2019

The Gender Gap in Patents: An Exploration of Bias Against Women in Patent Attainment and "Blockchain" As Potential Remedy

Susan Stewart Stute
Wright State University

THE GENDER GAP IN PATENTS: AN EXPLORATION OF BIAS AGAINST WOMEN IN PATENT ATTAINMENT AND "BLOCKCHAIN" AS POTENTIAL REMEDY

A thesis submitted in partial fulfillment of the
requirements for the degree of
Master of Humanities

By

Susan Stewart Stute
B.A., The Ohio State University, 2013
B.A., Wright State University, 1991

2019
Wright State University

WRIGHT STATE UNIVERSITY

GRADUATE SCHOOL

May 1, 2019

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY **Susan Stewart Stute** ENTITLED **The Gender Gap in Patents: An Exploration of Bias Against Women in Patent Attainment and "Blockchain" as Potential Remedy** BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Humanities.

Kelli D. Zaytoun, PhD
Thesis Director

Valerie Stoker, PhD
Director, Master of Humanities Program

Committee on Final Examination:

Kelli D. Zaytoun, PhD

Zdravka K. Todorova, PhD

Nancy G. Garner, PhD

Barry Milligan, PhD
Interim Director, Graduate School

ABSTRACT

Stewart Stute, Susan. M. Hum. Department of Humanities, Wright State University, 2019. The Gender Gap in Patents: An Exploration of Bias Against Women in Patent Attainment and "Blockchain" as Potential Remedy.

Steering women toward educational paths and careers in fields of invention would seem, in theory, to be the obvious solution to closing the gap between the number of men and women filing for and being granted invention patents. Billions of dollars have been invested at the federal, state, and local levels to spur interest and competency in science, technology, engineering, and mathematics (STEM) learning, but gender disparity in innovation workplaces persists. Studies indicate that, in addition to the educational barriers that can be and have been addressed legislatively, social and cultural influences affect outcomes for career women, as well as young women considering STEM degree programs. Evidence suggests that as more male students are drawn to STEM fields as a result of these same educational initiatives, the inventive patent ownership gender gap will widen. By considering the historical treatment of women with regard to intellect, employment, and property ownership, an enormity of scope emerges that, in turn, creates questions about the efficacy of current suggested strategies to narrow the gap.

Table of Contents

ACKNOWLEDGEMENT

This thesis is the mere result of learning and work. It is a small thing when compared with the scholarly abilities and dedication of the women who supported me. Thanks to Professor Kelli Zaytoun, director, Professor Zdravka Todorova, Professor Nancy Garner, and Professor Valerie Stoker. Life takes some funny turns, and I am indeed fortunate to have found a path that crossed theirs.

I. INTRODUCTION

Though the gender wage gap might be viewed as reflective of society's higher regard for male productivity, the gender patent gap might be viewed as the consequence of a system designed to protect male superiority in the fields of both invention, and innovation in technology and means of production. While the United States Patent and Trademark Office (USPTO) does not record the gender of applicants and grantees, data indicate that approximately only 8 percent of U.S. utility (mechanical) patents belong to women.[1] This figure is startling when compared with the percentage of women in the U.S. workforce – 47 – and the percentage of women working in science, technology, engineering and math (STEM) fields – 26.[2]

Feminist scholars have examined this disparity and constructed logical and effective analyses, and the predominant discussion revolves around what women and workplaces are not doing to keep up, such as having risk fears or tiresome job demands. The general intent of the theories seems to be aimed at correcting the unenlightened behavior of employers and/or educators, which is commendable, but none really take into consideration the broad scope of feminist scholarship on longstanding discrimination against women or attempt to investigate an

[1] Jessica Milli et al., "Equity in Innovation: Women Inventors and Patents," *Institute for Women's Policy Research* C448 (2016), 8. Note: An increase in the number of patents being awarded to research teams headed by women in the field of biomedical research is notable, but these patents are considered business assets of the entity employing or contracting the researchers.

[2] U.S. Bureau of Labor Statistics. "Report 1071." Women in the Labor Force: A Databook. https://www.bls.gov/opub/reports/womens-databook/2017/pdf/home.pdf pages 68-67. (Retrieved December 5, 2017).

aggregate underpinning.[3] What is missing from existing literature is an explanation of how the patent system has evolved into a site of male privilege. I hope to add to the conversation by establishing this point, and by further suggesting that female inventors threaten male superiority in fields of patentable innovation, which leads to the privilege protection and perpetuation of the problem. From this position, a discussion of alternative intellectual property protection methods, outside of the current system, can take place. Alternative solutions would entail finding a way around "how it's currently done" and implies action, something toward which Charlotte Bunch recommends feminists should gravitate. Her "Model for Theory," which she divides into four parts: description, analysis, vision, and strategy, provides the framework for my exploration. Although her essay is an "instruction manual" for teachers of feminist theory, this project, if successful, will reflect her "guide … in sorting out options, and to keep us out of the 'any action/no action' bind."[4]

Two important notes about the scope of this paper: To effectively explore the niche of women and patentable invention, it will necessarily sidestep issues of copyright, trademarks, and trade secrets. These mechanisms afford authors and corporations protection for intellectual property, but by their natures have subjective legal and intent differences than does patent protection. Further, because this project eventually will look back to find possible ways forward, the discussion of "inventors" is limited to what might be thought of as the "garage inventor" (in contrast with the contemporary version, usually an engineer or researcher earning wages from the eventual patent holder, her employer), primarily because pre-industrial- and industrial-age innovation resided in such confines. This type of inventor generally was/is awarded what is

[3] This paper will look more closely at these discussions beginning on page 34.

[4] Charlotte Bunch, "Not By Degrees: Feminist Theory and Education," in *Feminist Theory: A Reader*, 2013, ed. Wendy Kolmar and Frances Bartkowski (New York: McGraw-Hill, 2013) 13.

called a “utility patent,” and is required to present a working model of her work at the time she applies for intellectual property rights protection.

Relevance of Research

Steering women toward educational paths and careers in fields of invention would seem, in theory, to be the obvious solution to closing the gap between the number of men and women filing for and being granted patents. Since the inception of the United States government’s “Race to the Top” performance-based education initiative in 2009, billions of dollars have been invested at the federal, state, and local levels to spur interest and competency in science, technology, engineering, and mathematics (STEM) learning, but gender disparity in innovation workplaces persists. Studies indicate that, in addition to the educational barriers that can be and have been addressed legislatively, social and cultural influences affect outcomes for career women, as well as young women considering STEM degree programs. In light of this scholarship, it may be unreasonable to expect STEM education initiatives to lead to a narrowing of the gender patent gap. Evidence suggests that as more male students are drawn to STEM fields as a result of these same educational initiatives, the inventive patent ownership gender gap will widen. By considering the historical treatment of women with regard to intellect, employment, and property ownership, an enormity of scope emerges that, in turn, creates questions about the efficacy of current suggested strategies to narrow the gap.

Sequence of This Paper

In keeping with Bunch’s suggested methodology, this paper will be divided according to her “four interrelated parts.” To start, a *description* is needed to facilitate “interpreting and naming reality.” To that end, a more detailed look at current gender patent gap data will provide

justification for the concern about this inequality. Then, a brief summary of the rationale behind protecting intellectual property through patent systems will be followed by a history of the unique opportunity the United States patent practices should have afforded early women inventors, but did not. To illustrate "the reality" that has become the problem, the paper includes the stories of three 19th century women inventors who were shortchanged. These vignettes will provide a basis to explore the evolution of societal attitudes about women's intellect and creative abilities through the rise of industrialization in the United States, as well as how those attitudes were magnified in the country's growing capitalist economy. The straight line connecting these women's missed opportunities with what is reflected in current disparity data provides the *description* but it cannot provide, as Bunch's method proposes, an *analysis* of bias. To facilitate the analysis, the paper will consider current interdisciplinary scholarship on the gender patent disparity, which sharpens the focus on inherent systemic and institutional shortcomings.

Although each of the cited interdisciplinary scholars makes salient observations and provides compelling support for their arguments, they do not, as Bunch hopes, provide a practical vision and, therefore, a basis for devising a strategy "to change what is to what should be."[5] Looking elsewhere might offer a better view, and so the paper will explore historical premises centered on the effects of industrialization, which amplified the masculinity of the public sphere and, by default, isolated women. These engrained biases are with us still, so with regard to the *vision* element of Bunch's model, the paper also will consider the ways in which recent government policy might be exacerbating the gender patent gap. In addition, it is important to document the flaws and criticisms against the United States patent system as it functions today. Considered together, these influences – historical isolation of women,

[5] Bunch, "Not By Degrees," 14.

government policies, and patent system flaws – explain "what happened" and help "determine what should exist."[6] Though this might seem a bit counterintuitive, Bunch believes progress is made by "making a conscious choice about those (things) in order to make … goals concrete."[7] Finally, with a plan for what "should be," the paper will propose a *strategy* to achieve that end, an exploration of a different method for protecting intellectual property. A current peer-to-peer technology known as "blockchain" might be considered as a way to decentralize the power of the United States patent office and, among other things, eliminate biased patent review.

[6] Ibid.
[7] Ibid.

II. DESCRIPTION: GATHERING AND INTERPRETING FACTS

A Closer Look at the Gender Patent Gap

For more than fifty years, following the second-wave women's movement, significant attention has been paid to workplace inequalities between the sexes, and one issue that has been regularly addressed is wage disparity, generally phrased as "unequal pay for equal work." A perhaps more modern take is that a man, on average and through no effort of his own, is privileged 23 cents more per hour worked than a woman, simply by virtue of the sex assigned to him at birth. Though decades old, the subject still is relevant and important. More recent feminist scholarship has raised a companion concern: whether or not the gender gap in patent assignments is problematic. Throughout the history of the United States, patents, which are an indicator of achievement or professional success in the field of engineering, have been a vehicle for generating wealth. Similar to gender wage disparity – women's earnings not being equal to men's for the same work – current data suggest that, although women make up more than half of the U.S. workforce, they comprise just 7.7 percent of U.S. inventive patent holders.

On the one hand, some argue that this inequality simply is the function of fewer women than men working in fields that provide an opportunity to file a patent application. From this perspective, a logical fix would be to increase the number of women employed by technology and innovation or engineering companies. On the other hand, however, some argue that contemporary corporate philosophy and workplace practices drive women away from careers in STEM industries. Workplace diversity scholars Xu and Martin are proponents of this view, and

believe "women feel that their freedom of expression is stifled. It may be … still a 'men's club'".[8] According to the authors, non-inclusive work environments interfere with a woman's ability to collaborate with male peers on projects that could potentially lead to a patentable invention or improvement. In sum, then, discussion of the gender patent gap issue could be reduced down to whether women aren't in the right place, or the place isn't right for women. Institutional and legislative changes that might address the former argument would do nothing to address the latter. Cultural changes that might address the latter argument fall beyond the scope of legislation or institutional change. This part of the conversation should not be bypassed.

Correctly naming the cause of the gender gap in patenting is a critical detail in the dialogue about how it best can be addressed. Though definitively agreeing on a cause is fraught because many other explanations are backed with good data as well, enacting legislation, government policy, or institutional reforms to address such inequalities without an agreement about which "problem to solve" can be short-sighted at best, but economically irresponsible and, perhaps, ineffective at worst. For example, in an effort to draw more women and minorities into STEM fields, the United States government, along with various states and school districts, implemented a slate of STEM educational programs. Although some might point out that such programs (even if they do not achieve all they are "supposed" to achieve), in the aggregate, will do more good than harm, evidence suggests that might not be the case.[9] The issue is important because trying to "fix" the inequality without knowing its root cause appears to be perpetuating

[8] Yonghong Jade Xu and Cynthia Martin, "Gender Differences in STEM Disciplines: From the Aspects of Informal Professional Networking and Faculty Career Development," *Gender Issues* 28, no. 3 (2011): 148.

