits in the Woman's Pavilion drew negative reviews. For example, *Scientific American*, known for its "profound belief in the benefits and promise of science and technology" recognized and supported "female inventive talent" well before the

Philadelphia Centennial opened (Shenton 11). In an article which discussed "the question of what women can do and what they cannot do well," it was concluded from the publishers experience that "women have as much natural inventive talent as men, and that the circumstances under which most of them pass their lives only prevent an equal manifestation of this talent on their part." To unbelievers, they argued,

> . . . in regard to the power of women to achieve, as a class, anything higher than a pound-cake or a piece of embroidery, that the inventions made by women, and for which they solicit patents through our agency, are generally found to be in their practical character, and in their adaptation and selection of means to effect a definite purpose, fully equal to the same number of inventions selected at random from among those made by men (Sept 17, 1870).

But six years later, in review of the Woman's Pavilion, their comments were few and terse regarding women's inventions:

> Leaving out fancy work, woman's labor is but poorly represented. There are a few inventions, where there might be many. We notice some dish washers and a life-preserving mattress, which, it is said, is to be officially tested, and there is a fine collection of medicines prepared and put up by fair hands (June 24, 1876).

The rest of the review, though, suggests that they "noticed" far more than a few dish washers and such. A considerable amount of detail went into describing "Queen Victoria's beautiful napkin" and the "deft persevering fingers, in the innumerable worsted pictures, hair chains, feather and shell ornaments, the marvelous pieces of knitting" and a quilt with fifteen hundred rosebuds.

The review opened with the observation that the most interesting "object" found in the Woman's Pavilion was the person of Miss Emma Allison, who operated the Baxter steam engine used to power the printing presses for the *New Century for Women.*

Allison surprised visitors by her seemingly incongruous dainty and attractive features with her master competency over the machinery (Macdonald 83). Although the *Scientific American* writer had never "seen a woman manage a steam engine before," it was noted that "the lady herself suggests very truly that there is a good field for woman's work in taking charge of the thousands of small motors in minor manufacturing operations" (June 24, 1876). [4] The idea that the "fair sex is quite competent for the duty" of operating "small motors in minor manufacturing operations" conveys the prevailing discriminatory attitude that women and machines had a limited relationship in even the most liberal minds of American men of science. But for the exception of Miss Allison, the larger picture of women's relationship with technology, was dismissed as disappointing. The reviewer wrote, "We wish we could speak as highly of the rest of the woman's display in general; but it must be considered, as a whole, to be disappointing."

The mention of only 2 inventions and some patented medicines out of 79 inventions, certainly raises suspicion as to what criteria *Scientific American* adhered to when writing that there should have been many inventions instead of the noticed few, particularly in view of its extensive and laudatory reviews of other exhibits such as the boats, machinery hall, the aquaria and such (June 17 & 24, 1876). Did the 70 or so other inventions which constituted a quarter of the entire Woman's Pavilion simply miss their attention? (Warner 103). Or were they so insignificant as to be considered invisible because of their domestic categorization? If they weren't agricultural, mechanical, or industrial, did the reviewers find them so trivial as not even worth a mention for description's sake? Or if they did fall into a masculine category outside of conventional domestic boundaries, was the oversight influenced by prejudicial standard which assumed

that women could not possible produce significant inventions which required chemistry, engineering, physics, or mechanics? Inventions such as the pyrotechnic flares, electrotherapeutic appliances, nolanum building material, a ribbon making loom, a self-inflator for raising sunken vessels, and a gauge used in the manufacture of candy lozenges offered serious challenge to the persistent notions of women as antitechnocrats. Yet, the above inventions do not even rank a mere mention by *Scientific American*. Why? These inventions were out of cultural context in the Woman's Pavilion, and, therefore, not part of the collective ideology the building represented in its very structure and in its exhibition contents on a whole.

Innovative inventions which were perceived as connected with the home, family, or women specifically, were considered less valuable by their very categorization as domestic. Their lack of significance is implicit in their garnering a conspicuous lack of media attention. It is difficult to imagine that so many exhibits could have been missed by any professional reporter and writer. Innovative domestic inventions such as the following were on display:

> Several dish washers, a rotary washing machine, various sewing machines and sewing machine attachments, such as a feeding mechanism, needle and arm, vertical handle attachment and a machine for straw braiding, a one eyed sewing machine needle, scissors with sewing machine tools, parlor cook stove, the Reliance cook stove, Potts cold-handled sad-iron, gas smoothing iron, several window related inventions such as ventilating strip and shutter fastener, bedstead with drawers below, combined traveling chair and bag, bathing chair for ladies and invalids, Stiles combination desk, work table, leather table with checker board, stereoscope, a globe, chemically preserved process for natural flowers, underclothing for women and children, baby jumper, dress cutting system, dress maker's marking and cutting gauge, models for fitting ladies dresses by self-measurement, and Demorest's

> several very successful pattern and dress cutting inventions (Warner 110-119). [5]

Despite falling mainly into the domestic category of invention, women's inventions were well represented with machines, appliances, furniture, child care items, women's clothing, cooking devices, cleaning products, and miscellaneous household innovations in such obvious quantity and diversity that it would have been impossible for an exhibit reviewer to miss their presence altogether. Rather, by their very preponderance, they functioned as a cultural index of women's accomplishments as being exclusively centered in domestic activities. For those inventions that were not domestic, they appeared as deviant exceptions in this setting, something which was downplayed and minimized as to significance.

For some, this was viewed as a way to protect feminine virtue from intruding, corrupt masculine influences. For others, it was a way of controlling and limiting women's relationship with technology so as not to encourage encroachment into male domains, occupations, and profits. But for still others, mainly women, the quality and nature of what was exhibited under the roof of the Woman's Pavilion spurred a factional opposition lead by "many liberal-minded women" because it did not help, but rather hindered, the "cause of Woman" (*Woman Journal,* July 29, 1876). In an article entitled *"Woman and the Centennial"* opposition was based, in part, because,

> The kind of work which we wish shown is not there. The building might be called a "huge work-box," filled with an immense variety of needle-work. There are a few patented articles such as a dish-washer, carpet sweeper, bed-stead with drawers, a new model to cut dresses by; things which help in the narrow sphere, which has been called Woman's -- that of housekeeping (*Woman's Journal*, July 29, 1876, 243).

A strong contingent of women wanted representation in occupational fields outside of the home, where "many other employment's monopolized by men, but eminently suited to women," had yet to be opened to them. And specifically concerning women inventors, they wished to display evidence to disprove the heresy that women are deficient in inventive faculty (*Woman's Journal*, March 25, 1876, 97; June 30, 1888, 204) .

The article, *"Women and the Centennial"* continued by asking the rhetorical question, "Why did not we women come out in full force, and take our stand beside the men, as some of our best artists have done?" It is not surprising that the reason remained unknown or distorted as to why women were not exhibiting among the men. As noted, it was Gillespie's first choice to do just that and she was initially granted "ample space" for women's exhibits in the main building. But even relatively recently, this fact has been obscurely or incorrectly referenced. For example, in Dee Brown's 1966 edition of *The Year of the Century: 1876,* she included the following erroneous account:

> Actually, in the early years of her reign, Elizabeth Gillespie met with considerable resistance from the directors of the Exhibition. By 1875 her plans for a display of the abilities and skills of women were so extensive that she had to be told firmly that there would not be space for a tenth of these exhibits (139).

It was true that she was told firmly that there would be no space for women's exhibits, but it was clearly a political control move aimed at minimizing and devaluing women's involvement in the exhibition.

Regardless of the misconceptions as to why women didn't produce a more expansive and impressive exhibit, the result was fairly unanimous. Even women supporters of the Centennial agreed that there was "a poverty of exhibit in some branches

of industry, or, in certain cases, an entire failure to be represented at all" (New Century, Aug 19, 1876). As acknowledged by the *New Century,* the exhibition was "one-sided, limited" in reference to domestic development (Aug 19, 1876). The *Woman's Journal* concluded,

> As it is, this imperfect show of Woman's work is given to the world, and our enemies may well say, "After all your talk you plainly show your vocation." Never shall we obtain a just share in the management of this great Republic, until we are willing to have all our work compared with that of men . . . (July 29, 1876, 243).

With the exception or a very select few women, their accomplishments were exhibited in the Woman's Pavilion or not all. Two, who had their work compared with that of men, were notable exceptions and inventors, Susan Stuart Frackleton and Susan Taylor Converse. Frackleton, a respected artist and inventor, invented a portable gas-kiln for firing her china paintings (2 patents, 1886 & 1888). It was her china paintings, though, and not her kiln, which were exhibited alongside men's work (Willard and Livermore 298; Macdonald 128-130). Converse patented the "Emancipation Suit" in 1875, which was the first "hygienic" undergarment approved by the Dress Reform Committee. She exhibited it among the regular commercial exhibits and not in the Woman's Pavilion because she was asked to sell her garment at a reduced price in the Woman's Pavilion. Her response was emphatic. She invented because she "intended to use any invention for profit," and would not forego the twenty-five cent royalty she earned on each garment sold. She asked, "With all your zeal for women's rights, how could you even suggest that "one woman like myself should give of her head and hard labor without fair compensation" " (Warner in Trescott 108; Stanley *Mother* 246-247; Macdonald 113-115). Like other inventors, she invented for money and exhibited at the

Centennial to promote her invention, find backers and established manufacturers. She was not particularly interested in solidarity for the sake of woman's rights. This was not an original agenda by any means, but one followed by the majority of male inventors who considered the Centennial as a trade fair (Warner/Trescott 103).

The *Scientific American* summed up its review that "the severest criticism that can be made on the woman's Pavilion is that its contents show woman's amusements, not her work" (June 24, 1876, 401). So along with the *New Century* and *Woman's Journal*, the *Scientific American* agreed that what women exhibited was disappointing in comparison to the anticipated potential. But that is where the unanimity of opinion began and ended. The reasons why each of these three sources had rendered such an opinion varied considerably. The range of difference as to why the experiment of the Woman's Building didn't work reveals the complexity in reading the cultural indexes which evaluated women's inventions (Greenhalgh 177-178).

The *Scientific American* expressed disappointment in the Woman's Pavilion, in part, because it was "too pretty" and couldn't be taken seriously as a scientific and inventive exhibit of professional caliber. Other than "fancy work, woman's labor was poorly represented" it intimated because she wasn't good at anything else. Reviewing the article, *"Female Inventive Talent"* only six years earlier, the basis for the evaluation criteria was suggested with the caveat that the only thing that prevents women from competing equally with male inventors was "the circumstances under which most of them pass their lives." Such circumstances were so culturally ingrained in the whole affair of the Woman's Pavilion, that what few exceptions managed inclusion were hastily

overlooked, submerged, or pardoned and became quite invisible to even the most favorable of visitors.

In defense of the "poverty of exhibit," the mouthpiece of the Woman's Pavilion, the *New Century,* stated that there was no claim "to a full representative exhibit" because it was "the first attempt of its kind ever made" and reiterated that because of limited resources, women made slow progress. But for any that claimed the Woman's Department was failure, the *New Century* assured its readers that it was they themselves who had surely failed to catch its real meaning. The real meaning of the Woman's Pavilion was "to show her exact measure of her capacity as well as her points of deficiency" and "to render it impossible ever again to impugn woman's practical ability." It wasn't that she was incapable of anything but housework. Rather, that she could "carry forward successfully anything she choose to undertake." But because of imposed limitations, which included economic, political, and social resources, her progress was understandably slowed, almost halted in some industries (Aug 19, 1876). Inventive progress was undeniably present in the Woman's Pavilion in the form of 79 inventions, but the cultural devaluation of such, whether because it was "just" domestic or a deviance thereof, worked toward devaluing of invention itself as something in which women were incompetent and incapable.

And as for the *Woman's Journal,* disappointment was based on the blatant inequity surrounding the entire involvement of women in the Centennial. Most all of the patented inventions on display they claimed helped to glorify that "narrow sphere, which has been called Woman's--that of housekeeping." What was on exhibit was an "imperfect show of Woman's work" (July 29, 1876, 243). And although women made

the best of the resources they had, their obstacles were immense. The journal claimed that women had been "cabined, cribbed, confined, as though they were children, or lunatics, or wild beasts" because it was feared that if the way were open to them, they would "rush off into all manner of folly and evil, forsake all natural instincts, select those paths for which they were least fitted and grow into all manner of monstrosities." The sarcastic tone conveyed the ludicrousness of such absurd fears. The article admonished, "Give women knowledge and they will become wise, give them tools, and they will invent; cease to look down upon them, and they will rise to the level of men . . ." (July 1, 1976, 209). In the case of the Woman's Pavilion of 1876, they did not get knowledge, tools, or equality. In part, the preponderance of displayed domestic inventions were a measure of such cultural constriction which limited women's relationship with technology in the domestic field. What they got was "a little pavilion with piles of needle-work, rich with the golden sands of wasted hours" which would not do much to teach the world about women's accomplishments. The *Woman's Journal* believed they had gotten a "puny show" (July 1, 1976, 209).

Because the *Woman's Journal* was more closely aligned with the women's movement than the *New Century*, the inequity of the entire Centennial hit nerve after nerve. Besides the puny show in the Woman's Pavilion, women felt the sting of inequity when they were not allowed a place on July 4th program to read their "Declaration of Rights for Women." They were given 6 tickets to the program instead of the 50 tickets they requested so that at least one women from each of the states could attend. On July 4th, Susan B. Anthony and five other women presented their "Declaration" to the master of ceremonies and several others and then withdrew from the assembly. Anthony

publicly read the Declaration outside in Independence Square atop a music platform to a supportive crowd:

> While the nation is buoyant with patriotism, and all hearts are attuned to praise, it is with sorrow we come to strike the one discordant note," she began, and went on to explain that women in 1876 had "greater cause for discontent, rebellion, and revolution than had the men of 1776 (Weinmann 4).

The extent to which women inventors experienced discontent and inequity is only now just beginning to be recognized and understood. The democratic ideology upon which the U.S. Patent Office was founded was flawed from the beginning in extending equal opportunity to women inventors (See Dissertation Chapter 1).

Another memorable sting was delivered ironically on what was designated at the Centennial as "Women's Day," November 7th, election day. The choice behind the designated date was that "while men were doing their duty at the polls the women would have the day all to themselves" (Greenhalgh 177-178). For those women who were aligned with the suffragettes or those merely sympathetic to women's rights, the politics of the exhibition made a mockery of the entire concept of progress, the principals of independence, and the democratic process. No specific responses by women inventors to either the July 4th or the November 7th incidents are known. But given many of their experiences, women inventors often indicated sympathy, affiliation, or in the least, personal understanding, of the issues surrounding women's rights.

A case in point of someone who exhibited at the Centennial and won an award for her pyrotechnic flare was Martha Coston. With a degree of certainty, her reaction to such inequity can be imagined based on the echoes of her feminist voice throughout her autobiography, *A Signal Success*. In her experience as an inventor she considered "it a

most bitter thing to find in the lofty institution of our country, the Navy, men so small-minded that they begrudged a woman her success" (Coston 272). The assumption may confidently be made that she was not alone in her discovery of small-minded men when it came to women's inventions.

Matilda Gage, noted 19th feminist, author and advocate for women inventors, was duly aware of how women inventors were begrudged of their success at the Centennial Exhibition. She was one of the writers of the "Declaration of Rights of Women" and accompanied Anthony when it was delivered and read. She experienced first hand the limited resources with which women inventors contended at the first national exhibit of their work. With her characteristic straightforward style, her lengthy and indepth comments delineate why success was begrudged and lend valuable insight into why there was such a poor representation of women's work at the Centennial:

> Let the Woman's Pavilion gather all it can of woman's work, it will still fall very far short of an accurate representation of women's industries and inventions, because most of the large manufacturing establishments are owned by men; and, although largely employing women, the work done in these establishments owned by men will be entered in men's names. For instance, Lynn, the great shoe-mart of the country, employs more women than men in the manufacture of shoes: yet, as no woman owns such an establishment, all such work exhibited at the Exposition will come in under men's names. . . .
>
> Many of woman's inventions have been patented under men's names. The largest foundry in the city of Troy is run to manufacture horseshoes, one of which is turned out every three seconds. The machine which does this work was invented by a woman; but the manufacture is carried on under a man's name, and will be exhibited as man's work. . .
>
> . . . Elevators, lubricating felt for car-wheels (a most important invention), volcanic furnaces for smelting ores, steamer screws, machinery for cotton-factories, wood-sawing machines, musical

> instruments, syllable type, submarine telescopes, looms capable of doing three times the work of the ordinary looms, are among the various inventions of women of this country, that will, to a great extent, be exhibited as man's.
>
> . . . Women need to become something more than laborers, something more than mere hands in order to secure just recognition of their industry: they need to themselves become heads of establishments, to own the manufactories, as well as to have designed the work done in them. So, at the best, the Woman's Pavilion will but poorly represent the industries of the women of this country and of the world (Hanaford 621-624).

Until women inventors were recognized as more than houseworkers who simply tinkered at invention to make their workload lighter, their inventions would continue to be relegated rather than celebrated. Until women assumed ownership and leadership positions in American industry, their technological contributions remained consigned and obscured behind a multi-featured false identity. Gage believed that until women assumed ownership and leadership positions in industry, their technological contributions would remain devalued and unrecognized.

In the final analysis, the Woman's Pavilion at the Philadelphia Centennial in 1876 was an experiment with mixed results. It wasn't a complete failure simply because of the poor representation of women's industries. But neither was it a resounding success simply because it was the first. Historian Deborah Warner of the Smithsonian Institute comments that what it did do was signal " the entrance of skilled crafts-women into the world of industrial fairs of nineteenth century America." But even though it was the first time women had a separate building devoted exclusively to women's "thought and labor," none of the women's inventions, she thought, were "important in any large social

or technological sense, but many were successful on their own terms" (Warner in Trescott 102-104).

Other current historians, such as Jeanne Madeline Weimann, author of *Fair Women*, tend to agree with Warner's conclusions. In concurrence, Weimann believed that the exhibition had "no great symbolic significance" because, in part, "its birth pangs had been made too agonising" (Weinmann 4). Both historians agree that while the Philadelphia Centennial did not prove to be especially significant in and of itself, it was the beginning of women's presence at national fairs. As such, the Philadelphia Centennial Exhibition served as a public platform indicating an expanding social place for women in the context of American progress. Although that presence was mediated with resistance and prejudicial values, the Exhibition functioned as a social and cultural artifact which rendered a positive answer to the persistent question, "Can a woman invent?" (Hanaford 621). The technological, social, and cultural value of such inventions, though, remained undermined.

The significance of the Philadelphia Centennial to women inventors specifically should not be overlooked in the general appraisal of its overall mediocre importance to women. Women inventors were nationally recognized for the first time as a collective group and individual merit was given to at least 15 women in the form of Centennial awards, including the highest award of the Centennial (Warner in Trescott 103). [6] The cultural value assigned to women's technological contributions, regardless of their categorization, remained, however, domestic. And although the recognition of woman's inventive capabilities was a measure of social progress, the persistent domestic characterization solidified women's place in a narrowly defined work place -- the home.

Women's inventions were valued primarily in the context of their proscribed social roles as wife, mother, and homemaker. The cultural index registered a positive change in the acceptance of women inventors, but persistently characterized their activity within a narrow domestic scope.

As the 19th century drew to a close, feminist activity grew in scope. The Philadelphia Centennial had laid the ground work for exhibitions to increasingly become centers for women's activity (Greenhalgh 174). By 1893 the cultural indexes were primed for change as the women organizers of the World's Columbian Exposition joined forces in planning their presence in the greatest international fair of its time (Badger xiii). They had learned and benefited from women's first attempt to exhibit separately in the 1876 Centennial and were well aware of some of the challenges ahead of them. The Board of Lady Managers, like their predecessors in 1876, the Women's Executive Committee, felt a sense of responsibility to show the world what women had accomplished. But unlike the 1876 committee, the women administrators of 1893 made a clear alliance with the woman's movement and publicly advocated their support of women's rights. In the early planning stages, from 1891-1892, they attempted to get support from American and foreign women by billing the exposition as "an agent for reforming current attitudes about woman's work and woman's place in the progress of the century" (Badger 79).

American progress was the overwhelming theme of the World's Columbian Exposition for both men and women, individually and nationally. It resounded from the beginning in 1890 with the Congressional approval through to the closing addresses late in October, 1893. Beyond that date, the Exposition became a historical cultural icon

epitomizing and celebrating the idea of progress (Burg xi-xiv). It presented a colossal image of cultural unity and national self-confidence (Badger 123). The exhibition, despite its quick physical demise after the closing, was considered as "an imperishable part of the progress of mankind" (Burg 283). [7]

When Congress passed approval of the "World's Columbian Exposition" on April 25, 1890, it was with the express purpose that, "the four-hundredth anniversary of the discovery of America be commemorated by an exhibition of the resources of the United States of America, their development and the progress of civilization in the New World" (Kirkland 418). [8] Like the first American international fair, the Philadelphia Centennial, national progress was the kernel cause of celebration. But America's second international fair, the World's Columbian Exposition in Chicago, celebrated progress on a scale never before seen in any world's fair.

In comparison, it was simply bigger than any other. Encompassing the area known as Jackson Park in Chicago, "it covered a total of 1,037 acres, nearly three times the space of any previous exposition." The number of square feet under roof was over 5,000,000, square, twice the amount of any other fair, constructed with the aid of 12,000 to 14,000 workers. The landscaping was claimed to be "one of the most superhuman efforts in the history of landscape architecture." Eighty-six foreign nations, states, principalities, and colonies exhibited on what was termed "neutral ground." To put that figure into perspective, "the space allotted to foreign exhibits exceeded the total space of any previous world fair" (Burg 83, 85, 89, 95, 112). The bigness of it all became one of the fair's identifying trademarks. One visitor wrote, "Everywhere talk of the fair is big . . . In fact, the unit of measure in this enterprise has been set so large that one is in danger

of forgetting that the Yankee nation was established for any other purpose" (112). In addition to being big, it claimed the world's first ferris wheel with cars the size of busses, the first amusement park in a world's fair, the first electric transit system in the United States, and the first use of electric lighting for purely decorative purposes (Bolotin and Laing 156).

It was unlike the Philadelphia Centennial in another important way. While both had a women's building, women's participation and presence in the Columbian Exposition made a significant impact in recognizing women's accomplishments outside of the home and became a reckoning force concerning the advancement of women's rights. From the very beginning, women's presence was stronger, their voice louder, and their purpose more clearly defined. The results were impressive, revealing much about the changing status of women inventors and the social climate in which change fermented. What they exhibited, how their presence was mediated, and the ensuing media response served as important cultural indicators.

Cultural historian, Reid Badger, observed that international fairs, like the Columbian Exposition, functioned as a "symbolic cultural expression . . . that testify to the self-consciousness of the age." They provided industrialized America with a medium for cultural synthesis (Rydell, *All* 39). And in the broadest sense, this self-consciousness represented an "attempt to both acknowledge the reality of rapid change and to understand and control its direction" (Badger xvi). For women inventors exhibiting at the Columbian Exposition, this concept had particular application. Changes were evident in their stronger representation in quantity and quality of inventions. A sense of self-consciousness prevailed in the projection of a collective and individual

identity as inventor. Directional control of this identity no longer rested passively out of their reach, but by their inventions which afforded economic leverage, they placed themselves within the progressive context of the Exposition as valuable, credible, and significant in other than domestic categories. Many of the women exhibiting were professional inventors with successful inventions. Most exhibited in the Woman's Building, with a few more exceptions than at the Philadelphia Centennial exhibiting elsewhere, and their awards were from a wider range of committees outside of the Woman's Building. The categories showed increased diversity with a serious intent on economic gain. The newly emerging professional public image projected by women inventors at the Columbian Exposition had far reaching 20th century implications in expanding the relationship between women and technology to include industrial interests. Seventeen years after their "puny" first public debut as a working class of women at the Philadelphia Centennial, the Columbian Exposition "showed inventive women in a good light" (Macdonald 185).

From the beginning, women's participation in the Columbian Exposition, or as it was popularly called, the White City, was fraught with less hostility and more empowered organizational authority than at the Centennial. [9] Although there were no women appointed to the exposition's original National Commission, the Springer amendment to the Fair bill authorized an appointment of a "Board of Lady Managers" (Weimann 35; Badger 78-79). Many women found the name offensive, calling it a "ridiculous title" because,

> It conveys the impression that we are a useless ornament --; idle women of fashion; whereas our board comprises as many workers, as much representation of the active industries of the country, as if

> it were composed of men. There are doctors, lawyers, real-estate agents, journalist, editors, merchants . . . (36).

But regardless of the insulting name, the Board functioned with exceeding administrative effectiveness. The formation of the Board was initially considered a complimentary concession to women. They were "not expected to take an active part and no particular responsibilities or rules for their selection were stipulated" (Badger 79). Frances Willard of the Women's Christian Temperance Association, later wrote,

> The framers of the World's Fair bill probably builded better than they knew when incorporating the section which created the Board of Lady Managers. They can scarcely have anticipated the importance this unprecedented body was destined to assume. Nothing like it had ever existed before; its creation was entirely experimental . . . (Weimann 36).

Bertha Palmer, wife of a wealthy Chicago businessman and influential community leader, was voted President. She utilized the Congressional provision as a unique opportunity for women recognizing that,

> The provision of the act of Congress, that the Board of Lady Managers appoint a jury of woman's peers to pass judgment upon her work, adds to the significance of the innovation, for never before was it thought necessary to apply this fundamental principle of justice to our sex (Burg 105).

Palmer believed that women's enlarged participation in the exposition was more representative of progress than the fair itself. She considered it a milestone of huge proportion as she later remarked that "even more important than the discovery of Columbus was the fact that the general government has discovered woman" *(Book of the Fair* 267). Palmer and her fellow board members petitioned Congress for a definition of their responsibilities, which included the request they be allowed to do some "useful work" (Badger 79). There was a collective sense of responsibility to gather together the

best examples of women's wide ranging accomplishments. The judgment upon their efforts, she felt, would carry an important weight in determining the future of women's rights, social status, and employment opportunities. At a Board meeting held in September of 1891, after a trip abroad to drum up international support, she spoke prophetically:

> I must say again to our members, as women of America we have been given an opportunity such as has never before occurred. . . If we do not realize the almost solemn nature of the trust placed in our hands, we shall set back the clock of time half a century for women. If we live up to the possibilities, we shall open a new era for them (Kirkland 431).

An international community of women embraced the opportunity "to dispel the prejudices and misconceptions, to remove the vexatious restrictions and limitations which for centuries have held enthralled the sex" (*Book of the Fair* 267).

For women inventors, a new era of increased recognition and identity opened up. Although their work did not meet with universal support, a majority responded with approval which ranged between tacit recognition to high recommendation. Several underlying social and cultural developments supported a more favorable reception which were absent during the Philadelphia Centennial.