[9] Discussion of this point begins on page 39.

the imbalance. To begin, though, it might be helpful to consider why innovation is important, how patents encourage innovation, and how history has treated women innovators.

A Closer Look at Patents

In his book *Innovation and its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It*, Queensland University Economics Professor Adam B. Jaffe writes that innovation leads to social benefits such as longer and healthier lives, rising incomes, and more numerous consumer choices for a population. Therefore, he says, "[I]t is in our collective interests to create social, cultural, and legal institutions that foster technological innovation."[10] Jaffe notes that because technological innovation is capital-intensive, engineers and inventors are motivated to spend time and resources in the research and development process because they expect that they will be able to make "a bunch of money if the thing pans out."[11] To that end, most governments grant patents, which convert the innovator's intangible creation into "property that can be bought and sold, or upon which a business can be founded."[12] (The buying and selling of patents is accomplished by "assigning" the patent rights to someone else, or by licensing the use of the patented property.) In the United States, the government uses its legal system to provide restitution to innovators whose proprietary ideas or products are made, used, or sold by others. Juries decide the penalty (usually

[10] Adam B. Jaffe, *Innovation and Its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It*. Princeton University Press, 2004, 42.

[11] Ibid., 43.

[12] Ibid., 41.

a significant amount of money) that a patent "infringer" must pay to the patent awardee as compensation for the violation.

So patents protect the economic investments made in research and development, but they also protect the career interests of the researchers and inventors. Patents are the ultimate indicator of innovation and engineering success and, in the working world of invention, having no patents means not having the opportunity to qualify for career advancement.[13] As the USPTO numbers indicate, not many women have, or have had, this opportunity.

In the early part of America's history, the accumulation of wealth started through ownership of bounty land, granted to those in the military by the government at the end of their service. Future generations were born into the wealth that land ownership created. But for those living in the United States who did not own land, wealth achievement could be facilitated under the auspices of the United States patent system, which protected the intellectual property rights of all inventors and opened a door for marketing and selling innovations. This well-intentioned and conceptually virtuous system should have worked for all, but it did not work for some. Even during the late 19th-century innovation boom, women did not benefit, as patent holders, to the enormous extent men did.

The patent system exists so that innovators can protect and monetize their inventions or product improvements. The monetization mechanism, basically a legal, short-term monopoly on the production and selling, or licensing, of the invention, allows the patent holder to enhance their credibility, accumulate wealth and (perhaps more importantly) accumulate capital to fund future endeavors. History shows that legislation created to protect an inventor's right to her

[13] Sue V. Rosser, "The Gender Gap in Patenting: Is Technology Transfer a Feminist Issue?" *NWSA Journal* 21 no. 2 (2009): Intro.

intellectual property has clashed with laws created to protect a husband's right to his wife's property, and more egregiously, laws created to protect a slaveowner's "property." The deck was stacked against women, whether black, white, mulatto, or slave, who, although they did invent, could not benefit from this important vehicle for wealth accumulation.

At its inception, sometime toward the end of 1787 when a Congressional committee met to formalize discussion about intellectual property protection, the patent system was egalitarian. The committee recommended that the United States Congress be empowered "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."[14] If any legislators objected, there is no record of the debate, and the recommendation passed without a dissenting vote. It was added to the Constitution as paragraph 8, section 8, of Article I.[15] Although across the United States, property rights of women and slaves were negligible, the patent system framework intended that any inventor's intellectual property be protected. The Patent Act of 1790 declares that "upon the petition of any person or persons that *he, she, or they*, hath invented or discovered any useful art, … it shall be lawful … to cause letters patent to be made out in the name of the United States" (this provision ended the need for inventors to sail to England to secure the same type of letter). The key mechanism to the protection of intellectual property via patenting was the inventor's oath, taken to "swear or affirm that he/she did verily believe that he/she was the true inventor or discoverer of the art, machine or improvement for which he/she solicited a patent,"[16] sworn in

---

[14] Kenneth W. Dobyns, *A History of the Early Patent Offices* (Fredericksburg, Va.: Sergeant Kirklands Press, 1997), 18.

[15] U.S. Const. art. 1. sec. 8. cl. 8.

[16]Willard Phillips, *The Law of Patents for Inventions; Including the Remedies and Legal Proceedings in Relation to Patent Rights* (New York: Gould, Banks and Company, 1837), 303.

the presence of witnesses "authorized to administer oaths."[17] In 1836, a section was added requiring that the oath also state "of what country he is."[18] This small addition is important because, although inventors from other countries could apply for a U.S. patent, those applicants from the United States taking the oath would be stating they were "of the United States," which legally implied the applicant was a citizen of the United States.

A Closer Look at Early Disparities

The patent system's protective capacity was tested in the 1850s when Mississippian Oscar Stuart applied to patent an invention devised by his slave. The application and specification drawings were returned to Stewart by the patent commissioner, along with a pamphlet that outlined patent laws. Also included was a letter explaining that, in this particular matter, the fact that the applicant must make an oath, which included a verification of citizenship, precluded the application, as such a declaration would be impossible because United States law did not recognize slaves as citizens.[19] So while the court did prevent Stuart from infringing on the intellectual property rights of his slave, the slave was prohibited, by law, to use the patent system to profit from his intellect. After this rejection, Stuart petitioned Congress to

---

[17] Ibid., 303.

[18] Ibid.

[19] Norman O. Forness, "The Master, The Slave, and The Patent Laws: A Vignette of the 1850S." *Prologue* 26 (1994): 24.

amend the law so that "a patent may issue to the master for a useful invention by his slave," but the bill was never passed into law.[20]

Although the true owner of the intellectual property was not granted rights in the Stuart case, legal precedent protecting any inventor's rights was established. It should be noted that there is no documentation suggesting that a slave woman was a party in any similar cases. It is possible that slave ingenuity could be stolen by the owner, and patents issued under false pretenses, but it might also be that owners did not, in most instances, want to suffer the embarrassment of crediting a slave and, therefore, patent applications were abandoned or never initiated. In either case, the mechanical and inventive abilities of women, slave or free, were not rewarded through the patent system. From 1790 through 1860, the USPTO granted 4,850 patents. Of those patents, just 77 were awarded to women.[21] The lack of opportunity for women to accumulate wealth through this government-administered vehicle was obvious from its earliest days.

One significant impediment for any married woman, inventors included, to accumulate wealth lie in the disability of coverture from the Laws of England, which prescribed that "by marriage the husband and wife are one person in law; that is, the very being or legal existence of the woman is suspended during the marriage."[22] Linda Kerber's interpretation of the adoption of laws in the early Republic reveals "where male Americans believed women belonged in the

---

[20] Zorina B. Khan, *The Democratization of Invention*: *Patents and Copyrights in American Economic Development, 1790-1920* (Cambridge, MA: Cambridge University Press, 2009), 86.

[21] Khan, *The Democratization of Invention*, 135.

[22] Sir William Blackstone, *Commentaries on the Laws of England* (London: S. Sweet, 1836) 442.

political culture," and that by choosing coverture over independence, they necessarily chose dependence over autonomy.[23] By virtue of their suspended legal existence, married women could not enter into contracts, which would include the necessary associations with regard to patent applications. Married women also, by law, had no right to wealth or income, and this would have extended to negate any right to collect profits from patented inventions.[24] Toward the middle of the 19th century, states slowly began to draft and enact laws modifying married women's legal status. The first articulated married women's property laws permitted the creation and protection of a wife's estate from claims a creditor might make against her husband. Legislation of this type was something of a charade, as women did not gain any economic rights – a husband still was in charge of his wife's estate. It wasn't until 1895 that the majority of states had adopted laws allowing married women to own property, control their earnings, and engage in business as a "sole trader."[25] The unrealized, potential innovations and quality-of-life improvements married women could have made notwithstanding, these legally invisible Americans were denied the chance to earn and contribute. Consider what could have been: after Massachusetts passed "sole trader" laws in 1860, allowing married women to enter the marketplace, Boston entrepreneur Lavinia Loy earned $25,000 annually on licensing and production of her patented line of corsets.[26] For perspective, if Loy were conducting business today, she would be earning over

[23] Linda K. Kerber, *Women of the Republic* (Chapel Hill NC: University of North Carolina Press, 1980), 119.

[24]Zorina B. Khan, "Married Women's Property Laws and Female Commercial Activity: Evidence from United States Patent Records, 1790-1895," *Journal of Economic History* 56, no. 2 (1996): 361-362.

[25] Ibid., 357.

[26] Anne L. Macdonald, *Feminine Ingenuity* (New York: Ballantine, 2010), 247.

$400,000 per year.[27] It was 70 years (Massachusetts, Maryland, and New York were the first states in 1860 to expand property laws) after the United States government established the Patent Act[28] that the "opportunity" for women to keep wages and engage in business as a sole trader finally knocked. Sociologists Melvin Oliver and Thomas Shapiro maintain the missed opportunities for women inventors to accumulate wealth have an exponential effect in that "private wealth thus captures inequality that is the product of the past, often passed down from generation to generation."[29] For more than two generations, women, who were resourceful and inventive, were stuck inside looking out as men commandeered control of a young but wealthy nation headed toward the industrial age.

The Importance of Networking to Invention

Judy W. Reed was awarded a patent after property rights expansion in 1884 for a mechanized bread dough kneader and roller, but it seems she was not able to benefit from the introduction of her invention into the marketplace. She was a former slave who signed her patent application with an "X," likely indicating she was illiterate.[30] How beneficial might it have been for Reed, monetarily, and for other women tasked with baking a household's daily bread, if she could have established a market presence? While Reed was enslaved, she likely was the main

[27] Consumer Price Index statistics from Historical Statistics of the United States (USGPO, 1975) https://data.bls.gov/cgi-bin/cpicalc.pl

[28] Khan, *The Democratization of Invention*, 167.

[29] Melvin L. Oliver and Thomas M. Shapiro, *Black Wealth, White Wealth* (New York NY: Routledge, 1995), 2.

[30] United States Patent and Trademark Office, issue 305,474, date September 23, 1884.

cook for a household of six, and would also have had to cook for her own family. The daily chore of baking bread was laborious, even taxing. An 1896 cookbook gives this description:

> There is no mechanical operation in cooking more fascinating than the deft, quick touches a natural kneader gives to a mass of dough … but the rings and bracelets should be left in the jewel case. The stitches in tight dress sleeves are *not* "warranted not to break" during this process. Perfect freedom for the muscles of the arms and chest is absolutely essential to making and kneading of bread.[31]

The drudgery of such a chore, done each day and in large quantities surely was the inspiration for Reed's bread dough kneader and roller invention.

From a theoretical perspective, the importance of inspiration to inventors would make sense. Current scholarship on the social aspect of innovation recognizes that the knowledge or experience an inventor acquires likely comes through and across social networks. One example of such a social network is an apprenticeship arrangement. Many men were trained at trades like carpentry or blacksmithing while they were apprenticed to a tradesman. These types of widespread and important knowledge networking mechanisms helped propel the United States toward industrialization.[32] A steady supply of skilled, mechanically competent workers was a considerable asset for companies trying to secure capital and financing for additional manufacturing facilities. Therefore, it is not unreasonable to suggest that women, like Reed, shared their knowledge and expertise across their own networks and sought to improve the way their work was conducted.

---

[31] Mrs. D. A. Lincoln, *Mrs. Lincoln's Boston Cook Book: What to Do and What Not to Do in Cooking* (Boston: Roberts Brothers, 1896), 55-56.

[32] Lisa D. Cook, "Inventing Social Capital." *Explorations in Economic History* 48, no. 4 (2011): 507.

This joint stock of knowledge can demonstrate the plausibility for sharing, or marketing, one's intellectual property across economic networks.[33] Consider that from the time Reed's patent was approved, 40 more years would pass before sliced loaves of bread were widely available in markets. Surely an invention such as Reed's would have been welcome in many households had it made its way to manufacture and merchandisers. No evidence suggests she was successful in bringing her invention to the market, but a near-identical model was submitted for patent approval in 1894 to Joseph Lee of Boston.[34] Lee, a former slave, used this dough kneader in his restaurant, but there is no indication he used his patent to manufacture or market any reproductions of the kneader.

What is known about United States patent number 305,474 is that it was, indeed, issued to Judy W. Reed. What is not known is how exactly this unlikely event came to pass, or to whom the rights and potential earnings *might* have passed. The same cannot be said for Ellen Eglin's invention, which never was assigned a number. Eglin, who was born in Maryland in 1836, might or might not have been a slave, but she worked for many years as a domestic servant in Washington, D.C.[35] Perhaps the drudgery of laundry work, similar to what Reed must have experienced as she kneaded and rolled countless loaves of bread, drove Eglin to devise a mechanical means to wring water from clothing prior to hanging it to dry:

> Without running water, gas, or electricity, even the most simplified laundry process consumed staggering amounts of time and labor. One wash, one boiling, and one rinse used about fifty gallons of water – or four hundred pounds – which had to be moved from pump or well or faucet to stove and tub, in buckets and wash boilers that might weigh as

---

[33] Ibid., 517.

[34] United States Patent No. 524,042 dated August 7, 1894.

[35] United States Census 1850, 1860 and 1890; Washington, D.C. resident directories 1888-1894.

> much as forty or fifty pounds. Rubbing, moving clothes about with a wash stick in boiling water, wringing, and lifting water-laden clothes and linens … wearied women's arms and wrists and exposed them to caustic substances. … *repeat the entire process* on progressively coarser and dirtier loads of clothes.[36]

Eglin and other domestic servants likely endured such backbreaking work once a week at the homes of their employers, and then would return to their own homes to go through the same procedure.

As a Washington, D.C. resident, Eglin had the opportunity to hear several speeches given in her town by Charlotte Odlum Smith, a reformer and labor activist from St. Louis. Smith was driven to crusade on behalf of all working women, and established the Women's National Industrial League to work to elevate labor and increase the dignity of wage-earning women.[37] Smith was especially vocal about women whose innovation and inventions were stifled or even ignored as the United States entered a period of industrial and technological expansion. She spearheaded a campaign to highlight women inventors' ingenuity that included a short-term goal of putting their work front and center at the 1891 Centennial Patent Convention in Washington, D.C.[38]

Her broadsheet publication *The Woman Inventor* made its debut in conjunction with the convention and included articles she had written about the need for recognition of women's innovative contributions. Smith's long-term goal was to harness the interest and excitement from the convention and carry it forward to a similar exhibition at the World's Columbian Exposition

---

[36] Susan Strasser, *Never Done* (New York: Pantheon Books, 1982), 105-106.

[37] Autumn Stanley, *Raising More Hell and Fewer Dahlias* (Bethlehem, PA: Lehigh University Press, 2009), 186.

[38] Macdonald, *Feminine Ingenuity*, 81.

in Chicago, scheduled for 1893.[39] This goal was unrealized. Smith's hope for equal representation of women's inventions, through their display in the same space and manner as men's, was smashed. In one corner of the first floor of the Women's Building, squeezed between the Information Desk and the men's restroom, the Women in Science exhibits were staged as second fiddles to the displays that glorified the feminine, domestic sphere.[40] Be that as it may, Eglin was inspired by Smith's passion and believed in her crusade to change the conversation about women's contributions to innovation.

Among the stories Smith wrote for the first edition of *The Woman Inventor* was one featuring Eglin herself. By comparison, Smith allocated nearly a quarter of a page column to Eglin's invention when others' inventions received but two lines. In addition, the Eglin piece was given its own headline, rather than being relegated to the "Recent Patents to Women" list. The attention Smith gave Eglin likely can be explained by the unusual fact that a black woman was an inventor. The headline, "Colored Woman Inventor," ensured the reader would understand that this situation was out of the ordinary. But in Eglin's own words, her experience was every bit ordinary for a black woman in late 19th-century America:

> Ellen Eglin, of this city and a member of the Woman's National Industrial League Invented a clothes-wringer. She sold the invention to an agent for the sum of $18.00 in 1888. The wringer is a great financial success to the present owner. When asked by the writer why she sold the invention so cheap after giving months of study to it, she replies, 'You know I am black and if it was known that a negro woman 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.'[41]

---

[39] Ibid., 367.

[40] Maud Howe Elliott, *Art and Handicraft in the Woman's Building of the World's Columbian Exposition, Chicago, 1893* (Chicago: Rand, McNally and Company, 1894), Preface.

[41] "The Woman Inventor" broadsheet publication by Charlotte Smith, 1891. Reference URL: ia801200.us.archive.org/25/items/Womaninventor1Smit/Womaninventor1Smit.pdf

Whether legal counsel advised Eglin not to attempt to market her invention or this was wisdom she gathered in the course of her life (she would have been her mid-50s at the time she sold the rights) is unknown. In either case, she was blocked from benefitting from the patent system.

In 1890, United States patent number 450,080 for "CLOTHES WRINGER' was issued to the Lovell Manufacturing Company from Erie, Pennsylvania. In the USPTO database, Lovell is named as the patent assignee, meaning that the rights to the intellectual property, drawings, monetization privileges, etc., were conveyed through purchase from the inventor – the source of the intellectual property. If this invention was the one for which Eglin sold the rights, her statement that the "present owner" realized financial success was accurate: through the year 1930, the Anchor brand clothes wringer manufactured and sold by Lovell was one of just two widely available models and accounted for half of all sales.[42]

The influence of social networking on innovation and invention[43] might have led to a possible personal relationship between Smith and Eglin. Though Eglin did work for many years as a domestic servant and housekeeper, she worked as a federal clerk beginning in 1890.[44] Smith was working in Washington, D.C., too, also as a federal clerk,[45] and at the same time was organizing the Woman's National Industrial League. One mission of the WNIL was to organize women wageworkers, among them clerks, who did not work in unionized industries. Smith testified at a United States Senate Hearing on Relations Between Labor and Capital, voicing her

[42] Lee M. Maxwell, *Save Women's Lives*: *History of Washing Machines* (Eaton, Co.: Oldewash, 2003), 123.

[43] See note 20 above, 508.

[44] United States Census 1890.

[45] Autumn Stanley, "Scribbling Women as Entrepreneurs." *Business and Economic History* 21, (1992): 80.

concern about the discrimination women faced in the workplace, from unfair hiring practices to unequal pay for equal work. Her anger at the looming dismissal of women working as federal clerks by Cabinet officers was evident during her testimony.[46] Perhaps Eglin felt a connection to Smith because of her determination to seek workplace changes for all women, and especially for those women working in their common occupation as federal clerks. The two women lived within a mile of each other,[47] might have worked together, and Eglin was a member of Smith's WNIL. These layers of networking might have spurred Eglin to invent, and perhaps shed light on the reason Smith would choose to dedicate an unusual amount of space in her publication to Eglin's patent application experience.

Because of Smith's endorsement of Eglin in *The Woman Inventor*, it is somewhat ironic that, in addition to her working-women's-dignity activism, Smith also was responsible for the first recognition given by the USPTO to women patentees. Smith lobbied Congress for funds to pay Patent Office clerks to compile a list of women inventors based on accumulated office data.[48] In 1888, "Women Inventors to Whom Patents Have Been Granted by the United States Government, 1790 to July 1, 1888" was published, and updates were generated in 1892 and in 1895. But, it is distressing to note that in the official United States government listing, Judy W. Reed's name did not appear.

Nonetheless, through patent records and newspapers, evidence of the creative intellect of Reed and Eglin exist. Feminist historian Guion Griffis Johnson made a timely observation about the link between intellect and earnings, writing that the reformers were crying for the chance to

---

[46] Stanley, *Raising More Hell and Fewer Dahlias*, Senate Hearing Transcript, App. 1.

[47] Addresses included in Washington, D.C. city directories plotted on mapping software.

[48] Macdonald, *Feminine Ingenuity,* 145.

be financially independent and that cry "would be answered by women who are able to earn a livelihood by intellectual means."[49]

A Closer Look at Early Logistical Obstacles for Women Inventors

By the time Judy W. Reed's patent application was approved in 1884, slaves throughout the United States had been emancipated, but that freedom did not necessarily guarantee equal treatment with regard to legal affairs and the costs associated with the patent application process. In Reed's case, this inequity might be observed in the patent application itself, where, at the time she was seeking protection of her intellectual property, witness signatures were required. The prescribed procedure for completing an application for a patent included the submission of drawings of the invention. The drawings were signed by the applicant, the applicant's attorney and two witnesses, who were required by law to be, as mentioned in an earlier section, authorized to administer oaths. In addition, the applicant was required to provide a written explanation of the invention's nature, its function, and the features that made it "new" or "an improvement" of an existing device. Two witnesses, who were not witnesses to the drawing, also signed this written explanation. What qualified a person as an appropriate witness was not dictated by any governmental guidelines, but varied by geographic regions, states, or even cities. For example, in rural areas someone as "important" as a notary or postmaster might be listed as a witness on a patent drawing or written description of the invention. In more urban areas, attorneys, engineers, or city officials might act as witnesses.

In Reed's case, her attorney's sister signed her drawings, but the signatures on the patent description are from two Virginia members in the United States House of Representatives. In

[49] Guion Griffis Johnson, "Feminism and the Economic Independence of Woman" *Journal of Social Forces* 3, no. 4 (1925): 615.

comparing the patents (by numbers assigned) issued immediately before and after Reed's, none show the signatures of witnesses with stature similar to Virginia Representatives Lewis McKenzie and John Ambler Smith.[50] That these presumably busy men would have the time or inclination to sign the patent application documents of a former slave woman is puzzling. Could it be that black inventors were burdened by discriminatory or overly tedious requirements with regard to the application procedure? There is no evidence that other inventors (presumably mostly white) from Virginia during this time period submitted applications with signatures of such notable witnesses.[51] Perhaps Reed "assigned" or sold her patent rights to McKenzie and/or Ambler Smith (who then sold them, maybe to inventor/restaurateur Joseph Lee?) in order to pay for the costs of the patent application and review process. Between the years of 1790 and 1879, of the 1,273 patents issued to women inventors, at least 323 – a quarter of the awards – were assigned to the lawyers and/or agents of the applicant at the time the patent was granted.[52] There is no documentation to verify such a transaction took place in Reed's case, but it is possible, especially considering the patented bread dough kneader that Lee used in his restaurant was identical to the drawings Reed submitted to the USPTO.

An alternative explanation for McKenzie's and Ambler Smith's witness signatures on Reed's patent application could be related to her illiteracy. The possibility exists that she was

---

[50]USPTO database search from issue dates August 24, 1884 – October 24, 1884.

[51]European Patent Office filtered database search for Boolean values in "Issue Location = Virginia, United States" and "Washington, D.C., United States" and "Massachusetts, United States" restrained to the filtered dates September 24, 1883 through September 24, 1885, yielding results for the most active locations for patent application for the time period beginning one year prior to Wells' approval and ending one year after. The United States Patent and Trademark Office database is not searchable with filters for activity prior to 1976. The EPO has assimilated data from many countries and is searchable when some information is known.

[52] Khan, *The Democratization of Invention*, 155.