To begin with, the building in which most women exhibited their inventions presented a decidedly different cultural perspective of women's place in American society. For women inventors, the building was a cultural signifier which delineated an expanded relationship with technology, one which moved beyond the constricting domestic scope. This time, unlike at the Philadelphia Centennial, the building was designed by a female architect from Boston. Sophia Hayden, a 21 year old graduate from

Massachusetts Institute of Technology, won an architectural competition and became the first woman to design an international exposition building (*Book of the Fair* 257; Burg 78). The building was once again one of the smallest structures on the grounds, covering 1.836 acres. The only one smaller was the Administration Building, covering 1.274 acres. It was also one of the least costly of all of the buildings, at the cost of $138,000 (Weimann 152; Bolotin and Laing 44). Because the size necessitated a reduction in the scale of detail and a heightening of profile of its classic and Italian Renaissance style, some critics said it revealed the sex of its author because of "a smaller limit of dimension, a finer scale of detail, and a certain quality of sentiment, which might be designated in no derogatory sense as graceful timidity or gentleness." The derogatory sense was plainly intended as the critique further pointed out, of course, that such design flaws "at once differentiate it from its colossal neighbors" (*Book of the Fair* 257-259; Greenhalgh 180). A few others joined in the attack on the structure based on the gender of the architect, rather than any legitimate design defects (Greenhalg 181).

By cultural standards and more favorable design critiques, the Women's Building reflected an air of studied classical elegance, with an imposing formality some considered to be palatial and a fitting monument to the emancipation of women (Shaw 61). Hayden, the architect, said regarding the design that the "exterior expression had,

> evolved quite naturally from the interior conditions. It is not modeled after any precedent. In style it may be called Classic or Italian Renaissance, although it follows, strictly speaking, neither style . . . It is the result of careful training in classical design and the expression of what I liked and felt (Weimann 150).

Congruous with the classical design, the building was fronted by a lagoon, expanding into a bay about 400 feet wide and 10 feet above the water. The landing was a stone stairway

which led up to a 100 foot wide terrace landscaped with blooming shubbery and "beds of flaming color." The main entrance was a triple arched colonnade with Corinthian style columns "supporting an entablature and frieze decorated with wreaths in relief" (Shaw 61; Buel n.p.). The building boasted a popular roof garden adjoined to a cafe with a balcony running the length of the building on the upper story. The interior of the building included a host of foreign exhibit rooms, state rooms, sales rooms, record rooms, an educational room, the Smithsonian Indian and African exhibit, an assembly room, parlors, committee rooms, library, scientific rooms, and a room for inventions. (Weinmann 267, 152; *Scientific American* Sept 9, 1893, 171; *Book of the Fair* 257).

The stateliness of the building was further enhanced with original art by Mary MacMonnies, Mary Cassatt, Dora Wheeler Keith, Lucia Fairchild, Amanda Brewster Sewell, Rosina Emmet Sherwood, and Lydia Emmet. Throughout the building a series sculptures by San Francisco sculptor, Alice Rideout, depicted women's roles, attributes, and the parts they played in world history (Burg 144, 166; *Book of the Fair* 260). Some have argued that exhibits, such as Rideout's, which celebrated many of women's traditional and Victorian stereotypes of ideal womanhood, created paradoxical images of women, which sent confusing cultural signals (Badger 121). [10] But despite the integrated focus of conventional womanhood with feminist secular ambition, the master level of art maintained the culturally sophisticated image of the building. It supported the representation of women's accomplishments as significant and world class. Unfortunately, very little of these works survived after the exposition ended, but their record left a lasting impression of communal effort, high artistic achievement, and intellectual accomplishment (Burg 167-168).

Both the exterior and interior of the building projected a cultural image of worldly refinement, classical intelligence, and respected knowledge of many disciplines far afield of home and hearth. It joined the other architectural styles and interior designs at the fair which conveyed a cultural sense of elevated civilization. Although there is much debate over the image verses the reality of the cultural significance of the architecture, art, and the entire visual facade of the fair itself, the cultural status of the Women's Building was in harmony with the rest of the fair's mission (Badger 119-128; Burg xi- xv, 114-119). It, like the other structures, participated in the illusion of representing progress and advancement. And like the other buildings, what was exhibited inside registered contradictory cultural values which continue to perplex historians. By looking closely at what women inventors exhibited and the kind of criteria which determined standards, evidence suggests that women inventors were viewed as part of the progressive cultural element which celebrated progress unlike any other preceding time.

A *Preliminary Prospectus* was issued as a circular after the second Board meeting in September, 1891, outlining the purpose of women's exhibits. A focus on showcasing women's inventive abilities was central:

> It is our intention to make in the Woman's Building an exhibit which will clear away existing misconceptions as to the originality and inventiveness of women . . . The footsteps of women will be traced from prehistoric times to the present and their intimate connection shown with all that has tended to promote the development of the race, even though they have worked under the most disadvantageous conditions. . . It will be shown that women, among all the primitive peoples, were the originators of most of the industrial arts, and that it was not until these became lucrative that they were appropriated by men, and women pushed aside. . . Impelled by the necessity for its use, she invented the needle, and twisted the fibers of plants into thread. She invented the shuttle. . .She was the first potter. . . She originated basket-making, and

> invented such an infinite variety of beautiful forms and decorations as to put to shame modern products (Weimann 392; *Book of the Fair* 268-269).

At a later meeting of the State Boards on December 11, 1891, Palmer expressed her sincere desire that, "No sentimental sympathy for women will cause the admission of second-rate objects; for the highest standard of excellence is to be strictly maintained." She then outlined a nine-point agenda of what the Commissioners cooperating with the Lady Board of Managers would be asked to do, which detailed the kinds and caliber of exhibit selections they would solicit (Kirkland 431). In line with that agenda, Mary Lockwood, a widow, owner of the Strathmore Arms Hotel in Washington, D.C. and feminist interested in women's historical accomplishments, especially invention, was appointed to the Patents Committee by Palmer who hoped to find the unusual by seeking out women inventors (Weimann 428).

Lockwood was advised to speak with F. T. Bickford of the Smithsonian Institute, who was the Secretary of the Government Exhibits at the Exposition. After an hour's discussion, Bickford made it plain that the institution had no plans for showing women's inventions. It was possible, he said, that if "some woman had invented a needle or sewing machine superior to a man's similar invention, then the government might well include that woman in their exhibit, but that was far as they would go." He then pointed out the pages of bonnets, trimmings, dresses and other wearing apparel in the Fair's book of classification and "suggested the Ladies content themselves with exhibits like that, instead of trying to mount exhibits of inventions" (Weimann 429). The incident concluded with a "few fitting remarks" by Lockwood who left in agitated frustration. Palmer followed up in writing to Bickford that the Board desired "to ascertain what

proportion of patents have been issued to women" which resulted in a response from Mr. Simmons, a Patent Commissioner. The Commissioner said that there were over 3,000 women's patents and it would be best if the Board made its own selections.

Palmer passed the information onto Lockwood and advised her:

> Will you not send me a list of those patents that it would be worth while for us to "crow over". I felt rather discouraged about having a collective exhibit when I saw you last in Washington, and would much prefer to make no note of the inventions of women unless it is something quite distinguished and brilliant. We must not call attention to anything that will cause us to lose ground and if their inventions are merely confined to simple processes, it would be better for us to show only the few remarkable things than a mass of uninteresting ones. Please let me hear, consequently, what you consider important enough to call attention to. Perhaps your plan of sending the one hundred best with drawings and specifications would be the best (Weinmann 429).

Lockwood wrote to inventors, but was disappointed to find that "many inventors were unwilling to ship [their models] at their own expense, and their own risk."

Consequently, the Inventions Room was filled with "an odd assortment of smaller items, and in many cases, simply drawings" Lockwood later published in an 1893 pamphlet entitled *"The Woman's Building and What is to Be Seen in It"*. Another disappointed response was written in *Cosmopolitan*, September, 1893, by Ellen Henrotin, a board member, club woman, and personal friend of Palmer. She commented that "none of the most valuable and scientific inventions are shown . . . and it seems such a pity

. . . when the patent books of the U.S. show such hundreds of women's names . . ." (Weimann 430).

But these kinds of reviews proved to be exceptions to the overall positive response elicited by the volume and variety of women's inventions at the Exposition. [11] The *Woman's Journal* of September 9, 1893, reported that in the Transportation Building a woman's invention attracted a great deal of attention. It was Annie Chilton's Horse-Detacher and Brake. This was demonstrated by a women sitting in cart attached to a model horse in the Transportation Building. A miniature model was on display in the Women's Building. This invention helped to prevent the dangers of vehicles turning over or of shafts being broken after a horse was released from the carriage. It represented an important safety invention because of the persistent danger of runaway horses (Stanley *Mothers* 482; Macdonald 184; Weinmann 428, 431).

The same issue of the *Woman' Journal,* also praised Josephine Cockran's dish-washing machine as a "great labor-saving machine." It was manufactured by the Cockran Crescent Washing Machine Company in three sizes, the largest operated on steam and the smaller ones by either gas or gasoline." It was generally too expensive for home use as the smallest one cost $250, but several Chicago hotels and restaurants reportedly used them because they could "wash, scald, rinse, and dry five to 20 dozen dishes of all shapes and sizes in just two minutes" (Macdonald 182; Stanley *Mothers* 438-439; Weimann 431).

The *Woman's Journal* also lauded Margaret Wilcox's combination stove and house heater. They considered it "so perfect in its arrangement that a house of 10 rooms can be heated by it 24 hours and the cooking for the family done besides, with only four scuttlefuls of coal" (July 29, 1893, 236). The Board of Lady Managers Patents Committee found this invention among those most interesting. Wilcox had nine patents

to her name, most were stoves or related inventions. One, though, was quite unique, a combination dish and clothes washer (1890) (Stanley *Mothers* 85-86, 439; Macdonald 182).

Other media sources also offered support of women's inventive capabilities exhibited at the Exposition. Chicago newspapers generously praised Harriet Tracy's lock-stitch and chain-stitch sewing machine. The lower bobbin carried more than a thousand yards of thread and was said to "have baffled a generation of masculine inventors" (Weimann 431). The *Herald* praised the bobbin, saying that she "triumphed in what a generation of skilled inventors have failed" Her inventions, they said, were marked with "great originality, ingenuity and utility." After seeing all of her inventions, they claimed that no one could "truly say that woman has never invented anything valuable (Macdonald 183). Chicago's *Mail* reported that her sewing machine's rotating shuttle was "one of the most novel, simple, efficient and ingenious devices in the World's Fair. . . All ladies who see the machine are delighted with it and her other meritorious inventions, and proud that a woman has accomplished what man failed to do" (Macdonald 183). The Lady Board of Managers found this invention to be in the "distinguished and brilliant" category.

Among Tracy's 16 patents, another meritorious invention exhibited and used in the Exposition was the Tracy Gravity Safety Elevator. It competed against other bids but won the contract for installation in the Woman's Building because of its safety advantage of "automatic platforms that keep the shaft constantly closed, and prevent any person falling through it, or flames ascending it." Tracy had two other elevator related inventions and as early as 1881 Tracy's safety automatic accident- and fire-proof floors

for elevators shafts" was installed in "the large new building" at No. 80 E. 14th Street in New York City. By 1893, Tracy's reputation as a professional inventor was well established and respected (Weimann 431; Stanley *Mothers* 436; 504-506; Macdonald 61-63; 182-184).

Another well respected inventor who exhibited at the fair was Harriet Russell Strong of Oakland, CA. She had five patents, two (1887 and 1894) pertaining to dam and reservoir construction which she exhibited in the Science Room in the Women's Building. Her systems were used to irrigate and hold back water and proved particularly successful on her California walnut ranch. Her 1894 invention was grossly misclassified in the LWP under "Culinary Utensils": #528,823, Method of and means for impounding debris and storing water. It was apparently assumed to be some kind of kitchen device! But her invention was not misrepresented at the Exposition. It won awards in both mining and agriculture, definitely constituting her contributions as "something to crow over."

Her presence at the Exposition was also marked by the "Pampas Palace" which was built completely from pampas grass grown on the Strong ranch. The grass was primarily used for decorative purposes and was grown mostly in Germany, but found a lucrative U.S. market. As elected President of the feminist Business League of America, Strong spoke at the fair on the importance of business training for women. Her success in business was hard won and she said that she would "train every girl so that instead of prefacing some innovation by saying, 'A man suggested this,' she would rely upon her own judgment." The judgment of her inventive and business accomplishments proved to be of the highest degree. Not only could she claim success as an inventor, but also in the

business of inventing (Weinmann 436; Stanley *Mothers* 444, 463; Macdonald 232, 393, Logan 887).

The woman who claimed to have the most inventions at the Exposition was Caroline Westcott Romney of Colorado, with at least 14 inventions on exhibit. Romney also edited *The Journal of Industrial Education* during the time of the Fair and was the editor of a journal for the porous earthenware industry. [12] She had several inventions relating to that line of industry in which she conducted experiments with cellular brickware made of a mixture of clay, sawdust and asbestos. Although unpatented, her iceless milk cooler and refrigerator displayed in the Agriculture Building showed economic promise as did her foot-warming stone for use in railway cars exhibited in the Transportation Building. She also exhibited oven fixtures for conservation of heat in the Manufactures Building. Romney was understandably proud of her inventions and did not in any way make excuses for their domestic categorization. She claimed to have "more articles of domestic utility on exhibition, all inventions of her own brain, than any other man or woman at the Fair" (Weimann 430-432; Stanley *Mothers* 67; Macdonald 184).

Women inventors, both individually and collectively, had made a distinct impact on women's accomplishments at the Columbian Exposition. Their success was apparent in the number of inventions exhibited, the diversity of the inventions and in the favorable response from the media and the Fair administration. Another standard of success was measured by the economic remuneration women realized from the exhibited inventions. Among such notable successes, consider the following orders: 600 Harris refrigerators, 900 Eberhard bread pans, 300 Bay pressing boards, and 60,000 Hambell egg and cake

beaters (Weimann 432). Women's inventive capabilities had reached a new plateau of public respect, technological recognition, and economic success.