McKenzie's former slave. Records indicate that she was free as early as 1860, which is 24 years prior to the approval of her patent application.[53] Although McKenzie was considered a Unionist, slave schedules indicate he owned a mulatto woman born in the same year as Judy Reed. He also owned a mulatto child the same age as one of Reed's children.[54] Following her emancipation, Reed lived with her husband Allen and several of their children and a grandchild. The family moved from Alexandria to Charlottesville sometime prior to 1860.[55] The move put the Reeds quite a distance from McKenzie's home, but they were still in his congressional district. At the time Reed filed the application for her patent in 1883, she lived in Washington, D.C., near McKenzie's home and near John Ambler Smith's office. The possible past relationship of Reed to McKenzie, and McKenzie's political and business connection to Ambler Smith, could explain their willingness to provide witness signatures on Reed's patent description. Although there is no stipulation about an applicant's literacy in Patent Law from that time period, perhaps Reed's illiteracy created a necessity that the witness signatures be of those in positions of elevated authority, that is – beyond the requirement that the witness be authorized by law to administer oaths. The legal wording on all patent documents from this time period contain the precise phrase: "In testimony whereof I affix my signature in presence of two witnesses," so perhaps these men were required to vouch for the identity of the woman signing an "X," as well as to her inventor's oath. Assuming prior personal relationships existed, and for all their power, however,

[53] United States Census, 1860.

[54] United States Schedule 2 Slave Schedule for city of Alexandria, Va., dated August 7, 1850 and same entries shown on Slave Schedule dated July 18, 1860.

[55] United States Census 1860 and 1870 lists the Reed family as residents of Charlottesville, Va. Patent document states Judy W. Reed was a resident of Washington, D.C. at the time her application was filed in 1884.

Reed's well-known witnesses appear to have had little sway in helping Reed bring her dough kneader to market.

Eglin and Reed had what might seem to be the right mix of opportunities to become accumulators of wealth. Both women were still living when slavery was abolished, so they could legally own property. Both found inventive solutions for common, gender-specific burdens through their inventiveness, their intellect. Both lived in an area of the country where innovation was celebrated and manufacturing centers were close at hand. Both had access to people who could handle the legal aspects of transforming an idea into a finished, saleable product. Both should have been able to benefit from the spirit of a government policy that did not favor one race, gender, or class over another in its administration. Yet as far as can be determined, neither woman accumulated wealth. This suggests that the same societal mechanisms that allow white, well-funded, males to accumulate wealth fail women. The formal and fundamentally unequal treatment women faced, including inadequate or no compensation, scarce recognition or attribution, and faulty or dubious legal representation or advice, directly interfered with the proper meting out of patent system incentives and the intended immanent effects. In the cases of Reed and Eglin, the democratic intent of the United States patent system was compromised by policy and law, and likely as well by sexism and racism, to seemingly perpetuate oppressive economic and social structures.

Harriett Strong's story pivots on her unfortunate choice to marry. Published correspondence and newspaper articles written about husband and wife Charles Lyman Strong and Harriet Williams Russell Strong, when taken together, provide a unique contrast between the gendered expectations of men and women in pre-industrial America. An article about Charles published in an 1884 issue of "The Engineering and Mining Journal" cements historians'

observations that late-19th century masculinities were based on the Eastern-Anglo belief that men became more powerful and manly if their lives were productive, in the most-strictly capitalistic sense. Similarly, newspaper articles in *The Los Angeles Herald*, *The Daily Alta California* and San Francisco's *The Morning Call*, written about Harriet, glorify her embodiment of American femininity: her resourcefulness, her cheerfulness, her sobriety, her slender figure. A more careful inspection of these newspaper articles written about Harriet reveals perhaps another gendered expectation of 19th century American women: their willing acceptance of an inferior role in marriage.

Harriet's husband's life was chronicled, posthumously, in the February 16, 1884 issue of the journal, approximately a year after he took his own life.[56] The writer, Eben Olcott, conceivably as a professional courtesy to Strong, framed his death by his life thusly: "… (Strong) was a pioneer in American mining, and his life affords some great lessons from which all can well profit. He was a victim of the American monster, 'overwork.'"[57] Nancy Quam-Wickham points out in her essay "Rereading Man's Conquest of Nature" that in the industrialization era, mining, like other extractive exploits, demanded much from its pioneers, "men who based their gender identities as workers on … the ability to produce."[58] Olcott documented that Strong worked tirelessly to accumulate wealth through mining, but did not achieve success:

> Every economy was practiced … He did his own bookkeeping, and, at times, assaying, surveying, and chemical work, besides the general duties that usually fall to the lot of a superintendent. He personally visited every part of his mine daily,

---

[56] Jane Apostol, "Harriet Russell Strong," *California History* 85, no. 2 (2008) 53.

[57] American Institute of Mining Engineers, *Engineering and Mining Journal*, 37, (1884) 118.

[58] Nancy Quam-Wickham, "Rereading Man's Conquest of Nature," *Men and Masculinities* 2, no. 2 (1999) 144.

> ran a lixiviation mill at times without a fireman, and in every way saved every cent he could for his company. It is a harder thing to be the unfortunate director of unsuccessful operations than to conduct more extensive profitable enterprises; and this Mr. Strong felt. Surely it was no fault of his that his company did not pay dividends.[59]

Strong's unceasing efforts to extract wealth from his mines could have cost him his life, but it is a surer thing that this failure caused him to question his own manhood. As Susan Lee Johnson noted in her essay "Bulls, Bears, and Dancing Boys: Race, Gender, and Leisure in the California Gold Rush," the rise of industrialization in the United States forced a change in one of society's most prevalent parameters for measuring masculinity: self-control. Instead, the hallmark changed to "their own experience as economic actors and the notion that success, increasingly defined as the accumulation of capital, resulted from hard work, and prudent plans."[60] In Charles Strong's case, his business failure also would have signaled his failure as a man.

Newspaper mention of Strong's wife, Harriet, first appears on October 9, 1884, several months after his suicide. The *Daily Alta California* included two lines reporting that a United States inventor's patent was issued to "Harriet W. Strong, Oakland, device for raising and lowering windows."[61] Presumably focused on domestic duties during the years she was married, this snippet shows Harriet had an ability to problem solve and to invent, and this is an example of what Mary Ann Irwin described as "women crossing the line into what was, essentially, the

---

[59] American Institute of Mining Engineers, 119.

[60] Susan Lee Johnson, "Bulls, Bears, and Dancing Boys: Race, Gender, and Leisure in the California Gold Rush," in *Across the Great Divide*, 2001, ed. Matthew Basso, Laura McCall, Dee Garceau-Hagen (New York: Routledge, 2001), 47.

[61] "Sparks From the Wires." *Daily Alta California,* (San Francisco, CA), Oct. 9, 1884.

masculine sphere."[62] Irwin points out that in mid- to late-19th century, "separate spheres" was more of a metaphor than a reality because a certain flexibility was emerging, perhaps due to early suffrage.[63] Nonetheless, a *Los Angeles Herald* article from 1909 seems to gloss over Harriet's ingenuity in favor of her domesticity:

> Given a piece of ground and water and almost any woman with a little spare time ought to be able to raise something … It was a woman, Mrs. Harriet Strong, who first raised pampas plumes.[64]

Missing, however, from (readily searchable) press coverage in the years between Harriet Strong's 1884 domestic invention and the 1909 recognition of her glorious pampas grass plumes were her 1887 and 1894 inventions: dam and reservoir design/construction, and a reclamation system for the water used in the hydraulic mining process. At the time she was granted patents on these inventions, she was a widow. She filed the patent applications under a defeminized version of her name, using "H.W.R. Strong" instead, because she believed using "Mrs. Harriet Strong" or "Harriet W.R. Strong" would lead to objections of the inventions' practicality because "it was thought of by a woman!"[65]

Strong's California property was in a semi-arid area and irrigation was a continuous struggle, not just for her and her family, but also for the entire region. Harriet invented an irrigation system that took advantage of the geography around her. Instead of relying on one dam, which would always be in danger of collapsing, she built and patented a series of ascending dams, which would allow irrigation at the highest elevations while the backpressure the

---

[62] Mary Ann Irwin and James Brooks, *Women and Gender in the American West*, 2004 (Albuquerque: University of New Mexico Press, 2004), 249.

[63] Ibid., 258.

[64] "Opportunities For Women." *Los Angeles Herald,* (Los Angeles), Mar. 23, 1909.

[65] Apostol, "Harriet Russell Strong." 62.

downstream dams provided prevented collapse. This ingenious design was eventually used to harness the Colorado River, and thus provide a major source of water for California farmers.[66]

In 1892, San Francisco's *The Morning Call* published a lengthy article about Strong titled "A Woman's Brains," and subtitled "They Have Made Her Rich and Famous." The article's first paragraph does not, however, allude to her brains:

> She is tall and slim, willowy is the word. Her forehead is high, her hair pompadour, her whole face oval and pleasing. The eyes are intellectual, the mouth determined. She dresses very neatly, always in black, and is altogether a striking figure.[67]

In fact, the reader learns that Harriet is a charming conversationalist before her business acumen is even mentioned. The obvious attention paid to Harriet Strong's appearance before her accomplishments indicates that even for a high-achieving woman, the domestic sphere was still her "place." These descriptions of Strong's attributes were written by unidentified local newspaper reporters, so it is disingenuous to speculate whether or not gender bias contributed to such a narrow view. She might have been, however, a theoretical case in point for a writer at the United States Government's 1905 publication *Women's Bureau Bulletin* who declared, "[i]f … the number of patents granted women is accounted for merely by the increase in the number of patented hairpins … and such trifles in feminine equipment, it is without large significance either to civilization or as an indicator of women's inventive abilities."[68]

The chronology of these documents show that married women, in particular, were not welcome in the public sphere. Charles Lyman Strong was married to a woman with intellectual power, yet he could not or would not utilize her abilities to benefit his failing mine enterprise.

---

[66] Lisa Marovich, " 'Let Her Have Brains Too.' Commercial Networks, Public Relations, and the Business of Invention," *Business and Economic History* 27, no. 1 (1998): 150.

[67] "A Woman's Brains" *The Morning Call* (San Francisco, CA), Nov. 20, 1892.

[68] Khan, *The Democratization of Invention*, 131.

After his death, Harriet Strong, a poor widow with four children, drew on her capabilities to find new and better ways to ranch and farm, as well as undo some of the damage the mining industry had leveled on western lands. With respect to gender expectations in the 19th century, the married Strongs lived the narrative, but only upon her husband's death did Harriet have an opportunity to step out into the public sphere.

III. ANALYSIS: WHY WHAT IS … IS

Women and Invention Today

These historical influences are important to consider upon returning to the task of agreeing on which gender patent gap problem of causation to solve. Today, as in the 19th century, an obvious correlation can be made between a low number of patents granted to women and a low number of women in the fields of technology and engineering. But today, unlike in the 19th century, women seem to be pursuing the educational requirements that should lead to careers in STEM fields. The United States Bureau of Labor Statistics (USBLS) data indicate that in 2015 women made up approximately 15 percent of the engineering workforce, and just 8.3 percent of the patent-producing field of mechanical engineering.[69] Of course there are broad, traditionally male-dominated employment fields (i.e., in the construction industry, 2.7 percent of the workforce is female), but the percentage of engineering and technology jobs held by women is lower than the percentage of women leaving college with marketable STEM degrees.

American Society for Engineering Education (ASEE) data show that for the 2014-15 academic year, women earned 19.9 percent of all undergraduate engineering degrees,[70] 25.2 percent of all engineering master's degrees,[71] and 23.1 percent of all engineering doctorates.[72] The difference between the percentage of STEM degrees granted to women and the percentage of women finding employment in engineering or technology fields indicates that some obstacle

---

[69] United States, Bureau of Labor Statistics, Report 3, Washington, D.C., (2015) 3.

[70] American Society for Engineering Education, *Engineering College Profiles and Statistics*, Washington, D.C., (2015): 12.

[71] Ibid., 20.

[72] Ibid., 24.

other than the prerequisite education level keeps women from careers in fields of patentable innovation. Feminists from different disciplines have studied these disconnects, and a review of their scholarship follows without counterargument because the data is good and the interpretations rational.

Suggesting Women Aren't "Right" for the Place

Gender bias against women engineers influences hiring as well as workplace practices. Joan Acker focuses on two big obstacles for women who work or wish to work in patent-producing jobs: recruiting/hiring, and the "old boys" networks, which are already in place and populated by men who wish women were not there. Evidence suggests that plenty of women have the educational credentials to work in high-powered engineering positions, but do not find jobs or stay in jobs. Acker finds that firms with flat hierarchies, engineering firms for example, engage in more collective decision-making processes. In hiring, the collective would have to be determined to hire a woman, but these firms – run by competitive, ambitious white men – would fall back on their homophily and pick a man just like all the other men.

The term "homophily," literally "love of the same," names a social bond along the lines of "birds of a feather (flocking) together."[73] To Acker, this networking produces an "inequality regime"[74] and informs another patent-specific area where women experience discrimination: venture capital procurement. Women struggle to find financial backing for concepts or research and development, and this is due to the venture capitalists' exclusive comfort with "known" or

[73]Morteza Dehghani, Kate Johnson, and Joe Hoover, "Purity Homophily in Social Networks," *Journal of Experimental Psychology* 145 no. 3, (2016): 366.

[74]Joan Acker, "Inequality Regimes: Gender, Class, and Race in Organizations," in *The Kaleidoscope of Gender*, eds. Joan Z. Spade and Catherine G. Valentine (Los Angeles: Sage, 2017), 393.

established success. If the person requesting the financial funding does not look like the prototypical success agent, the capitalist will not invest.

Steven C. McKay's less-theoretical but still discouraging work finds that the gender makeup of high-tech patent-producing engineering workplaces is over 90 percent men, but the emerging career field of engineering technology, which does not offer the opportunity to patent, has a higher percentage of women, 30 percent.[75] He also notes that in the electronics industry there is a "mismatch between women's high education" and their ability to advance. Women engineering techs, generally speaking, have the same high-level education as the male engineers but are "pushed" into these lower-paying, closed-ended jobs when they aren't hired by engineering firms or are hired but leave soon after.

Not many women, however, are hired by engineering firms, let alone make a decision to leave. As Brooke Conroy Bass writes, at the time women engineers present themselves to potential employers, after they have completed at least a master's degree and in many cases a doctorate, they are in their mid- to late-20s. Because of the essentialist nature of a gendered society, employers assume that females will reproduce, so they have the expectation that this should and will happen. Since "supplemental" roles are best for workers who will soon be leaving the workforce, and since there are no supplemental positions in patentable-project firms, women are passed over for men who have the ability to "ramp up" their careers.[76] This is exactly what a cutting-edge, competitive company looks for in its workers. In addition, "ramping up

[75] Steven C. McKay, "Hard Drives and Glass Ceilings: Gender Stratification in High-Tech Production," in *The Kaleidoscope of Gender*, eds. Joan Z. Spade and Catherine G. Valentine (Los Angeles: Sage, 2017), 429.

[76] Brooke Conroy Bass, "Preparing for Parenthood? Gender, Aspirations, and the Reproduction of Labor Market Inequality," *Gender and Society* 29, no. 3 (2015): 379.

men's" drive for extra dollars translates into willingness (in the employers' view) to work the long, extra hours innovation and invention require.

Conroy Bass offers a caveat that her study was limited because it focused on "mostly class-privileged heterosexual couples." This disclaimer might be interpreted as a rewording of Xu and Martin's "old boys' network" previously discussed.[77]

As mentioned in this paper's Introduction, some researchers today observe that there are numerous women embarking on careers in technology or engineering, but then exiting the field. Public policy scholar Sue V. Rosser attributes this pattern to – not surprisingly – lack of patents. In her work, Rosser studies the impediments women face once they have moved from STEM education to STEM careers and how those roadblocks keep patents out of women's reach. Interviews conducted with industry professionals show that women encounter gender discrimination in at least two important phases of the patent quest: acquiring venture capital to fund projects that could culminate in a patent grant, and during the patent "review" process.

Gender bias exhibited by venture capitalists is thought to be a function of the prevailing societal attitude that commercialized innovation is a male domain, likely derived from the historical underrepresentation of women in fields of invention.[78] A case can also be made that women are stereotyped as deficient money handlers or investors. Therefore, they are thought to present a greater risk for the venture capitalist's outlay of funding for a project presented by a woman versus a project presented by a man.[79] In either case, Rosser's interview findings,

---

[77] See note 4 page 6.

[78] Fiona Murray and Leigh Graham, "Buying Science and Selling Science: Gender Differences in the Market for Commercial Science," *Journal of Industrial and Corporate Change* 16, no. 4, (2007): 679.

[79] Ibid., 676.

referred to in the preceding paragraph, are consistent with data showing that 76 percent of venture capital investors take prior patent grants into account before deciding to fund.[80]

Rosser's research documented other barriers encountered by women seeking to patent an innovation, the most ominous of which is typically all-male patent review panels.[81] The perceptions of these review panels are gender-biased because their collective experience edifies that they themselves, privileged males, are responsible for the engineering of new technologies, as well as supplying the money to create them.[82] Such prejudiced views often result in the rejection of the patent application, and further undermine women's attitudes about the practicality of remaining in fields of invention.

Rosser points out that "few women obtaining patents hurts scientific innovations, technology and competitiveness overall,"[83] but even more problematic, because patenting is integral to technology and science firms, women literally cannot succeed.[84] This lack of success drives the downward spiral because the venture capitalists behind commercialized science, as discussed, might not back the projects of a non-patented female inventor.

---

[80] Jessica Milli et al., "The Gender Patenting Gap," *Institute for Women's Policy Research* C441 (2016): 7.

[81] Rosser, 74.

[82] Ibid., 79.

[83] Ibid., 67.

[84] Ibid., 71.

Suggesting the Place Isn't "Right" for Women

A portion of economist Zorina Khan's research and writing about patents concentrates primarily on what she calls the "democratization" of invention and how this dynamic helped push the industrialization of the United States, and she believes deficiencies in the legal system, as contrived then and of influence now, explain the gender patent gap. The purpose of patenting an invention, ostensibly, is for financial benefit, and that "commercial exploitation of patent property depended on the right to contract and to sue, in order to produce the invented article, to assign the patented invention, or to prosecute infringers."[85] Women, who by law had no ability to enter into or engage in legal action, could not benefit financially by seeking an invention patent, so no effort was made. Khan believes women invented, but did not patent, and this directly influences the way women inventors are studied today. The void leads historians to assume "innovating" is not something women "did," and "one is left with the strong sense that the industrial revolution is primarily a men's story."[86]

Economist Alison Booth found that, when placed in an all- or predominately-male environment, women exhibited less risky behavior as compared to when the women were in groups comprised of only women (her study was based on observations of women participating in lottery games). Based on the findings, Booth made a connection between the speculative field of invention and women's aversion to risk as a consideration in their career choices, effectively removing themselves from the competition pool for patent-producing jobs.[87]

---

[85] Khan, *The Democratization of Invention*, 162.

[86] Ibid., 129.

[87] Alison Booth et al, "Gender Differences in Risk Aversion: Do Single-Sex Environments Affect Their Development," *Journal of Economic Behavior,* 99 (2014) 140.

Other researchers maintain that a sufficient number of women are employed as engineers, but that they are not in jobs that can lead to patentable projects. This contention seems plausible. ASEE data, again from the 2014-15 academic year, indicate that 38.9 percent of electrical and mechanical engineering master's degrees were awarded to women. Recall that presently 7.7 percent of all patents awarded go to women. If all women engineers – a total of 15 percent of the engineering workforce – earned their degrees in either electrical or mechanical engineering and entered the workforce, technological advances and the patent awards in STEM would likely increase from 7 percent to around 24 percent.[88]

The varied explanations for why or if women are underrepresented in STEM workplaces, coupled with the possibility that the workplace itself is a deterrent, suggests that implementing incentives to provide more opportunities for women innovators should be undertaken carefully. However, against this backdrop, wholesale adoption of STEM education programs has taken place, and as inequitable as the gender patent gap might be, the situation could well be going from bad to worse.

Solving One Problem, Creating Another

According to the United States Government Accountability Office (GAO), federal involvement in STEM educational programs began in 2003.[89] At that time, the government sought to increase the number of STEM field college graduates to help mitigate what was then viewed as a "STEM crisis" — that is, the lack of job growth in the United States in the late

[88] Jennifer Hunt, Jean-Philippe Garant, Hannah Herman, and David J. Munroe. "Why Don't Women Patent." *Working Paper 17888. National Bureau of Economic Research*, (2012): 13.

[89] United States Government Accountability Office. *Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends*. Washington (2005): 17.

1990s, combined with what was perceived to be a loss of technological superiority to foreign businesses. The "crisis" was introduced into political conversation at about the same time the No Child Left Behind Act became law in 2001, and STEM education discussion expanded to include K-12 as well as post-secondary institutions.[90] It is worth noting that in 2004, the U.S. government reported spending $2.8 billion on STEM education programs across 13 agencies.[91] GAO reporting of the budget for and progress made in these programs began in 2005 and included figures for the 2004 fiscal year. The mission of the lone gender-focused program, "Research on Gender in Science and Engineering," was to facilitate drawing more girls and women into STEM classes, majors and careers by providing funds for research and extension services. The 2004 budget for this initiative was $10 million, or 0.4 percent.

GAO reported in 2010 that the agencies' budget increased to over $3 billion, and the Research on Gender in Science and Engineering received a proportional $11.5 million. More important, however, is the GAO's statement that "efforts to coordinate STEM education programs across the government remain limited."[92] The GAO also determined that the success of any of the prior initiatives could not be measured due to the inability of agencies to procure data from schools (primarily K-12). To address these shortcomings, oversight of the U.S. government's STEM education agencies was passed to the National Committee on Science,

---

[90] Michael Anft, "The STEM-Crisis Myth," *Chronicle of Higher Education* 60, no. 11 (2013): A30.

[91] United States Government and Accounting Office, "Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends" (2005): 18.

[92] United State Government Accountability Office, *Science, Technology, Engineering, and Mathematics Education: Strategic Planning Needed to Better Manage Overlapping Programs Across Multiple Agencies,* Washington (2012): 21.

Technology, Engineering and Math Education (CoSTEM).[93] At this point, the U.S. government had spent $15 billion for STEM education before analyzing the effectiveness and ancillary outcomes of the programs.

Based on these analyses, changes were made to address the shortcomings, but the budget expanded. In March 2016, the 2017 U.S Federal Budget that was presented included $7 billion for STEM education initiatives, but made little provision for female-specific programs ($500,000 for the Nancy Foster Scholarship granted through the National Oceanic and Atmospheric Administration). Surprisingly, a paltry $109 million (or 1.6 percent) will be targeted to increase the number of all undergraduate engineering majors. Included in the goal statement of this "Transforming Undergraduate Teaching and Learning" program is "the need to recruit more women … into majors in computer science."[94] In 15 years, federal monetary investment in programs that could steer women into fields of patentable innovation, that is, engineering, has gone from very little – 0.3 percent in 2004 – to nearly none. The Trump Administration's 2019 budget eliminated provisions for female-specific initiatives, and reduced STEM education spending from the previous administration's $7 billion to $200 million,[95] and has proposed the elimination of STEM education spending for 2020.[96]

---

[93] Ibid., 21.

[94] Executive Office of the President of the United States, *Progress Report on Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education*. Government Printing Office, (2016): 6.