The prevailing change in attitudes about women inventors and their inventions were not just by the inventors themselves and the media, Fair visitors and administrators reflected a changing cultural index. Women's relationship with technology had significantly expanded to include industrial and mechanical application outside of the domestic realm. By the close of the century *Success* magazine stated in "Women to the Front" :

> The rapid stride which women have made in nearly all the professions and occupations during the last thirty years are remarkable. . . Not so many years ago, it was thought that, with very rare exceptions, the feminine mind had no inventive genius; but now scarcely a week passes that does not record in the patent office at Washington some patents by women. . . Indeed, women have proved their natural qualifications for work in science . . . they certainly possess a great deal of creative force, and a natural capacity for scientific investigation, and excel in most of the fields which they enter (May 27, 1899, 442).

Women inventors who exhibited in the Columbian Exposition did much to remove the persistent assumption that women did not invent. Women such as Harriet Tracy, Margaret Wilcox, Caroline Romney and the others, presented outstanding examples of women's inventive genius and progressive capacity for scientific investigation.

The social pulse of the Exposition vibrated with a heightened excitement for all that was progressive, technologically advanced, and distinctly innovative. For the first time, women's inventive contributions were integrated in the mainstream image of American progress. The values assigned to American technology as exceptional and superior, were in a some measure shared by men's and women's accomplishments. Of

the women's exhibits it was said, "they form of themselves a unique and distinctive feature of the Exposition, such as never before was presented to the world, such as never before was attempted" (*Book of the Fair* 266).

Women inventors participated publicly on a national scale in what was considered "typically American." This, of course, did not mean that gender lines were erased, but it did mean that there was a progressive fusing of the boundaries of women's relationship with technology, one which expanded the previously culturally imposed limitations. *The Illustrated World's Fair*, a publication issued in 1890 before the opening of the Fair, anticipated that the Exposition would present "such a display of the world's products as will pale all preceding exhibitions." America was to be the "prime mover" because of its spirit of enterprise. The world, it claimed, recognized America as the most wide awake and progressive of all people (3). This ideological rhetoric had been touted since the Age of Jackson, but for the first time in the history of technology, women's inventions were recognized and included as an important part of the American spirit of enterprise (See Dissertation Chapter 3).

The American spirit of enterprise was uniquely featured in the formation of the World's Congress Auxiliary, held from May 15 to October 28. "The congresses were a series of meetings attended by people who represented virtually every conceivable spectrum and activity of humanity" (Burg 235). [13] They were designed to "bring about a real fraternity of nations" by establishing personal acquaintances and friendships among the "leaders of the intellectual world" (Badger 77). As in other aspects of the Exposition, women played a conspicuous and responsible role in the World's Congress Auxiliary as a whole, and specifically in the Congress of Women where such notably women as Susan

B. Anthony, Lucy Stone, Julia Ward Howe, May Wright Sewall and inventor, Caroline Westcott Romney gave presentations. Women's inventive capability was endorsed, supported and enhanced within this progressive intellectual atmosphere. With retrospective insight, Lucy Stone in her address, "The Progress of Fifty Years", noted that a "half a century ago women were at an infinite disadvantage in regard to their occupations. The idea that their sphere was at home, and only at home, was like a band of steel on society" (Eagle 59). Part of her life's work was to create a "wholesome discontent" in women that would "compel them to reach out after far better things" (59). There was plenty of work still ahead for women, but Stone believed that "the last half century ha[d] gained for women the right to the highest education and entrance to all professions and occupations, or nearly all" (60). Like other women who participated in the Women's Congress and other Congresses, Stone recognized a measurable degree of progress had transpired over the last 50 years because of the efforts of countless women to push the limits of social convention and expand the circumference of their restricted freedoms. Particularly in the case of women inventors, the circumference of their inventive activity had taken on enlarged proportions, both culturally and technologically.

Entrance into the business and industrial world of commerce as professional inventors was just beginning to open up for women. Within the cultural context spawned by the Columbian Exposition and cultivated through such cooperative intellectual endeavors as the Women's Congress, women inventors participation and technological contributions were held in a newly elevated esteem as significant and important components of America's progress.

What inventions women exhibited, how their presence was mediated, and how the public responded to them at the Philadelphia Centennial Exhibition of 1876 signified that they were reluctant concessions. Their validity as significant technological contributors was dubious at best, deniable and invisible at worst. Women inventors resources were impinged in 1876 at the Exhibition by restrictive limitations in allotted space, planning time, and funding. They were also culturally restricted by social conventions which persistently characterized woman's place in the home. Her work, occupation, and talents were narrowly best suited for domestic pursuits. Invention, even with a domestic application, was seen as masculine. The poverty of the women's exhibit seemed to some, all that could be expected from women. They had a limited range of capabilities which simply did not spread out very extensively in industrial development. A manipulative control of women's participation in the Exhibition resulted in a pinched projection of women's relationship with technology. As a "custodian of culture," the Philadelphia Centennial had done little to change the cultural index of women's inventors progress. But what it did do, was signal future world fair endeavors that women would be a contending cultural force in international exhibitions. Women inventors marginalized presence at the Centennial was a function of Victorian time, a place saturated with conventional values, and limited resources. Like the pulse of the fair, symbolized by the "silent and irresistible" Corliss engine, mechanized control exerted power, but left the question of control to the next generation of American technological progress (Rydell, *All the World*, 35). For women inventors, the issue of power and control over their relationship with technology, remained relatively unchanged. The prototypical inventor was as before, still absolutely male.

Seventeen years later, the tides of progress blew in change which signified that women inventors had secured a measure of success in defusing the persistent assumption that women did not invent. It wasn't a culmination of absolute confidence, but rather a long overdue beginning. A new era opened for women inventors as the world viewed, evaluated, and then applauded their inventive efforts. Their diverse, sophisticated, and economically successful inventions became integrated into the American cultural landscape of progress like never before. They carried cultural authority which was validated by an international acceptance of their place in pursuit of progress. The authority evolved over a century of struggle for equality in legal rights, educational access, employment opportunity, an economic independence. A social miasma strictly characterized women's place as domestic and, consequently, her inventive abilities were circumscribed and limited. But with the Chicago Columbian Exposition, a definite and distinct lifting of the weighty conventional standards began. Women's inventions were exhibited within a cultural context which validated technological progress. Gender bias did not completely evaporate, but it did lessen based on the strength of the evidence and the contextual placement of it in the Fair. In an article in the *Forum*, "Some Lasting Results of the World's Fair" it was concluded that "women found an opportunity to prove their ability as a banded sex. . . After what has been achieved, the self-consciousness of women will be lessened, and their sensitiveness about their own position, capacity, and rights will be naturally outgrown" (Weimann 599). In retrospect, the Columbian Exposition marked the end of an era, just as it ushered in a new beginning for women inventors. The image of the inventor had not shifted in gender, but it had changed its cultural shape.

World fairs function as indicators of important cultural trends. They projected the self-consciousness of the age (Badger ix, xvi, 122). The last quarter of the 19th century was an age which persistently subjected American women in a struggle for technological recognition for their inventive ability. A struggle for cultural synthesis was evident in both the Philadelphia Centennial Exhibition and the World Columbian Exposition, which attempted to adapt technological progress with social progress regarding women's relationship with technology. By the close of the Columbian Exposition, control of that relationship had been significantly altered by the undeniable evidence of women's inventive genius.

Bertha Palmer's dream and purpose that a new era would open up for women by clearing away "existing misconceptions as to the originality and inventiveness of women" was realized. Along with the hundreds of women who participated in both world fairs, women inventors took a "few forward steps" into the what the 19th century boasted as the "so-called 'Age of Invention'" (Woman's Journal, May 13, 1893, 150). The progress of 19th century women inventors paved the way for 20th century advancement far beyond the illusions of the great White City's vision of progress.

Chapter 6 - NOTES

[1] This figure varies according to different sources. The Philadelphia sources claim anywhere from 74 to 85 women inventors exhibited (Trescott/Warner 105; Macdonald 81; Gillespie 18; Ingrahm, 103-105; Stanley *Mother*s 760; Greenhalgh 176) The official Columbian exposition catalog lists less than 335 inventions on exhibit (Macdonald 181).

[2] In comparison, the other buildings were as follows: Main building, 870,464 square feet; Machinery hall, 504,720 square feet; Art Building, 76,650 square feet; Horticultural Hall, 350 feet by 160 feet; Agricultural Building, 117, 760 (Norton Charles B, 42). Other sources cite the size of the Woman's Pavilion at 30,000 square feet and 40,000 square feet, both in disagreement with the 43,264 square feet cited by Benjamin Charles Norton (Weinmann 3; *Illustrated History of the Centennial Exhibition*, 1877). Regardless of the conflict over the actual size of the Woman's Pavilion, it was clearly the smallest building at the exhibition.

[3] Because of the preponderance of domestic inventions by women at the Philadelphia Centennial, many of women's significant contributions were undermined. More than 100 years later, Deborah Warner in "Women Inventors at the Centennial" claims that "none of the women's inventions was important in any large social or technological sense," but then goes on to cite more than 15 non-domestic inventions which included sewing machines, lubricated plaster molds, machine for sewing straw braid, fluting machine, washing machine, pyrotechnic signal flares, a self-inflating lift preserve and others (Trescott 104; 110-119). The value of such inventions remains stagnated within the existing theoretical male bias of the history of technology.

[4] Miss Emma Allison has been cited as one of the most popular attractions of the Woman's Pavilion. People were "surprised to find "no low, vulgar woman, but an educated and accomplished lady" " (Brown, D. 142). There had been some concern that she might blow the Pavilion to "smitherines by reading novels instead of monitoring the steam gauge" (Macdonald 83). She calmly replied to such misgivings that operating a steam engine was "far easier than nursemaiding and less fatiguing than bending over a kitchen stove" and that it was "cleaner, safer, and much easier than firing up a wood cook stove every day." She also though that it was harder to teach school and that it paid better too. (Weinmann 3).

[5] For a comprehensive list of women inventors and the inventions exhibited at the Centennial see Deborah J. Warner's Appendix in *"Women Inventors at the Centennial Hall"*, the *Philadelphia International Exhibition 1876 Catalogue of the Women's Department* with supporting information in *New Century for Woman* no 3 p. 1, pp. 34, 51, 58, 69, 74, 84-85; 91,114, 115, 117,135-136, 147, 164, 204, 212.

[6] The highest award of the Centennial went to a woman inventor, Betsey Ann Sterns, for her dress cutting invention tailor method for cutting clothes (Logan 889; Willard and Livermore 678). Some other award winners included Martha Coston, for her pyrotechnic flare, Harriet Strong for her dam and reservoir system, Olivia Flynt for her Flynt Waist, and many others both exhibiting in the Women's Building and elsewhere in the Exposition.

[7] On January 4, 1894, fire destroyed the Casino, the Peristyle, and the Music Hall. Fires continued to destroy many of the buildings on the fair grounds. The clash between federal troops and striking railroad workers on July 5, 1894, resulted in major fires which within two hours reduced many of the great buildings "to a wilderness of ashes and gaunt and twisted girders" (Badger 130). A few buildings were removed and salvaged, as discussed in detail in the "Epilogue" of Norman Bolotin and Christine Laing's, *The Chicago World's Fair of 1893, The World's Columbian Exposition.* By 1896 *Scientific American* recorded, "The World's Columbian Exposition Salvage Company have completed their task of removing the building. . . A few buildings have been permitted to remain, but they stand only to serve special purposes, and are only faintly suggestive of the architectural glories which once graced Jackson Park" (Burg 287-288).

[8] Congress adopted the name "World's Columbian Exposition," but it was also known as the "Chicago's World Fair of 1893", and the most popular reference was "The White City" (Kirkland 418; Burg xi)

[9] The powers and duties of the Ladies Board of Managers, which numbered 115 women representing various states and territories, were: "To appoint one or more members of all committees authorized to award prizes for exhibits which may be produced in whole or in part by female labor: To manage and control the "Women's Building" on the Fair grounds: To have general charge and management of all the interests of women in connection with the Exposition; so that its management, so far as it relates to women's work, exhibits and interests in general, shall be under the direction of the Board of Lady Managers, through its Presence, shall be necessary before final and conclusive action is taken" (Kirkland 428-429; Badger 79).

[10] Cultural historian Reid Badger may have been referring to a variety of exhibits which celebrated women's traditional roles as wife, mother, and housekeeper and which were proudly integrated with women's accomplishments in the arts and industry. For Ried, this projected a paradoxical image of the women's roles as represented by the fair (120-123). Domestic exhibits such as the Corn Exhibit Model Kitchen, received a great deal of attention. It was billed as a model of domestic efficiency equipped with inventions by women and the latest in gas appliances. It was used for demonstrating cooking techniques and recipes. A few exhibits on child care and the glories of motherhood were also to be found in the Women's Building. Elsewhere on the fair grounds was the Children's Building and Ellen Richards Rumsford Kitchen near the Liberal Arts Building, which involved women almost exclusively. In addition, the high profile of the Columbian Housekeepers, an offshoot of the Household committee of the

World's Fair Congress, represented traditional work and roles for women (Weimann 325-352; 459-464).

[11] One visitor claimed to have seen 335 inventions exhibited in the Invention Room of the Women's Building, but the official catalogue lists less. Some women exhibited in other buildings, such as Harriet Tracy who exhibited her "Tracy Lock-Stitch and Chain-Stitch Sewing Machine" in the Liberal Arts Building. No consistent total number of women's inventions at the Columbian Exposition surfaced in a wide variety of consulted sources. The range does appear to be somewhere between 250 and 300 based on a sample of 19th journals, magazines, fair books and 20th century secondary sources.