[95] United States and Office of Management and Budget, *Efficient, Effective, Accountable*. 43.

[96] United States and Office of Management and Budget, *Promises Kept. Taxpayers First*. 33.

Government policy, whether well-intended or mean-spirited, can result in expanded disparities. Any administration could benefit by appointing inequalities experts to the panels of preliminary policy discussions. With specific regard to patents, economist Dean Baker believes the aggregate effect of U.S. policy is "to redistribute income upward."[97] He notes that such policies and laws provide the forms of protection that become the foundation for the accumulated wealth of some of the richest Americans, and uses Microsoft's Bill Gates as an example. To the contrary, he points out that low-income households rarely own patents or other intellectual property rights protection. This upward redistribution drags income inequality along with it, and to the extent that a government can aid or hinder these disparities as they pertain to gender, feminist economist Susan Himmelweit proposes, "[w]hen the policies under consideration would worsen gender inequalities, gender analysis, by revealing this, can strengthen the case for counteracting policies to remedy these effects."[98] Himmelweit's appeal for legislation in these matters seeks reconciliation for inequalities present in the UK and, as she theorizes, created by policy that concerns itself only with the paid economy and neglects the unpaid care economy, but the stipulation could be for any type of policy discussion. If the United States had adopted Himmelweit's views prior to enacting its STEM and education initiatives in early 2000s, the veritable of flood of white males into high-tech workplaces, which will be looked at more closely in the next section, might have been anticipated and alternative policies adopted.

[97] Dean Baker, "Is Intellectual Property the Root of All Evil? Patents, Copyrights, and Inequality," (presentation, Economics, Institutions and Policies in the Age of Inequality Conference, University of Utah, Sep. 27, 2018). 15.

[98] Susan Himmelweit, "Making Visible the Hidden Economy: The Case for Gender-Impact Analysis of Economic Policy" *Feminist* Economics 8, no. 1 (2002): 51.

Gender inequality as an integral part of policy discussion could reveal the crucial role of parents in a girl's decision-making process, and the influence that they can exert over her through their own gendered thinking. Education professor Lou Jean Beishline studied and collected via interviews data about female undergraduate engineering students' childhood home life. She found that stereotyped gendered thinking by a girl's parents discouraged the pursuit of an engineering career by conveying the expectations associated with engineering in a burdensome way. This might be expressed through parental concerns about the intense workload of the engineering profession or the limits such a career would place on a woman's ability to raise children and care for a home.[99]

Beishline's interviews also indicated that a high percentage of the young women experienced or recognized unintentional inequities. In their grade school and high school math and science classrooms, for example, they were not called on to solve problems or explain concepts. The young women said their teachers most often selected boys in the class to provide solutions and answers. Beishline believes these biases, absent parental encouragement to do so, discourage female students from entering college engineering or technology programs.[100]

The gradual elimination of government policies intended to close the STEM-learning gender gap, as was discussed in the immediately preceding government policy section, is one side of a two-edged sword. The bulk of the $7 billion STEM education budget for 2016 was earmarked for the Obama Administration's mandated "Computer Science for All" program.[101]

---

[99] Lou Jean Beishline, "Perceptions of Women in Engineering Programs Regarding Parental Influence on Academic Choice: A Qualitative Study" (Dissertation, Marywood University, 2008): 32.

[100] Ibid., 32.

[101] Ibid., 1.

With a $4 billion allocation, the program's goal was to expose all students, beginning in pre-school, to computer science. The remainder of the budget, which was discretionary, was intended to help K-12 schools support STEM education through academic enrichment grants,[102] to train teachers in best STEM education practices,[103] and to provide research money for development of both formal and informal educational tools.[104] Discretionary spending on STEM programs in middle schools and high schools should have lead, ostensibly, to an increase in the number of girls preparing for STEM college degrees, but the does not seem to be the outcome.

One such discretionary-funded high school program, Project Lead the Way (PLTW), provides a pre-engineering curriculum for participant schools. For a school or school district to offer such introductory-level courses, investments must be made in the building(s) to accommodate updated computer systems, as well as specialized work stations. PLTW literature estimates $35,000 would be needed to create an adequate classroom if the room was not previously used for science classes. Once the infrastructure is updated, the school(s) incur additional costs to train teachers, purchase laptops capable of running engineering software, specialized printers, equipment, and setup fees, totaling about $30,000. PLTW's Principles of Engineering course requires $450 worth of consumables per student. As these figures show, the costs of such pre-engineering programs – intended to *interest* students in STEM fields – is significant and out of reach for many school districts.

---

[102] Ibid., 3.

[103] Ibid., 5.

[104] Ibid., 9.

School districts likely to incorporate packaged programs such as PLTW in their curriculum are located in affluent suburban areas and receive state funding or grants to help implementation.[105] For many reasons, this disparity is disheartening, but it does provide a clear look at participation by gender: in schools where parental income levels are high, both boys and girls are offered the opportunity to participate in pre-engineering programs. Because of the socioeconomic profile of students taking advantage of programs such as PLTW, the costs of earning a STEM degree from a four-year institution are not prohibitive to the student, whether male or female. Yet across the United States, in schools offering the PLTW pre-engineering curriculum, girls account for only 17 percent of program enrollment. According to PLTW calculations, enrollment of females would have to triple in order for proportional representation to be attained.[106]

In studying this imbalance, IUPUI researchers Kenneth Reid and Charles Feldhaus also analyzed the preparedness of PLTW students from Indiana high schools for engineering coursework at the time they enter college. While Reid and Feldhaus believe PLTW does influence readiness for rigorous college-level work, they do not think the program, in and of itself, results in a student choosing to major in a STEM discipline. Rather, they say, success in and the choosing of a STEM major is the result of a challenging high school course load that was discussed and agreed upon by the student during meetings with counselors and parents. If girls

[105] Douglas Walcerz, "Report on the Third Year of Implementation of Project Lead the Way," *Outcomes Assessment System Report,* (2009): 21.

[106] Ibid., 22.

are not advised at the beginning of high school to take STEM preparatory classes, they will not pursue STEM degrees as college undergraduates.[107]

So, considering that PLTW reports 17 percent of enrolled students are girls and comparing that figure to the 15 percent of engineering bachelor's degrees being earned by women, a case could be made that the money invested by local school districts is well spent. Girls who are guided by their parents and/or counselors to participate in STEM classes in middle or high school generally earn a STEM degree in college. This argument, however, precludes the fact that, for a woman, earning the engineering degree likely will not result in the career success a patent would bring. As it stands, developing an interest in STEM and choosing a STEM major is only half the battle.

Between 2009 and 2015, the number of all mechanical engineering master's degrees awarded increased by 50.7 percent, so clearly the government STEM initiatives are producing more employable innovators. On the surface, such gains would look to be a boon for both the STEM industry and the STEM worker. Further analysis, however, suggests that perhaps these gains are creating detrimental (or, more accurately, one-sided) results.

According to Harvard University's Michael Teitelbaum, the United States' anxiety over the STEM "crisis," which paved the way for subsequent STEM education initiatives, is unwarranted. He believes that the worried discussion about unfilled engineering- and technology-sector jobs is started and maintained by industries that employ STEM workers as well as those industries' Washington lobbyists and trade associations. Teitelbaum is particularly incited by this ongoing, inaccurate portrayal of the STEM situation because, "Such claims have

---

[107] Laura Horn and Xianglei Chen, For the National Institute on Postsecondary Education, Libraries, and Lifelong Learning, *Toward Resiliency: At-Risk Students Who Make It to College*. Government Printing Office, (1998): 14.

convinced some politicians and journalists, who echo them."[108] Government data indicates Teitelbaum's stance is solid.

In the May 2015 *Monthly Labor Review*, the USBLS acknowledged there is no nation-wide shortage of mechanical engineers,[109] so an increase in women's representation in the field, though possible, is not likely at this time. Further evidence suggests that the demand for mechanical engineers – even those with master's degrees – is stagnant and those who presently are employed are vulnerable to layoffs.[110]

The expanding pool of degree-qualified mechanical engineers – both male and female – is now competing for scarce jobs. Rochester Institute of Technology professor Ron Hira thinks there are only two possible outcomes for this problem of engineer oversupply: U.S. engineers will have to give up their demand for high wages, and workplace and career security; or U.S. engineers will have to find a way to make themselves more marketable (productive) to stave off the hiring of lower-wage immigrant engineers.[111] In either scenario, the demand for engineers is not rising, as the stagnation of engineering wages demonstrates. According to research at the University of California-Davis, 25 percent of mechanical engineers who graduated from The Massachusetts Institute of Technology in 2012 took jobs on Wall Street rather than in technology

---

[108] Anft, A30.

[109] United State Bureau of Labor and Statistics. *Employed Persons by Detailed Occupation, Sex, Race, and Hispanic or Latino Ethnicity*." Washington, (2015): 11.

[110] AFL-CIO, "Engineers," *DPEAFLCIO* (2014): 3.

[111] Ron Hira, "Not Enough U.S. Engineers?" *Issues in Science and Technology* 23, no. 4, (2007): 8.

sectors, ostensibly to earn a higher salary.[112] While the natural market response to this over-supply of engineering labor will turn from wage stagnation to wage erosion, another harsh reality is that newly minted female mechanical or electrical engineers will lose their shot at finding jobs that can lead to marketable patent applications.

Suggesting Neither Women Nor the Place are the Root of the Problem

In outlining a sample of scholarly thought on gender disparity in patent ownership, it becomes clear that the issue is not one that can be rectified by making changes through government policy or education reform. Gender inequality is part of STEM culture, whether in the classroom or workplace. As this literature survey has shown, scholars thinking about the gender patent gap have constructed cases that are logical and effective analyses, but the theses of the works range from psychological risk fears in women to parental gender bias. To put it in the context of Bunch's model, each suggested "strategy" differs because each "description" produces an incomplete "analysis" of the problem. Bunch encourages accurate analysis that looks at "what groups and institutions benefit from oppression, and why they will, therefore, strive to maintain it."[113] Bourdieu suggested that "invariants" remain even in the wake of progress and that they can be "observed in the relations of domination between the sexes … which in the course of history have continuously abstracted these invariants from history."[114] There is then, perhaps, an opportunity to look at the gender gap in patenting as something historically unenlightened, as rooted in and reducible to male privilege.

---

[112]Norman Matloff and Jeff Flake, "Should Foreign STEM Graduates Get Green Cards?" *U.S. News and World Report* 4 no. 20, (2012): 2.

[113] Bunch, "Not By Degrees: Feminist Theory and Education," 14.

[114] Pierre Bourdieu, *Masculine Domination*, Translated by Richard Nice (Stanford CA: Stanford University Press, 2001), 4.

In the introduction to her essay, "Examining Exclusion in Woman-Inventor Patenting: A Comparison of Educational Trends and Patent Data in the Era of Computer Engineer Barbie®," former director of the Science and Technology Law Center at Albany Law School, Annette I. Kahler, includes a brief overview of the obstacles American women have encountered in the pursuit of patents. As the cases of Judy Reed and Ellen Eglin demonstrate, many of the historical roadblocks Kahler cites are definable: no property rights, no educational opportunities, no or limited monetary resources, and societal condemnation if a woman left her "home." Indeed, historian Alice Kessler-Harris thinks it paramount to understand at that time in United States history, "the changing system of production … produced a shared understanding of 'women's proper place' that played a powerful part in perpetuating traditional roles for women while they simultaneously pushed men into commerce and manufacturing."[115] As the case of Harriett Williams Russell Strong demonstrates, other obstacles included a lack of legal remedy in the event a woman *did* invent something. In such a case, her husband would secure the patent, then sell and keep any profits made from the invention and she would be unable to benefit.[116] Kessler-Harris contends that even if women were tempted to appeal to their husbands for permission to procure earnings, their determination would be weakened because they realized, on some level, that men benefitted both from keeping their wives at home and by "legitimating and protecting" their workplace standing.[117] Kahler also believes that women in 19th-century

[115] Alice Kessler-Harris, "A New Agenda for American Labor History: A Gendered Analysis and the Question of Class," in *Perspectives on American Labor History*, eds. Alice Kessler-Harris and J. Carroll Moody (DeKalb IL: Northern Illinois University Press, 1989), 229.