[12] Autumn Stanley notes that Romney wrote a two-part article on women's inventions at the Columbian Exposition in *The Journal of Industrial Education.* "Unfortunately, the magazine evidently died before Part 2 appeared (inventors surnamed after H), which might have listed her own inventions" (68).

[13] The World's Congress Auxiliary included 20 departments and 225 general divisions. "These Congresses embraced Woman's Progress, The Public Press, Medicine and Surgery, Temperance, Moral and Social Reform, Commerce and Finance, Music, Literature, Education, Engineering, Art, Government, Science and Philosophy, Social and Economic Science, Labor, Religion, Sunday Rest, Public health, And Agriculture" (Charles Carroll Bonney, *World's Congress Addresses* (Chicago: Open Court Publishing Company, 1900, p. iii) in Burg 235).

CONCLUSION

Women continued to patent their inventions in growing numbers with increased diversity as the 20th century unfolded (US Patent Records). They had a strong historical 19th century legacy to build on, but even today as we approach the 21st century, that legacy remains unrecognized. It has only been in this last decade, the 1990s, that the first scholarly books have been published about women inventors. To date, the number of such scholarly works is two: Anne Macdonald's, *Feminine Ingenuity: Women and Invention in America,* and Autumn Stanley's, *Mothers and Daughters of Invention: Notes for a Revised History of Technology.* Upon the publication of this dissertation, the number will be three.

The retrieval process has begun and calls to arms able minded historians and educators of the 21st century to bring to fruition the placement of women inventors' contributions in the development of American technology. Without the inclusion of women's inventions, the history of technology remains significantly incomplete and seriously flawed. It continues to reflect the persistent gendered assumption that women don't invent and those few who do, do so with little impact on the development of American technological progress.

It will be necessary to continue not merely cataloguing women's inventions, but to place their contributions within the cultural context in which they invented. Gender analysis will continue to inform not only the way we look

at the social and economic impact of technological development, but will enlighten our perception as to the nature of inventive activity and the characterization of the inventor. It has not been an activity which excludes male or female innovation, yet the persistent recognition of it as an exclusive male activity reinforced the assumption that men produced and women consumed. Evidence reveals that such assumptions were based on ideological constructs founded on socially contrived ideals, not the reality. The reality of women's inventive accomplishments in the 19th century stand uncontroverted by nearly 5,000 patent records. Their experiences prove that they shared wholeheartedly in the pursuit for technological advancement and were nurtured by the fire of genius to produce significant inventions throughout the 19th century. Like their male counterparts, they were inspired, motivated, and skilled , but unlike men, their presence and progress was tempered by complex cultural barriers.

If women inventors like Margaret Knight, Martha Coston, or Clarissa Britain had shared the same relationship with technology as Cyrus McCormick, Samuel Colt, or Richard Gatlin ,what they accomplished would be recorded as part of the history of the development of American technology. But their relationship with technology was defined by male experiential values and mediated by male criteria which "firmly secured "inventor" as a masculine occupation" (Amram, Morgan 161).

This relationship is poignantly illustrated by Margaret Knight's experience who found herself throughout her life confined to a limited and narrow relationship with technology. She recalled later in life that as a child she "never

cared for the things that girls usually do. . . [T]he only things wanted were a jackknife, a gimlet and pieces of wood . . . I was famous for my kites, and my sleds were the envy and admiration of all the boys in town." But her friends were "horrified." She remembered, I "sighed sometimes because I was not like the other girls, but wisely concluded that I couldn't help it, and sought further consolation from my tools" (Mozans 35). She could no more help having the gift of invention than she could change the reception to that gift in a world which viewed invention as male activity and inventor as a masculine entity.

Concepts and definitions of masculinity and femininity affected the way professions were circumscribed , technology was developed and implemented, and skills defined (Wright, et al 61). With 27 known patents to her credit, mostly in machines, it is hard to define Margaret Knight as anything other than inventor. Yet her mention in the standard histories of technology remains minimal at best and generally non-existent despite that fact that her accomplishments successfully challenged the gendered assumption that women didn't invent, and those conspicuous few who did, did so in the domestic field. Even Knight viewed herself in masculine terms because she worked in a masculine profession, one which involved tools, machines, and industry.

By retrieving the legacy of 19th century American women inventors, Knight's experience surfaces as representative of other women inventor's experience. Knight was, in fact, like "other girls." The propensity to invent and the ability to produce technological solutions was not inherently masculine or feminine, but rather a product of human activity. The social construction of

gender created such circumscription for both the causal inventor who invented to meet an actual need and the professional inventor who invented as a business. Regardless of gender, all showed remarkable perseverance, originality and imagination (Rossman 41).

The body of knowledge respecting the history of American technology is incomplete and inaccurate without the inclusion of women's inventions and contributions to technological progress. The legacy must bring to light women's accomplishments in the same celebrated light as men's inventions. The historical record must explore and analyze the different co-existing relationships which either promoted or prohibited technical creativity for men and women because how one's relationship to technology was defined and mediated affected how an inventor was received and how their invention was diffused. And of consequential importance, it still affects how women's relationship to technology is defined today.

Biased gendered assumptions about invention still affect our perception of the inventor. When we think of inventor, we still do not think of Martha Coston, Clarissa Britain, or Margaret Knight. Their names and contributions are not cited right inbetween those of Cyrus McCormick, Samuel Colt, and Richard Gatlin. The legacy of women inventors is yet to come of age.

BIBLIOGRAPHY

"Address of Mrs. Potter Palmer." *Woman's Journal* 13 May 1893:150.

"American Patents. Patent Cause." *Niles' Register* 12 Sept. 1829: 47-48.

"American Women in the Industries." *Success: An Illustrated Weekly* 7 Oct. 1899.

"American Women Receiving Patents." *Shaker Manifesto* July 1890.

Amphlett, Hilda. *Hats: A History of Fashion in Headwear.* Hertfordshire, Great Britain: Garden City Press, 1974.

Amram, Fred M. and Jane A. Morgan. "Inventor is a Masculine Word." *Journal of Creative Behavior* 14 (1980): 161-174.

Arbuckle, Wendell Sherwood. *Ice Cream,* Fourth Ed. NY: Avi Publishing Co., 1986.
--- *Ice Cream.* Westport, CN: Avi Publishing Co., 1966.

Archibald, Julia Annie. "Women Clerks in the Executive Departments at Washington." *The Revolution* 1 (1868): 230-231.

Arnold, Lois. Four Lives in Science: *Women's Education in the Nineteenth Century.* NY: Schocken Books, 1984.

Arthur, Julietta K. "Noted Wives Remind Us." *Independent Woman* 28 (1939): 314-315, 339-340.

Badger, Reid. *The Great American Fair: The World's Columbian Exposition & American Culture.* Chicago: Nelson Hall, 1979.

Baker, Ernest J. "Betsey Metcalf and the First American Straw Bonnet." *The Hat Industry* (June 1923): 59-62.

Baker, R. *A Guide to the United States Patent and Trademark Literature.* London: National Reference Library of Science and Invention, 1972.

Bancroft, Hubert Howe. *The Book of the Fair: An historical and descriptive presentation of the World's science, art, and industry, as viewed through the Columbian Exposition at Chicago in 1893.* Chicago: Bancroft Co., 1893.

Bartlett, Elizabeth Ann. *Liberty, Equality, Sorority, The Origins and Interpretation of American Feminist Thought: Frances Wright, Sarah Grimke, and Margaret Fuller*. NY: Carlson Publishing, 1994.

--- *Letters on the Equality of the Sexes and Other Essays*. New Haven and London: Yale University, 1888.

Bartlett, Irving. *The American Mind in the Mid-Nineteenth Century*. Arlington Heights, IL: Harlan Davidson, 1982.

Benagh, Christine P. "The History of Private Patent Legislation in the House of Representatives" U.S. Government Print. Office (1978): 1-14.

Bennett, William B. *The American Patent System*. Baton Rouge, LA: Louisiana State University Press, 1943.

Berg, Anne-Jorunn and Merete Lie. Feminism and Constructivism: Do Artifacts Have Gender?" *Science, Technology, & Human Values* 20 (1995): 332-351.

Bernard, D. H. *Night Signals of World's Shipping*. Glasgow: James Brown & Sons, 1908.

Berrien County Probate Court File 417. Calvin Britain. (1862-1867).

Biesterfeld, Chester H. *Patent Law for Lawyers, Students, Chemists, and Engineers*. NY: John Wiley & Sons, 1949.

Bijker, Wiebe, Thomas P. Hughs, and Trevor J. Pinch, Eds. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA & London: MIT Press, 1987.

Bindocci, Cynthia. *Women and Technology, An Annotated Bibliography*. NY: Garland publishing, 1993.

Bishop, J. Leander. *History of American Manufacturing 1608-1860*. 1864.

Blair, Karen J. *The History of American Women's Voluntary Organizations, 1810-1960, A Guide to Sources*. Boston: G.K. Hall & Co., 1989.

--- *The Clubwoman as Feminist: True Womanhood Redefined, 1868-1914*. NY: Holmes & Meier, 1980.

Bode, Carl. *Midcentury America: Life in the 1850s*. Carbondale and Edwardsville: Southern Illinois Unviersity Press, 1972.

Boller, Paul F. *Freedom and Fate in American Thought From Edwards to Dewey*. Dallas, TX: SMU Press, 1978.

Bolotin, Norman and Christine Laing. *The Chicago World's Fair of 1893, The World's Columbian Exposition.* Washington D.C.: Preservation Press, 1992.

Bolton, Henrietta Irving. "Women in Science." *Popular Science Monthly* (1898): 506-511.

Bourque, Susan C. and Kay B. Warren. "Technology, Gender, and Development." *Daedalus* Fall (1987): 173-193.

Bowen, John. Civil War Days, *Everyday Life During the War Between the States.* Secaucus, NJ: Charwell Books, 1987.

Bowen, Roger. "Betsey Baker Was A Bonnet Maker." *Yankee* (1967): 71-73, 108-109.

Brainerd, Ezra. *A Plan for Improving Female Education by Emma Willard and Mrs. Emma Willard's Life and Work in Middlebury.* Marietta, Georgia: Larlin Corporation, 1987.

Braude, Ann. *Radical Spirits: Spiritualism and Women's Rights in Nineteenth-Century America.* Boston: Beacon Press, 1989.

Breeden, Rober, Ed. *Those Inventive Americans.* National Geographic Society, 1971.

Brink, Richard. Donald C. Gipple and Harold Hughesdon. *An Outline of United States Patent Law.* NY: Interscience Publishers, 1959.

Brocket, L. P. and Mary C. Vaughan. *Woman's Work in the Civil War: A Record of Heroism, Patriotism and Patience.* Philadelphia, Chicago & Boston: Zeigler, McCurdy & Co., 1867.

Brown, Charles Brockden. *Alcuin, A Dialogue.*[1798] New Haven, CT: Carl & Margaret Rollins, 1935.

Brown, Dee. *The Year of the Century: 1876.* NY: Charles Scribner's Sons, 1966.

Brown, Travis. *Historical First Patents: The First United States Patents for Many Everyday Things.* Metuchen, NJ: Scarecrow Press, 1994.

Buel, James W. *The Magic City.* NY: Arno Press, 1974.

Burg, David. *Chicago's White City of 1893.* Lexington, KY: University of Kentucky, 1976.

Burgess, Lauren Cook, ed. *An Uncommon Soldier*. Pasadena, Maryland: Minerva Center, 1994.

Burke, Arthur Devries. *Practical Ice Cream Making and Practical Mix Tables.* Milwaukee, WI: Olsen Publishing, 1933.

Burlingame, Roger. *March of the Iron Men: A Social History of Union Through Invention*. NY: Charles Scribner's Sons, 1940.
--- *Engines of Democracy: Inventions and Society in Mature America*. NY: Charles Scribner's Sons, 1940.

Burnap, George Washington. *Church and State Or The Privileges and Duties of an American Citizen*. Discourse delivered in the First Independent Church on December 12, 1844 [microform], Baltimore: John D. Troy, 1844.
--- *Lectures on the Sphere and Duties of Woman and Other Subjects.* Baltimore: John Murphy, 1841.

Burton, Martha Williamson. "Some American Women in Science." *The Chautauquan* (1898, 1899): 161-168; 361-368; 465-473.

Butcher, Patricia Smith. *Education for Equality: Women's Rights Periodicals and Women's Higher Education 1849-1920.* NY: Greenwood Press, 1989.

Butler, John P. *Patent Interference Case Files: 1838-1900.* Washington D.C.: National Archives and Records Administration, 1993.

Cabot, F. S. "Cotton Gins--Correction." *The Revolution* 1 (1868): 279.

Calvert, Robert, Ed. *The Encyclopdia of Patent Practice and Invention Management.* NY: Reinhold Publishing Corporation, 1964.

Campbell, Helen. *Women Wage Earners: Their Past, Their Present, and Their Future.* Boston: Roberts Brothers, 1893.

Cassara, Beverly Benner. *American Women: The Changing Image.* Boston: Beacon Press, 1962.

Cavalcante, Bernard F., Head, Operational Archives Branch of the Department of the Navy. Letter to author. 27 June 1997.

Centenary Edition. *The Complete Works of Ralph Waldo Emerson.* 2nd ed. 12 vols. New York: AMS Press, 1979.
"The Centennial Exposition." *Scientific American* 17 June 1876: 385.

"The Centennial Exposition." *Scientific American* 24 June 1876: 401.

"Centennial Notes by a Maine Woman" *Woman's Journal* 15 July 1876: 230.