[116] Annette I. Kahler, "Examining Exclusion in Woman-Inventor Patenting: A Comparison of Educational Trends and Patent Data in the Era of Computer Engineer Barbie®," *The American University Journal of Gender, Social Policy and the Law* 19, no. 3 (2011): 780.

[117] Kessler-Harris, "A New Agenda for American Labor History," 229.

America were discouraged from pursuing the higher education required to enter the fields of engineering and science. Further, she notes that women were dissuaded from embarking on labor-intensive innovation careers, primarily because of the societal attitude that workplace demands on their bodies might create reproductive difficulties.[118]

Kahler's and Beishline's research is similar in that they arrive at conclusions propped up by the patriarchal convention that a woman's place is in the private sphere – that is, the not-public sphere. Rosser and Booth, although concerned more with how women fare in the public sphere, also present evidence that the workplace environment in fields of innovation is designed to minimize the threat of women to male superiority by making the public sphere inhospitable. In this convergence is where thinking about the historical treatment of women's intellect and creative capabilities might facilitate an understanding of the patent-granting institution as a nearly impermeable site of male privilege, and breaches of it by women as threats to male superiority.

Keeping in mind that intellect (a capacity that denotes cognition and the ability to identify and analyze) is different from intelligence (a consciousness which allows one to extract meaning or purpose), historical understanding of intellectual capacity included an ability to create.[119] It is interesting to note that for part of history, intellect as a masculine domain was not always the rule. For a period of time within the Platonic Academy, roughly 300-500 C.E., philosophers "held that creativity, both intellectual and material, resulted from a union of masculine and

---

[118] Ibid., 781.

[119] J.P. Guilford, "The Structure of Intellect," *Psychological Bulletin* 53, no. 4 (1956): 273.

feminine principles."[120] Though perhaps such a philosophy laid the groundwork for the eventual gendering of roles and the "cult of domesticity," for a short while, long ago, reason and truth, and even the sciences of the Enlightenment if one considers the artwork gracing Diderot and d'Alembert's *Encyclopèdie*, were "all equally regal, equally feminine."[121] Even into the 17th century, men were writing about women as equally able, as Pierre LeMoyne did in 1660:

> "Surely in all this, there is nothing, which the understanding of women may not attain; nothing which is above their reach, and the tracts which Nature hath laid open to them. Why should they not be as capable as our selves of Contemplation, and of the sciences belonging to Speculative Philosophy?'[122]

However, as the Enlightenment produced knowledge for knowledge's sake, writings and essays about women's intellect turned. LeMoyne perhaps foreshadowed women and their intellect's impending relegation to the private sphere:

> "Nevertheless, whatever I have said, it is not my intention to summon Women to the Colledge; I intend not to make Graduates of them, nor convert their Needles and Distaffs into Astrolabes and Sphears … I respect the boundaries that separate us too well."[123]

The epoch produced the work of Voltaire as well as that of his companion, Émilie du Châtelet, and while it has been suggested that perhaps he did not voice his admiration of du Châtelet's intellect with regularity, Voltaire did speak to it in his poem "The Divine Émilie," declaring "[s]he has, I assure you, a genius rare."[124] But du Châtelet, herself, indicates that by

---

[120] Londa Schiebinger, "Feminine Icons," *Critical Inquiry* 14, no. 4 (1988): 674.

[121] Ibid., 663.

[122] Pierre LeMoyne, *The Gallery of Heroick Women,* Translated by John Paulet, Earl of Winchester (London, 1652) 74.

[123] Ibid., 76.

[124] Judith P. Zinsser, *Émilie du Châtelet: Daring Genius of the Enlightenment* (New York: Penguin Books, 2007), 63.

the early-18th century women were barred from access to philosophy and the sciences in the "Translator's Preface" she wrote to introduce her reworking from English to French of Bernard Mandeville's *Fable of the Bees*:

> "The prejudice that excludes us women so universally from the sciences weighs heavily on me … I am convinced that many women are either ignorant of their talents … or bury them out of prejudice and for lack of a bold spirit. What I have experienced myself confirms me in this opinion. Chance led me to become acquainted with men of letters, I gained their friendship, and I saw with extreme surprise that they valued this amity. I then began to believe that I was a thinking creature."[125]

Perhaps if du Châtelet, who died in 1749, had lived longer and had been able to further pursue her passion for science and math, she herself might have threatened the superiority of the men of letters around her.

Between the periods of LeMoyne's and du Châtelet's writings, political and economic changes in Europe intensified the public/private divide of lives for men and women. Feudalism was breaking down, and as the beginnings of capitalism appeared, wage work performed by women for the merchant class threatened the earning potential of craftsmen. Journeymen rebelled, petitioned authorities to ban women from working in craft guild jobs, and threatened to strike. Women, who had to work for wages because of the collapse of land assignments, resisted these bans to an extent, but ultimately failed. The ones brave enough to dare to work outside of the home – in the public, in "for the market" jobs – were referred to as "shrews," "witches," or "whores," and incurred the wrath of misogynists obsessed with the character of these

---

[125] Judith P. Zinsser, *Selected Philosophical and Scientific Writings* (Chicago: University of Chicago Press, 2009), 49.

"disobedient wives."[126] To protect male superiority, women were remanded to the private sphere of the home, and the die was cast.

By the late-18th century, early feminists began railing against confinement to the private sphere and the systematized disregard for women's intellectual development. Mary Wollstonecraft, for example, believed that the character of a woman would be changed if she were independent, and rejected the premise that by law a man and his wife are a unit. She blamed England's laws which, when applied, reduce women's independence as "the easy transition of only considering him as responsible, she is reduced to a mere cipher." A more natural law influenced he theoretical stance, and, in particular, her insistence that women's "first duty is to themselves as rational creatures."[127]

In the United States, and note this is forty years later so the situation is not much improved, Sarah M. Grimké, wrote about lack of or inferior education as the oppressive force keeping women from improving their intellectual capacities. While acknowledging that education was available to many women, she took issue with women who did not use the opportunity to create a life independent of a husband. These women, she wrote, worked to *maintain* intellectual inferiority because "where any mental superiority exists, a woman is generally shunned and regarded as stepping out of her 'appropriate sphere.' "[128] Particularly keen is her observation that by willingly remaining in the domestic sphere, women concede their

---

[126] Silvia Federici, *Caliban and the Witch*. (New York: Autonomedia, 2004), 96.

[127] Mary Wollstonecraft, "From A Vindication of the Rights of Woman," in *Feminist Theory,* eds. Wendy Kolmar and Frances Bartkowski (New York: McGraw-Hill, 2013) 79.

[128] Sarah M. Grimké, "From Letters on the Equality of the Sexes and the Condition of Women," in *Feminist Theory,* eds. Wendy Kolmar and Frances Bartkowski (New York: McGraw-Hill, 2013) 80.

utility is as domestic engines, "but of little value as the intelligent companions of men."[129]

It is at about this time, as these first wave feminists were writing about women's diminished intellectual standing, that the first industrial revolution brought new manufacturing processes and machines to the United States, as well as to many European countries. The rise of capitalism and its inherent market competition produced a need to protect the innovators driving the revolution forward. The patent system provided that protection. At the time Wollstonecraft was thinking and writing, the United States was readying for its fight for independence from England, writing its Constitution, and devising its Patent Act. Although Wollstonecraft would likely object to the underlying premise of this paper – that inventive women were denied the ability to accumulate wealth by virtue of their intellect or creativity at the time when being so privileged would have contributed to a societal balance of power – it is easy to imagine she would assume all women should be inventive, if not inventors, for "the value of turning oneself into something other than a kept dependent."[130]

The Married Women's Property Acts, which affirmed the rights of married women to own and sell property, keep earned wages, conduct legal affairs in their own names, and engage in business as a "sole trader" were too little, too late, being adopted near the end of the industrial revolution, as manufacturing-process innovation was slowing and capitalism was expanding.[131] By that time, conducting business and going out to workplaces were the entrenched, unthreatened domain of superior males. Nancy Folbre sees this dynamic – restricting women's

---

[129] Ibid., 82.

[130] Lena Halldenius, "Mary Wollstonecraft's Feminist Critique of Property: On Becoming a Thief from Principle," *Hypatia* 29,no. 4 (2014): 948.

[131] Anne E. Morris and Susan M. Nott, *All My Worldly Goods* (Brookfield VT: Dartmouth Publishing Company, 1995) 19.

freedom to compete in the marketplace – as creating another constraint: "normative encouragement for women to devote themselves primarily to the care of others."[132] By restricting women's access to the public sphere of nurturing intellect and, therefore, innovative contributions, a male-dominated hierarchy was reinforced by allowing only certain contributors to control and benefit from the invention process. Bourdieu's invariants resurface: as "progress" was made in the establishment of an economy in a new country under a new inventor protection system, women were banned from the creative process and wealth potential of patented invention, just as they were banned from the merchant craft businesses at the collapse of feudalism.

In a passage from "A Room of One's Own," Virginia Woolf wrote, "no one could fail to be aware, even from this scattered testimony, that (this country) is under the rule of a patriarchy."[133] Can such an entrenched institution – patriarchal regulation of invention and innovation – be challenged or is there a way to "to change what is to what should be" as Bunch suggests? As the previously discussed interdisciplinary scholarship points out, the giant bricks of prohibitive practices in the workplace, prohibitive gender-based cultural norms, prohibitive educational foundations, prohibitive government policy, and historically prohibitive laws have effectually constructed a wall with no door. On the inside of the wall, women's imagined inferiority is used as justification to limit their access to the public sphere (women aren't in the right place). On the outside of the wall, women's presence in the public sphere creates a threat to male superiority (the place isn't right for women).

---

[132] Nancy Folbre, *Greed, Lust and Gender* (New York: Oxford University Press, 2009) xxii.

[133]Virginia Woolf, *A Room of One's Own* (New York NY: Harcourt, Brace, and Company, 1929) 50.

The presence of women in fields of invention and creative innovation, areas that by their natures rely on intellect and reasoning skills, has threatened male superiority since before the rise of capitalism. Analysis from a feminist perspective can make visible engrained beliefs about the misappropriations that have constructed our understanding of intellect, innovation, and the application of these abilities in the workplace as masculine, and highlight the political economy of patents that has historically benefitted men more than women. The value of such an analysis is that it offers something that can be used to imagine what the future could hold if we are determined to rule out solutions that privilege men over women, ones that are resistant to invariants.