Chapman, Carrie, ed. "Woman's Century Calendar." *Political Science Study Series* 5 (1899): 5-86.

Clark, David Lee. *Brockden Brown and the Rights of Women. University of Texas Bulletin,* No. 2212, 22 March 1922.

Clinton, Catherine. *Tara Revisited: Women, War, & the Plantation Legend.* NY: Abbeville Press, 1995.

--- and Nina Silber, Eds. *Divided Houses: Gender and the Civil War.* NY: Oxford University Press, 1992.

Cochran, Thomas. *Frontiers of Change: Early Industrialism in America.* NY: Oxford University Press, 1981.

Cogan, Frances B. *All-American Girl: The Ideal of Real Womanhood in Mid-Nineteenth Century America.* Athens, GA and London: University of Georgia Press, 1989.

Conwell, Russell H. *Acres of Diamonds.* NY: Harper & Brothers, 1915.

"Convention of Inventors." *Niles National Register* 8 Nov. 1845: 146.

Cooper, Carolyn C. *Shaping Invention: Thomas Blanchard's Machinery and Patent Management in Nineteenth-Century America.* NY: Columbia University Press, 1991.

Copeland, Jennie E. *Every Day But Sunday: The Romantic Age of New England Industry.* Brattlebor, VT: Stephen Daye Press, 1936.

Coston, Martha. *A Signal Success: The Work and Travels of Mrs. Martha Coston.* Philadelphia, PA: J.B. Lippincott Company, 1886.

Cott, Nancy F. Root of Bitterness*: Documents of the Social History of American Women.* NY: P. Dutton & Co., Inc., 1972.

Courtais, Georgine de. *Women's Headdress and Hairstyles in England from AD 600 to the Present.* London: B.T. Batsford, 1973.

Craven, Avery Odelle. *A Documentary History of the American People.* Boston: Ginn, 1951.

Crawford, M.D.C. *The Influence of Invention on Civilization*. Cleveland & NY: World Publishing Company, 1942.

Croly, Jane Cunningham. *The History of the Woman's Club Movement in America*. New York: Henry G. Allen & Co., 1898.

Culpepper, Marilyn Mayer. *Trials and Triumphs: Women of the American Civil War*. East Lansing, MI: Michigan State University Press, 1991.

Cutliffe, Stephen H. and Robert C. Post. *In Context: History and the History of Technology*. London and Toronto: Associated University Presses, 1989.

Dahn, Frank W. "Colonial Patents in the United States of America." *Journal of the Patent Office Society* 3 (1920): 342-349.

Daniels, George H. *Nineteenth-Century American Science: A Reappraisal*. Evanston, IL: Northwestern University Press, 1972.

David, Paul A. *Technical Choice Innovation and Economic Growth, Essays on American and British Experience in the Nineteenth Century*. NY: Cambridge University Press, 1975.

Davies, Emily. *The Higher Education of Women* [1866]. London & Ronceverte: Hambledon Press, 1988.

Davis, David Brion, Ed. *Antebellum American Culture, An Interpretive Anthology*. Lexington, MA: D.C. Heath and Company, 1979.

Dawson, Francis Warrington. *Our Women in the War*. Charleston, SC: Walker, Evans & Cogswell, 1887.

Degler, Carl N. *At Odds: Women and the Family in America from the Revolution to the Present*. New York: Oxford University Press, 1980.

--- "Revolution without Ideology: The Changing Place of Women in America" *Deadalus* 93 (1964): 653-670.

Desmond, Kevin. *A Timetable of Inventions and discoveries from Pre-history to the Present Day*. NY: M. Evans, 1986.

Dickenson, Donna, Ed. *Margaret Fuller, Woman in the Nineteenth Century and Other Writings*. NY: Oxford University Press, 1994.

"Directions for Inventors and Others who desire to secure letters Patent." *The Inventor* 1 (1855): 9

Dodd, George. *Days at the Factories* [1843]. New York: Augustus M. Kelly, 1967.

Donovan, Hedley, editor-in-chief. "Remarkable American Women 1776-1976." *Life Special Report* (1976).

Douglas, Ann. *Feminization of American Culture.* NY: Anchor Press, 1988.

Eagle, Mary Kavanaugh Oldham, Ed. *The Congress of Women Held in the Women's Building, World's Columbian Exposition, Chicago, U.S.A., 1883.* Chicago & Philadelphia: International Publishing Co., 1895.

Early Unnumbered United States Patents, 1790-1836. Research Publications, 1980.

Eilliot, Maud Howe. *Art and Handicraft in the Woman's Building of the World's Columbian Exposition, Chicago, 1893.* Paris & NY: Boussod, Valadon & Co., 1893.

"The Education of Girls." *Woman's Journal* 3 Jan. 1891: 1.

"The Education of Women in America." *Westminster Review* 100 (1873): 320-337.

Emerson, Ralph Waldo. *Essays and Lectures.* NY: Literary Classics of the United States, Library of America, 1983.

"Employment of Women." *The New Century for Woman* 9 Sept.1876:138.

Eschbach, Elizabeth Seymour. *The Higher Education of Women in England and America 1865-1920.* NY & London: Garland Publishing, 1993.

Evans, Sara M. *A History of Women in America.* NY: Macmillan, Inc., 1989.

"The Exposition. The House We Live In." *The New Century for Woman* 27 May 1876: 1.

"The Exposition. The House We Live In. Stiles' Combination Desk and Book-case." *The New Century for Woman* 24 June 1876: 51.

"The Exhibition of Woman's Work." *The New Century for Woman* 13 May 1876: 4.

Faust, Drew Gilpin. *Mothers of Invention: Women of the Slaveholding South in the American Civil War.* Chapel Hill, NC: University of North Carolina Press, 1996.

"Female Industry." *Niles' National Register* 8 Jan. 1848: 298.

"Femal Inventive Talent." *Scientific American* 17 Sept. 1870: 184.

Filene, Peter Gabriel. *Him/Her Self: Sex Roles in Modern America.* NY: Harcourt Brace Jovanovich, 1975.

Foner, Philip. *Women and the American Labor Movement: From Colonial Times to the Eve of World War I.* NY: Free Press, 1979.

Foster, B. G. "Pioneer Publication on Inventions." *Journal of the Patent Office Society* 11 (1929): 558-564.

Frandsen, Julius Herman. *Ice Cream and Related Products.* Westport, CN: Avi Publishing Co., 1961.

Franklin, Benjamin. *The Autobiography and Other Writings.* NY: Penguin, 1987.

Fuller, Edmund. *Tinkers and Genius.* NY: Hastings House, 1955.

Funderburg, Anne Cooper. *Chocolate, Strawberry, and Vanilla: A History of American Ice Cream.* Bowling Green, OH: Bowling Green University Popular Press, 1995.

Gage, Joslyn. *Woman, Church and State.* Chicago: Charles H. Kerr & Company, 1893.

--- "Woman As Inventor." *North American Review* 136 (1883): 478- 489.

--- "Woman As Inventor." *New York State Woman Suffrage Association Tract* (1870) 3-32.

--- "Woman An Inventor." *The Revolution* 1 (1868):311-312.

--- "The Cotton Gin Invented by a Woman." *The Revolution* 1 (1868): 259-260.

Garraty, John A. *A Short History of the American Nation.* 4th ed. New York: Harper & Row Publishers, 1985.

Genin, John Nicholos. *An Illustrated History of the Hat from the Earliest Ages to the Present Times.* New York, 1848.

Gies, Joseph and Frances. *The Ingenious Yankees.* NY: Thomas Y. Crowell Company, 1976.

Gillespie, Elizabeth Duane. *A Book of Remembrance.* Philadelphia & London: J.B. Lippincott, 1901.

Glazer, Penina Migdal and Miriam Slater. *Unequal Colleagues: The Entrance of Women into the Professions, 1890-1940.* NY and London: Rugers University Press, 1987.

Glasgow, Maude. *The Subjection of Woman and Traditions of Men.* NY: Mi.I. Glasgow, 1940.

Goldfarb, Russell M. and Clare R. *Spiritualism and Nineteenth-Century Letters.* London: Associated Unversity Presses, 1978.

Golemba, Beverly E. *Lesser Known Women: A Biographical Dictionary.* Boulder & London: Lynne Rienner Publishers, 1992.

Greenberg, A.S. "Graphic Study of Economic Relations of the Patent System" *Journal of the Patent Office Society* 9 (1926): 65-68.

Greenhalg, Paul. *Ephemeral Vistas: The Expositions Univerelles, Great Exhibitions and World's Fairs, 1851-1939.* NY: St. Martin's Press, 1988.

Grimke, Sarah and Angelina. *The Public years of Sarah and Angelina Grimke: Selected Writings, 1835-1839, Showing the Progress and State of the Various Useful and Esthetic Pursuits.* NY: Columbia University Press, 1989.

Greeley, Horace. *Art and Industry as Represented in the Exhibition at the Crystal Palace, New York 1853-4.* NY: Redfield, 1853.

Gulliver, Julia Henrietta. "Why Should a Girl Have a College Education and What Will It Do For Her? A Rockford College Point of View." Address before the Chicago College Club, 13 Dec. 1913. n.p.

Habakkuk, H. J. *American and British Technology in the Nineteenth Century.* Cambridge: Cambridge University Press, 1962.

Hall, Kermit L., Ed. *Women, The Law, and the Constitution.* NY: Garland Publishing, Inc. 1987.

Hanaford, Phebe A. *Daughters of America or Women of the Century.* Augusta, ME: True and Company, 1882.

Harrison, Michael. *The History of the Hat.* London: Herbert Jenkins, 1960.

"The Hats, Caps and Bonnets." *The Niles' Register* 26 17 Apr. 1824: 98.

Henderson, Colonel G. F. R. *The Science of War: A Collection of Essays and Lectures 1891-1903*. London, NY, Bombay & Calcutta: Longmans, Green, and Co., 1913.

Herzenberg, Caroline L., ed. *Women Scientists from Antiquity to the Present: An Index. An International Reference Listing and Biographical Directory of Some Notable Women Scientists from Ancient to Modern timer.* West Cornwall, CT: Locust Hill, 1986.

Heyn, Ernest V. *Fire of Genius: Inventors of the Past Century*. Garden City, NY: Anchor Press/Doubleday, 1976.

Hindle, Brooke. *Technology in Early America.* Chapel Hill, NC: University of North Carolina Press, 1966.

Hine, Darlene Clark, Ed. *Black Women in America: An Historical Encyclopedia.* Brooklyn, NY: Carlson Publishing, Inc., 1993.

History of Berrien and Van Buren Counties, Michigan with Illustrations and Biographical Sketches of Its Prominent Men and Pioneers. Philadelphia: D.W. Ensign & Co., 1880.

Hobbs, Catherine. *Nineteenth-Century Women Learn to Write.* Charlottesville & London: University Press of Virginia, 1995.

Horowitz, Helen lefkowitz. Alma Mater: *Design and Experience in the Women's Colleges from Their Nineteenth-Century Beginnings to the 1930s.* NY: Alfred A. Knopf, 1984.

"The House We Live In. Woman's Patents and Inventions." *The New Century for Woman* 8 July 1876: 69.

"The House We Live In. Woman's Patents and Inventions, The Reliance Stove." *The New Century for Woman* 15 July 1876: 74.

"How it Came About." *The New Century for Woman* 13 May 1876: 4.

Hubert, Philip G. *Men of Achievement: Inventors.* NY: Charles Scribner's Sons, 1893.

Hughes, Thomas P. American Genesis, *A Century of Invention and Technological Enthusiasm 1870-1970.* New York: Viking, 1989.

Huls, Mary Ellen. *United States Government Documents on Women, 1800-1900. A Comprehensive Bibiliography, Vol. I: Social Issues.* Wesport, CT: Greenwood Press, 1993.

Hunt, Linda Grant de Pauw Conover. *Remember the Ladies.* NY: Viking Press, 1976.

The Illustrated History of the Centennial Exhibition. 1877.

Ingram, J.S. *The Centennial Exposition, Described and Illustrated.* Philadelphia: Hubbard Bros., 1876.

"Inventions and Patents." *The New Century for Woman* 10 June 1876: 34.

"An Invention Wanted." *Woman's Journal* 18 Jan. 1890: 18.

Irvin, Helen Deiss. "The Machine in Utopia*: Shaker Women and Technology."* *Woman's Studies International.* Quarterly 4 (1981): 313-319.

Ives, Patricia Carter. *Creativity and Inventions: The Genius of Afro-Americans and Women in the United States and Their Patents.* Washington, D.C., 1987.

James, Portia P. *The Real McCoy, African-American Invention and Innovation, 1619- 1930.* Washington D.C.: Smithsonian Institution, 1989.

Janeway, Elizabeth. *Cross Sections from a Decade of Change.* New York: William Morrow and Company, Inc., 1982.

--- *Women: Their Changing Roles.* Danbury, CT: Grolier Educational Corporation.

Jewkes, John. *The Sources of Invention.* NY: W.W. Norton, 1969.

Jones, Amanda Theodosia. *A Psychic Autobiography* [1910]. NY: Arno Press, 1980.

Kanowitz, Leo. *Women and the Law, The Unfinished Revolution.* Albuquerque, NM: University of New Mexico Press, 1968.

Kerber, Linda. *Women's America: Refocusing the Past.* NY: Oxford University Press, 1987.

Kessler-Harris, Alice. *Out to Work: A History of Wage Earning Women in the United States.* NY: Oxford University Press, 1982.

Khan, Zorina B. "Married Women's Property Laws and Female Commercial Activity: Evidence from United States Patent Records, 1790-1895. *Journal of Economic History* 56 (1996): 356-388.

Kirkland, Joseph. *The Story of Chicago.* Chicago: Dibble Publishing, 1892-1894.

Klein, Aaron E. And Cynthia L. Klein. *The Better Mousetrap: A Miscelolany of Gadgets, labor-Saving Devices, and Inventions that Intrigue.* NY: Beaufort Books, Inc. 1982.

Kohlstedt, Sally Gregory. "Parlors, Primers, and public Schooling: Education for Science in Nineteenth-century America." Isis 81 (1990): 424-445.

--- "In from the Periphery: American Women in Science, 1830-1880." SIGNS 4 (1978): 81-96.

--- *The Formation of the American Scientific Community: The American Association for the Advancement of Science, 1848-60.* Chicago: University of Illinois, 1976.

Kraditor, Aileen S. *The Ideas of the Women Suffrage Movement/ 1890-1920.* NY & London: W. W. Norton, 1981.

Kramarae, Cheris. *Technology and Women's Voices Keeping in Touch.* NY: Routledge & Kegan Paul, 1988.

Kranzberg, Melvin and William H. Davenport. *Technology and Culture: An Anthology.* NY: Schocken Books, 1972.

Kursh, Harry. *Inside the U.S. Patent Office.* NY: W.W. Norton & Company, 1959.

Lafollette, Marcel C. and Jeffey K. Stine. *Technology and Choice: Readings From Technology and Culture.* Chicago: University of Chicago Press, 1991.

"Laws of the United States in relation to Patents." *The Inventor* 1 (1855): 9-11.

Leonard, Elizabeth D. *Yankee Women: Gender Battles in the Civil War.* NY: W.W. Norton, 1994.

Lerner, Gerda. *The Creation of Feminist Consciousness From the Middle Ages to Eighteen-seventy.* NY: Oxford University Press, 1993.

--- and Jane De Hart-Mathews. *Women's America: Refocusing the Past.* NY: Oxford University Press, 1987.

--- *Women are History: A Bibliography in the history of American Women.* Madison, WI: The Graduate Program in Women's History, Department of History, University of Wisconsin, 1986.

--- *The Female Experience: An American Documentary.* Indianapolis: Bobbs-Merrill Company, Inc., 1977.

"Let the New Cycle Shame the Old." *Woman's Journal* 1 July 1876: 209.

Licht, Walter. *Industrializing America, The Nineteenth Century.* Baltimore and London: John Hopkins University Press, 1995.

Linderman, Jack, Ed. *The Conflict of Convictions.* NY: Chilton Book Company, 1968.

Livermore, Mary. "Woman As Inventor." *Woman's Journal* 6 Jan. 1900.

Lockridge, Kenneth A. *A New England Town: The First Hundred Years, Dedham, Massachusetts, 1636-1736.* NY: Norton & Company, 1970.

Logan, Mary S. *The Part Taken by Women in American History* [1912]. NY: Arno Press, 1972.

Lubar, Steven and W. David Kingery, eds. *History from Things: Essays on Material Culture.* Washington and London: Smithsonian Institution Press, 1993.

Macdonald, Anne L. *Women and Invention in America: Feminine Ingenuity.* NY: Balantine Books, 1992.

"Machinery Hall." *The New Century for Woman* 28 Oct.1976: 190.

"Machinery Hall. Woman's Work." *The New Century for Woman* 23 Sept. 1876: 150.

Marks, Patricia. *Bicycles, Bangs, and Bloomers: The New Woman in the Popular Press.* Lexington, KY: University Press of Kentucky, 1990.

Marlow, Joan. *The Great Women.* NY: A. & W. Publishers, 1979.

Martin, Theodora Penny. *The Sound of Our Own Voice: Women's Study Clubs 1860-1910.* Boston: Beacon Press, 1987.

Marx, Leo. *The Machine in the Garden, Technology and the Pastoral Ideal in America.* Oxford: Oxford University Press, 1964.

Massey, Mary Elizabeth. *Women in the Civil War.* Lincoln:NE: University of Nebraska Press, 1994.

Mattfeld, Jacquelyn and Carol G. Van Aken, eds. *Women and the Scientific Professions.* Cambridge, MA: M.I.T Press, 1965.

McDaniel, Susan A., Helen Cummins and Rachelle Sender Beauchamp. "Mothers of Invention? Meshing the Roles of Inventor, Mother, and Worker" *Women's Studies Int. Forum*, Vol. 11, No. 1, pp. 1-12, 1988.

McGaw, Judith A. "Inventors and Other Great Women: Toward A Feminist History of Technological Luminaries" *Technology and Culture*, 38, No. 1, (Jan 1997): 214-231.

--- *Early American Technology, Making and Doing Things from the Colonial Era to 1850.* Chapel Hill, NC: University of North Carolina Press, 1994.

--- *Most Wonderful Machine, Mechanization and Social Change in Berkshire Paper Making, 1801-1885.* NJ: Princeton University Press, 1987.

McHenry, Robert. *Liberty's Women.* Springfield, MA:G. & C. Merriam Co., 1980.

Mehaffey, Karen Rae. *Victorian American Women 1840-1880: An annotated Bibliography.* NY: Garland Publishing, 1992.

Merritt, Deborah J. "Hypatia in the Patent Office: Women Inventors and the Law, 1865-1900." *The American Journal of Legal History* XXXV (1991): 235-306.

Meyer, Annie Nathan, ed. *Woman's Work in America.* New York: Arno Press, 1972.

Meyers, Marvin. *The Jacksonian Persuasion, Politics and Belief.* Stanford, CA: Standford University Press, 1960.

Miller, Douglas T. *The Birth of Modern America 1820-1850.* NY: Macmillan Publishing Co., 1985.

Miller, Lillian B. Walter T.K. Nugent, and H. Wayne Morgan. *Indiana Historical Society Lectures 1972-1972: 1876, The Centenial Year.* Indianapolis: Indiana Historical Society, 1973.

Miller, Perry, Ed. *Margaret Fuller: American Romantic, A Selection From Her Writings and Correspondence.* NY: Doubleday & Company, 1963.

Minturn, J.A. "Women as Inventors." *Inventive Age* (1893): 5.

"Miscellaneous. . .in the town[or township] of Franklin" *Niles' Register* 25 Oct. 1834: 114.

"Modern Inventions." *New Ideas* (1897): 319.

Moussa, Farag. *Women Inventors*. Geneva: Coopi, 1991

Mozans, H.J. *Woman In Science*. Cambridge & London: Mit Press, 1974.

"Mrs. Palmer's Visit Abroad." *Woman's Journal* 18 June 1892: 195.

Myers, Robert C, Curator, Berrien County Historical Association. Letter to author. 16 Sept. 1996.

"The National Society for Inventors." *Niles' Register* 25 Oct. 1845: 128.

"The New Century, for Woman." *The New Century for Woman* 13 May 1876: 4.

"New Employments for Women." *Woman's Journal* 25 Mar. 1876: 97.

"A New Invention. Stiles' Combination Desk and Book Case." *The New Century for Woman* 28 Oct. 1876: 196.

Newman, Louise Michele, Ed. *Men's Ideas/Women's Realities: Popular Science 1870-1915*. NY: Pergamon Press, 1985.

"Nolanum." *The New Century for Woman* 19 Aug. 1876: 115

Norton, Charles Benjamin. *World's Fairs from London 1851 to Chicago 1893*. Chicago: Milton Weston Co., 1890.

Norton, Frank Henry. *Frank Leslie's Historical Register of the United States Centennial Exposition, 1876*. NY: Frank Leslie's Publishing House, 1877.

Notable American Women: A Biographical Dictionary. Cambridge, MA: Belknap Press, 1980.

"Notes From the Worlds Columbian Exposition Chicago 1893." *Scientific American* 24 June 1893: 387.

Oglivie, Marilyn Bailey. *Women in Science, Antiquity through the Nineteenth-Century: A Biographical Dictionary with Annotated Bibliography*. Cambridge, MA: M.I.T. Press, 1986.

Oliver, John W. *History of American Technology*. NY: Ronald Press Company, 1956.

Organ. Thomas W. "Woman Wronged." *The Revolution* 1 (1868): 214-215.

Ossoli, Margaret Fuller. *Woman in the Nineteenth Century and Kindred Papers Relating to the Sphere, Condition, and Duties of Woman* [1874]. NY: Greenwood Press, 1968.

Otten, Laura A. *Women's Rights and the Law.* Westport, CN: Praeger, 1993.

Paludan, Phillip Shaw. *"A People's Contest" The Union and Civil War 1861-1865.* NY: Harper & Row, 1988.

Papachristou, Judy. *Women Together: A History in Documents of the Women's Movement in the United States*. NY: Knoph, 1976.

Patent Interference Case Files: 1838-1900. A Special List of Patent Interference Cases in Record Group 241. National Archives Federal Records Administration. Microfice Edition, 1993.

"The Patent Office." *The Revolution* 1 (1868): 316.

"Patents." *Niles Register* 5 Mar. 1811: 135-137.
--- *Niles' National Register* 11 Feb. 1843: 384.

"Patents and Inventions. The House We Live In." *The New Century for Woman* 16 Sept. 1876.

"Patents Issued in 1812." *Niles Register* 30 Jan. 1813: 399-400.

Patterson, Veronica. "The Elusive Braided Straw Hat." *Piecework: All This By Hand.* 4 July/August (1994): 61-64.

Penny, Virginia. *How Women Can Make Money* [1870]. NY: Arno & The New York Times, 1971.
--- Think and Act. A Series of Articles pertaining to Men and Women, Work and Wages [1869]. NY: Arno & The New York Times, 1971.

Pierce, James Wilson. *Photographic History of the World's Fair and Sketch of the City of Chicago. Also A Guide to the World's Fair and Chicago*. Baltimore: R.H. Woodward and Company, 1893.

Pessen, Edward. *Jacksonian America: Society, Personality, and Politics.* Homewood, IL: Dorsey Press, 1969.

Ploski, Harry and James William. *The Negro Almanac: A Reference Work on the African-American*, 5th ed. Detroit: Gale Research, 1989.

Porte, Joel, Ed. *Representative Man: Ralph Waldo Emerson in His Time*. NY: Columbia University Press, 1988.
--- *Emerson in His Journals*. Cambridge, MA: Belknap Press, 1982.

"Pretty Corn-Husker Bonnets." *Success: An Illustrated Weekly* 4 Nov. 1899: 821.

Pretzer, William S., Ed. *Working at Inventing: Thomas A. Edison and the Menlo Park Experience*. Dearborn, MI: Henry Ford Museum & Greenfield Village, 1989.

"Progress in Women's Education." *Woman's Journal* 23 June 1900: 194.

"Progress of Woman's Rights." *Scientific American* 5 July 1873: 7.

"The Protective System." *Niles Register* 17 July 1824: 325.

Pursell, Carroll W. *The Machine In America: A Social History of Technology*. Baltimore and London: John Hopkins University Press, 1995.
--- *Technology in America, A History of Individuals and Ideas*. Cambridge: MIT, 1981.
--- "Women Inventors in America." *Technology and Culture* 22 (1981):545-349).
--- *Readings in Technology and American Life*. NY: Oxford University Press, 1969.

Rable, George C. *Civil Wars: Women and the Crisis of Southern Nationalism*. Chicago, IL: University of Illinois Press, 1989

Rakow, Lana and Cheris Kramarae. *The Revolution in Words: Righting Women, 1868-1871*. NY & London: Routledge, 1990.

Rayne, M.L. *What Can A Woman Do or Her Position in the Business & Literary World*. Chicago: F.B. Dickerson & Co., 1887.

Ray, William and Marlys Ray. *The Art of Invention*. Princeton: Pyne Press, 1974.

Remini, Robert V. *The Revolutionary Age of Andrew Jackson*. NY: Harper & Row, 1976.

Reynolds, Minnie Josephine. *Women as Inventors*. NY: Interuban Woman suufrage Series, No. 6, 1908.

Richmond-Abbot, Marie, Ed. *The American Woman: Her Past, Her Present, Her Future.* NY: Holt, Rinehart and Winston, 1979.

Riley, Glenda. *Inventing the American Woman. A Perspective on Women's History.* Arlington Heights, IL: University of Northern Iowa, 1987.

Robinson, Lelia Josephine. *The Law of Husband and Wife.* Boston: Lee an Shepard, 1890.

Romanes, George J. "Mental Differences in Men and Women." *Popular Science Monthly* 31 (1887): 383-401).

Rossiter, Margaret. *Women Scientists in America, Sturggles and Strategies to 1940.* Baltimore and London: John Hopkins University Press, 1982.

Rossman, Joseph. *Industrial Creativity, the Psychology of the Inventor.* NY: University Books, 1964.

--- "Women Inventors." *Journal of the Patent Office Society* (1927): 18-30.

Rothman, David J. and Sheila M. Rothman. *The Dangers of Education: Sexism and the Origins of Women's Colleges.* NY & London: Garland, 1987.

Rothschild, Joan, Ed. *Machina Ex Dea, Feminist Perspectives on Technology.* NY: Pergamon Press, 1983.

Rozwenc, Edwin, Ed. *Ideology and Power in the Age of Jackson.* Garden City, NY: Doubleday & Company, 1964.

--- *The Meaning of Jacksonian Democracy.* Boston: D.C. Heath and Company, 1963.

Rury, John. *Education and Women's Work: Female Schooling and the Division of Labor in Urban America, 1870-1930.* Albany, NY: State University of New York Press, 1991.

Russo, Ann and Cheris Kramarae, Eds. *The Radical Women's Press of the 1850s.* NY and London: Routledge, 1991.

Ryan, Mary P. *Womanhood in America from Colonial Times to the Present.* NY: Franklin Watts, 1975.

Rybczynski, Witold. *Taming the Tiger: The Struggle to Control Technology.* NY: Viking Press, 1983.

Rydell, Robert W. *World of Fairs: The Century-of-Progress Expositions.* Chicago & London: University of Chicago Press, 1993.

--- *All the World's A Fair: Visions of Empire at Amerian International Expositions, 1876-1916.* Chicago & London: University of Chicago Press, 1984.

Sadler, Richard and Hilda Amphlett. *Hats: A History of Fashion in Headwear.* London: Garden City Press, 1974.

Schmidt, Minna Moscherosch. *400 Outstanding Women of the World and Costumology of Their Time.* Chicago: M.M. Schmidt, 1933,

Scientific American Reference Book. NY: Munn & Co., 1876.

Scott, Anne Firor. *Making the Invisible Woman Visible.* Urbana & Chicago: University of Illinois Press, 1984.

Seely, Bruce E. "Technology and Early American History." *Reviews In American History* 23 (1995): 592-599.

Segal, Howard P. *Technological Utopianism in American Culture.* Chicago: University of Chicago Press, 1985.

Severn, Bill. *Here's Your Hat.* New York: David McKay Company, Inc., 1963.

Shaw, Marian. *A Woman Journalist Views Chicago's 1893 Columbian Exposition.* Pogo Press, 1992.

Shenton, James, Ed. *Free Enterprise Forever! Scientific American in the 19th Century.* NY: Images Graphiques, 1977.

Sherr, Lynn and Jurate Kazickas. *The American Woman's Gazetteer.* New York: Bantam Books, 1976.

"She Sights No Field." *Success: An Illustrated Weekly* 7 Oct. 1899: 738.

Sherman, Mary L. "The Exposition. In Machinery Hall" *The New Century for Woman* 7 Oct. 1876: 1.

Showell, Ellen H, and Fred M. B. Amram. *From Indian Corn to Outer Space: women Invent in America.* Cobblestone Publishing, Inc. 1995.

Siegel, Micki. "The Best Inventions by Women Since 1900." Good Housekeeping (1990): 140-143.

Siegel, Patricia Joan and Kay Thomas Finley. *Women in the Scientific Search.* Metuchen, NJ: Scarecrow Press, 1985.

Signal Book, United States Army. Washington, D.C.: Government Printing Offices, 1916.

Sklar, Kathryn Kish and Thomas Dublin. *Women and Power in American History: A Reader, Vol. 1 to 1880.* Englewood Cliffs, NJ: Prentice Hall, 1991.

Sloat, Caroline. "A Great Help to Many Families: Straw Braiding in Massachusetts Before 1825." *Annual Proceeeding (Dublin Seminar for New England Folklife.* No. 13, (1988): 89-100.

Smith, Charlotte, Ed. & Publisher. *The Woman Inventor.* 1, No. 1, 1891.
--- *The Woman Inventor*, 1, No. 2, 1891.
--- "Who is to Blame?" *Inland Monthly Magazine* (1877): 104.
--- "A Woman's Enterprise." *Inland Monthly Magazine* (1873): 336.

Smith, Frank. *A History of Dedham, Massachusetts.* Dedham, MA: Transcript Press, 1936.

Smith, Henry Nash.. Popular Cultue & Industrialism 1865-1890. Garden City, NY: Doubleday & Company, 1967.

Sokoloff, Kenneth. "Inventive Activity in Early Industrial America: Evidence from Patent Records, 1790-1846." *Journal of Economic History* XLVIII (1988): 813-847.

Solomon, Barbara Miller, *In the Company of Educated Women: A History of Women and Higher Education in America.* New Haven & London: Yale University Press, 1985

Stampp, Kenneth M. *America in 1857: A Nation on the Brink.* NY: Oxford University Press, 1990.

Stanely, Autumn. *Mothers and Daughters of Invention, Notes for a Revised History of Technology.* Metuchen, NJ & London: Scarecrow Press, Inc. 1993.
--- "The Champion of Women Inventors" *Invention & Technology* 8 (1992): 22-26.
--- "The Patent Office Clerk as Conjurer: The Vanishing Lady Trick in a Nineteenth-Century Historical Source" in Wright, *Women, Work, and Technology* (1987): 118-136.
--- From Africa to America: Black Women Inventors in Zimmerman, ed. *Technological.*

Starrett, Helen Ekin and Frances Ekin Allison. *The Future of Educated Women and Men, Women, and Money.* Chicago: Jansen, McClurg, and Company, 1885.

"Statistics. Annual Report of the Commissioner of Patents." *Niles' National Register* 15 June 1844): 244-245.

Stebbins, Sarah Bridges. "A Woman in Business." *Demorest's Monthly Magazine* (1876): 454-456.

Stephenson, Mary A. *Milliners of Williamsburg in the Eighteenth Century.* Report [microform], 1951.

Stern, Madeleine. *We the Women; Career Firsts of the Nineteenth-Century America.* NY: B. Franklin, 1974.

Stevens, Le Conte W. "University Education for Women." *North American Review* 136 (1883): 25-39.

The Story of the United States Patent Office. Pharmaceutical Manufactureres Association and U.S. Department of Commerce, 1965.

"A Study of women As Inventors." *Current Opinion* (1918): 38.

Subject Matter Index of Patents for Inventions, issued by the United States Patent Office from 1790-1873, Vol. 1. Washington D.C.: Government Printing Office, 1874.

"Successful Women Inventors." *Woman's Journal* 22 Aug.1891: 268.

Tarbell, Ida. *The Business of Being a Woman.* NY: Macmillan Company, 1914.
--- "Women As Inventors." *The Chautauquan.* March, (1887): 355-357.

Tharp, Louise Hall. "Bonnet Girls." *New England Galaxy.* (1960): 3-10.

Thomson, John. *Hat Making and Felting, Including a full expostion of the singular proprerties of fur, wool and hair.* Philadelphia: Henry Carey Baird, 1868.

Toulmin, Harry Aubrey. *Handbook of Patents.* NY: D. Van Nostrand Company, 1949.

Trescott, Martha Moore, Ed. *Dynamos and Virgins Revisited: Women and Technological Change in History, An Anthology.* NJ: Scarecrow Press, 1979.

Tunis, Edwin. *Colonial Craftsmen and the Beginnings of American Industry.* Cleveland and New York: World Publishing Company, 1965.

Turnbow, Grover Dean, Paul Hubert Tracy, and Lloyd Andrew Raffetto. *The Ice Cream Industry*. NY: John Wiley & Sons, Inc. 1947.

"Tuscan Hats.: *Niles' Register* 5 Dec.1835: 232.

Ulrich, Laurel Thatcher. *Good Wives: Image and Reality in the Lives of Women in Northern New England 1650-1750.* NY & Toronto: Oxford University Press, 1982.

United States Department of Labor, *Women's Contributions in the Field of Invention: A Study of the Records of the States Patent Office*, Women's Bureau Bulletin 28. Mary Anderson, ed. Washington, D.C.: Government Printing Office, 1923.

"United States Patent Office." *Niles' Register* 20 Sept.1845: 41.

United States Patent Office. *Annual Report of the Commissioner of Patents.* Washington, D.C.: Government Printing Office, 1972.

--- Decisions of the Commissioner of Patents for the Year 1871. Washington D. C.: Government Printing Office, 1872.

--- Patent Application Files, 1837-1918, Entry 9, Record Group 241, National Archives, Suitland, Md.

--- Patent Interference Case Files, 1835-1905, Entry 24, Record Group 241, National Archives, Suitland, Md.

--- *Women Inventors to Whom Patents have Been Granted by the United States Government 1790 to July 1, 1888 to October 1, 1892.* Appendix No. 1 Compiled under the direction of the Commissioner of Patents. Washington D.C.: Government Printing Office,1892.

--- *Women Inventors to Whom Patents have Been Granted by the United States Government October 1, 1892 to March 1, 1895.* Appendix No. 2. Compiled under the direction of the Commissioner of Patents. Washington, D.C.: Government Printing Office, 1895.

Vare, Ethlie Ann and Greg Ptacek. *Mothers of Invention: From the Bra to the Bomb, Forgotten Women and Their Unforgettable Ideas.* NY: Quill William Morrow, 1987.

Vance, Cyrus R., Lisa Taylor, Robert C. Post, Kendall Dood, Douglas E. Evelyn, and George Nelson. *American Enterprise: Nineteenth Century Patent Models.* NY: Smithsonain Institution, 1984.

Vaughan, Floyd L. *The United States Patent System: Legal and Economic Conflicts in American Patent History.* Norman, OK: University of Oklahoma, 1956.

Venet, Wendy Hamand. *Neither Ballots nor Bullets. Women Abolitionists and the Civil War.* Charlottesvill & London: University Presss of Virginia, 1991.

Violette, Augusta Genevieve. *Economic Feminism in American Literature Prior to 1848. The Maine Bulletin, University of Maine Studies,* Second Series, No. 2, Vol. XXVII, February, 1925.

Visitor's Guide to the Centennial Exhibition and Philadelphia. Philadelphia: J.B. Lippincott & Co., 1875.

Wajcam, Judy. *Feminism Confronts Technology.* University Park,PA: Pennsylvania State University Press, 1991.

--- and Donald MacKenzie. *The Social Shaping of Technology: How the Refrigerator Got its Hum.* Philadelphia: Open University Press, 1985.

Walker, Richard D. *Patents as Scientific and Technical Literature.* Metuchen, NJ & London: Scarecrow Press, 1995.

Walters, Ronald G. *American Reformers 1815-1860.* NY: Hill and Wang, 1978.

Watts, Margit Misangyi. *High Tea at Halekulania: Feminist Theory and American Clubwomen.* Brooklyn, NY: Carlson, 1993.

Weber, Gustavus A. The patent Office Its History, Activities and organization. Baltimore: John Hopkins Press, 1924.

Weimann, Jeanne Madeline. *The Fair Women.* Chicago: Academy Chicago, 1981.

Welter, Barbara. *Dimity Convictions, The American Woman in the Nineteenth Century.* Athens, OH: Ohio University Press, 1976.

Westrum, Ron. *Technologies & Society: The Shaping of People & Things.* Belmont, CA: Wadsworth Publishing Co., 1991.

Wheeling Female Seminary. *Catalogue, April 18, 1853 - June 30, 1854.* Wheeling, West Virginia: Daily Intelligence Job Office.

Willard, Frances and Mary Livermore. *A Woman of the Century: One Thousand Four Hundred Seventy Biographical Sketches Accopanied by Portraits of Leading American Women in All Walks of Life.* Buffalo, NY: Moulton, 1893.

Wilson, Fiona. *"Language, Technology, Gender and Power." Human Relations* 45 (1992): 883-904.

Whicher, Stephen E., Ed. *Selections from Ralph Waldo Emerson*. Boston: Houghton Mifflin Company, 1960.

Woloch, Nancy. *Early American Women: A Documentary History, 1600-1900.* Belmont, CA: Wadsworth Publishing, 1992.

"Woman and the Centennial." *Woman's Journal* 29 July 1876: 243.

"A Woman Genius." *Inventive Age* (1895): 187.

"A Woman's Invention." *Woman's Journal* 30 June 1888: 204.

"Woman as Inventor." *Woman's Journal* 6 Jan. 1900: 4.

"A Woman's Invention." *Woman's Journal* 28 Oct. 1893: 342.

"Woman's Patents and Inventions." *The New Century for Woman* 29 July 1876. 91.

"Woman's Pavilion." *The New Century for Woman* 19 Aug. 1876: 115.

"Women in Business." *Demorest's Monthly Magazine* (1876): 454-456.

"Women As Inventor" *Woman's Journal* 15 Feb. 1873: 56.

"Women As Inventors." *Woman's Journal* 18 Aug. 1888: 260.

"Women As Inventors." *Woman's Journal* 24 Feb. 1900: 58

"Women Inventors." *Scientific American* 4 Apr. 1903: 247.

"Women Inventors." *Woman's Journal* 21 May1892: 164.

"Women as Inventors: They Have Turned Their Bright Ideas into Actual Result." *Washington Post* 9 April1891: 2.

"Women's Inventive Genius." *Equal Rights* (1928): 230-231.

"Women to the Front." *Success: An Illustrated Weekly* 27 May 1899: 442.

"Women Inventors." *The Revolution* 1 (1868): 365.

"Women as Machinists." *The Revolution* 1 (1868): 169-170.

"Woman Suffrage at the World's Fair." *Woman's Journal* 1 April 1893: 111.

Woody, Thomas. *A History of Women's Education in the United States, Vol. II.* NY: Octagon Books, 1966.

"The World's Columbian Exposition--Interior of Woman's Building." *Scientific American* 9 Sept. 1893: 171.

"World's Congress of Representative Women." *Woman's Journal* 1 April 1893:103.

"World's Fair Notes." *Woman's Journal* 25 Jun 1892: 203.

"World's Fair Notes." *Woman's Journal* 14 Jan.1893: 9.

"World's Fair Notes." *Woman's Journal* 8 April 1893: 111.

"World's Fair Notes." *Woman's Journal* 29 July1893: 236.

"World's Fair Notes." *Woman's Journal* 9 Sept. 1893: 288.

Wright, Barbara Drygulski, et al. *Women,Work, and Technology Transformations.* Ann Arbor, MI: University of Michigan Press, 1984.

Wyllie, Irvin G. *The Self-Made Man in America, The Myth of Rags to Riches.* NJ: Rutgers University Press, 1954.

Wyman, William I. "The United States Patent Office: A Short Account of Its History, Organization and Procedure." *Journal of the Patent Office Society* 9 (1926): 71-81.

Young, Agatha. *The Women and the Crisis: Women of the North In the Civil War.* NY: McDowell, Obolensky, 1959.