IV. VISION: DETERMINING WHAT SHOULD EXIST

Whether it is generated in a cutting-edge Silicon Valley research lab or in a stiflingly hot plantation-era kitchen, an ingenious idea is an ingenious idea. Jen-Hsun Huang, founder and president of NVIDIA Corp., headquartered in Santa Clara, CA, was assigned United States Patent No. 7,053,901 in May 2006 for the invention of a "System and Method For Accelerating a Special Purpose Processor." The technical advancement represented by Huang's invention made his company a pioneer of artificial intelligence and deep learning capabilities applicable in the fields of medicine, vehicle automation, and "smart" cities.[134] Judy W. Reed, the illiterate slave woman from Charlottesville, VA, was assigned United States Patent No. 305,474 in September 1884 for the invention of a "Dough Kneader and Roller,"[135] and one would hope the device made her exhausting daily grind a little less unbearable. Huang and Wells likely would have had little in common, but their ability to recognize an opportunity to improve the manner in which a specific task could be completed makes them both patent-holding inventors. As this paper has shown, not all patent-holding inventors secure returns on their ingenuity. Judy Wells likely died poor. A snapshot from December 2018 lists Huang's net worth at $4.3 billion.[136]

This section will outline some of the problems the current United States patent system presents for most inventors, whether men or women (and men like Huang notwithstanding), which when combined with the historical resistance to women in places of invention, creates a

---

[134] Therese Poletti, "Nvidia Forges More Partnership with Auto Makers for Self-Driving Tech," last modified June 27, 2017, http://www.marketwatch.com/story/nvidia-forges-more-partnerships-with-auto-makers-for-self-driving-tech-2017-06-27.

[135] United States Patent and Trademark Office database.

[136] "Jensen Huang," *Forbes* online, last modified Mar. 20, 2019, https://www.forbes.com/profile/jensen-huang-1/#3ae7b4213a6c

most inhospitable environment. The "vision" will be to consider the nature/shortcomings of "what is" in an effort to visualize how it could be.

As was discussed earlier in the paper,[137] in the United States, patent documentation does not require nor request personal descriptors, such as gender, race, or marital status, of inventor applicants and grantees.[138] For research and theoretical purposes, requiring such demographic information at both the application and award portions of the process *would* help to clarify the degree of gender patent disparity. This could provide an excellent tool during governmental innovation and economic policy discussions, and aid in forecasting the ways proposed policies or initiatives could affect women and minorities, as Himmelweit would advise. However, such a change would not represent the optimum improvement in intellectual property protection systems, that being the anonymity of all identity details, a point that will become clearer with the discussion of invention-funding bias later in this chapter, and especially relevant to the proposal presented in the next chapter about "strategy" and the exploration of alternative practices.

Besides the benefit/problem of documenting the gender of an inventor, some less theoretical, more practical roadblocks should be mentioned: the cost of securing a patent; the time it takes to have the patent granted; and the funding required to bring an invention to the market. According to the United States Office of Management and Budget, almost half of the major technological advances of the past century can be credited to individual or small-business inventors,[139] read: garage inventors, without a lot of monetary resources. Some of the advances

---

[137] See page 3.

[138] Data collection for gender breakdown in these categories is achieved by "guessing" if an inventor might be a woman by scrutinizing the first name, if supplied rather using an initial, of the applicant or grantee.

[139] "Circular A-110 Revised 11/19/93 As Further Amended 9/30/99." 49.

were life-changing *innovations*, like the personal computer created in Steve Jobs' garage, or Harriet Williams Russell Strong's ascending walls to create damming and reservoirs in arid Southern California, while others were life-enhancing *inventions*, like Judy Reed's bread kneader. Gerald Udell, founder of the Innovation Institute at the University of Oregon, makes the distinction that "invention occurs without much fanfare, but innovation impacts people's lives."[140] There is a huge economic gap between those with the skills to commercialize their innovation and impact people's lives, and the independent inventor who cannot. In cases where an invention could be marketable, costs associated with such an endeavor can be prohibitive.

Up Front Costs

Because inventors and innovators want to protect their intellectual property from infringement by firms who might copy or steal the original idea (and from competitors for as long as possible), pursuing patents is a typical and wise practice. These legal certifications grant the patentee, in effect, monopoly status to own and/or market the new product or service for a stipulated length of time – generally 20 years. In 2015, an estimate of the cost of securing a patent for even the simplest invention, say a mechanical tool of some sort, was $12,080. If a college computer science major came up with a method to integrate web functionality into an existing computer program, the cost for her to obtain a patent would be closer to $23,000.[141] The administrative fees paid to the USPTO, part of the Department of Commerce, would be roughly the same for either invention, but the difference in total cost is directly related to the legal advice and prior art (existing technology) searches an applicant would need to file with the USPTO.

---

[140] Ibid., 232.

[141] Gene Quinn, "The Cost of Obtaining a Patent in the US Patents & Patent Law." 5.

These realities illustrate well the modern manner in which policy and law work to keep women from places of invention.

The Trouble With Funding

If a woman were able to secure a patent for her invention, commercialization likely would be the economic goal but these undertakings are cost-prohibitive as well, and might also be logistically impractical.[142] The systematization of set up and production for a manufactured good, or the establishment of a distribution network for a service or digital commodity, requires additional money. Large, high-technology firms can fund new proprietary products through an internal research and development (R&D) budget. Other innovators can attract outside investors – venture capitalists – who are willing to fund initial launch and operating costs in return for a share of equity realized at the (if all goes well) initial public sale of stocks. Recall, however, Acker's work on the "inequality regimes" that interfere with a woman inventor's access to venture capital.[143] Venture capital (VC) is most commonly contributed or dispersed in three strategic instances: seed capital, which provides the initial monetary resources to examine a project's viability, start-up capital (product progress and market introduction), and expansion capital.[144] Although either funding scenario – dedicated R&D resources or VC – would be helpful and perhaps even ensure success for the small-business inventor, such deals aren't typically made in her sector. The exclusion of small inventor firms from capital investment pools

[142] Khan, *The Democratization of Invention*, 137.

[143] See page 26.

[144] Christine Greenhalgh and Mark Rogers, *Innovation, Intellectual Property and Economic Growth*. 260.

can occur for different reasons, such as asymmetric information, geographic disadvantage, and lack of intellectual property certification.

The decision of an investor or a group of investors to participate in project funding will not be favorable if the venture capitalist (VC) is faced with information asymmetry, a deviation from the perfect information it prefers for decision-making. This situation presents itself when the inventor has better or more accurate information regarding the project than the investor or investment group.[145] Basically stated, investors would decide not to fund because the entrepreneurial inventor or innovator could take advantage of the VC's lack of knowledge by overstating cost estimates or understating market viability. In a worst-case scenario, an entrepreneur who possesses perfect information is in a position to defraud uninformed VCs. As Greenhalgh and Rogers observe, "[t]he inventor may be the only one who fully understands the project; hence the investor must trust the judgment of the innovator."[146]

A second impediment to small-business inventors securing project financing is that venture capital in the United States – like large high-tech firms in the United States – is geographically concentrated. The country's primary hotbeds of technological innovation are the Silicon Valley on the west coast and the corridor around Boston on the east coast. To take advantage of project "signaling" (purposeful study of day-to-day operations to garner advanced knowledge, for example) generated by these firms, VC groups exist, purposefully, within the social structure of these regions.[147] Unfortunately for small-business invention firms in the vast

---

[145] Pierre Nadeau, "Venture Capital Investment Selection." 328.

[146] Greenhalgh and Rogers, *Innovation, Intellectual Property and Economic Growth*. 22.

[147] Richard Florida and Donald F. Smith, "Venture Capital, Innovation, and Economic Development," *Economic Development Quarterly* 4, no. 4 (1990): 346.

middle ground, VC from the financial centers of Chicago and New York flows, as well, to these established centers. It is estimated that 78 percent of VC resources in the United States benefit the coastal technology bases.[148]

And finally, because most VC resourcing is made during the "start up" phase, the decision to fund is generally predicated on presentation by the entrepreneur of a patent application, which effectively represents "certification" of the invention or innovation. As Radjou and Prabhu note: "most banks and venture capitalists will not risk investing in start-ups."[149] Indeed, research indicates that new companies holding at least one patent on an invention before applying to a VC firm receive almost 52 percent higher funding than do companies that did not submit patent applications prior to requesting VC funding.[150] So, by their nature, venture capitalists search and target innovative firms in which to invest, and it is therefore incumbent upon them to vet these firms to increase all parties' chances of success. In the entrepreneurial, high-tech economy, VC is an important collaborator.[151] But, again unfortunately for the small-business or woman inventor, VC's preferred function is to facilitate the commercialization of a project rather than to foster its creation.[152]

---

[148] Ibid., 347.

[149] Navi Radjou and Jaideep Prabhu, *Frugal Innovation* (New York: Public Affairs, 2014), 137.

[150] Haibo Zhou et al., "Patents, Trademarks, and Their Complementarity in Venture Capital Funding" *Technovation* 47 (2016): 20.

[151] Greenhalgh and Rogers, *Innovation, Intellectual Property and Economic Growth*. 259.

[152] Ana Paula Faria and Natalia Barbosa, "Does Venture Capital Really Foster Innovation?" *Economic Letters* 122, no. 2 (2014): 131.

Although venture capitalists are not likely to fund them, there are some opportunities for individuals or small-business women hoping to commercialize their inventions. The United States government, as well as states and even smaller regional coalitions, sometimes work in tandem to encourage the venture capital industry to invest in smaller firms.[153] While on its face such an incubator philosophy is forward-thinking, the point of access – federal government programs – is still centralized and a site of the gender bias that permeates any other innovation workplace. In addition, the policies that drive such coalitions, as demonstrated by the differences between the Obama and Trump administration budgets, can be abandoned with a change at any government level, literally leaving the independent woman inventor out of the loop, again. For any other number of reasons, these government incubator opportunities also might be fleeting or problematic if the program is deactivated mid-project stream, and there is not an alternative source of funding.

A more plausible opportunity by which some small-business or independent women inventors might benefit is the sort of traditional arrangement to receive seed money from "angel investors." Angels most likely are a person or persons known to the inventor, have a high net worth, and typically have an appreciation for entrepreneurial endeavors because they are/were entrepreneurs themselves. Research data from the calendar year 2013 estimates that 70,000 angels invested more than $24 billion in invention launches.[154] Although it would be interesting to know, data with regard to downstream process investment by angels is not available, nor was it possible to determine if angels are able to exit the venture with adequate compensation.

---

[153] Greenhalgh and Rogers, *Innovation, Intellectual Property and Economic Growth*. 126.

[154] Will Drover, Matthew S. Wood, and Andrew Zacharakis, "Attributes of Angel and Crowdfunded Investments as Determinants of VC Screening Decisions," *Entrepreneurship: Theory and Practice* 41, no. 3 (2017): 325.

In the same vein as angel investors is the novel, but growing, crowdfunding opportunity, though in most cases these investors are unknown personally to the entrepreneur and tend to contribute capital in much smaller amounts. Because of the nature of crowdfunding, investors are brought into the project via a network mechanism and that is most often an online collaboration. More than $16 billion in crowdfunding went to inventors and innovation in 2014, and the World Bank predicts that by 2025 "the crowd" will be investing $100 billion globally per year in new ventures and inventions.[155]

Invent and Wait

Currently, patent applications are taking an average of 23.8 months from filing to issue, a time referred to as the "patent pendency." Due to departmental budget cuts at a time of increased patent applications, the USPTO predicts that this period will increase to 39 months by 2023 unless corrective measures are taken. As of December 2018, more that 550,000 applications are in the office's "unexamined inventory."[156] In response to these predictions, the USPTO plans to modify the fee structure to punish applicants filing reviewer-intense applications in an effort to generate revenue and facilitate the hiring of more examiners.[157] While this will increase the number of examiners available to meet the growing workloads it will initially have a negative impact on pendency, since experienced examiners will have to spend time training new examiners. These pendency timeframes do not include the mandatory applicant search of prior

[155] Ibid.

[156] USPTO, https://www.uspto.gov/dashboards/patents/main.dashxml

[157] L.W. Henderson, "US Patent and Trademark Office Proposals to Speed up the Patent Process." *IEEE Antennas and Propagation* 44, no. 6 (2012): 153.

art before submission of a patent application. A patent attorney, hired by the inventor and prior to the application being filed, typically does these searches.

Based on the logistical problems plaguing the USPTO, there is reason to think about methods for improvement. A current peer-to-peer technology known as "blockchain" could be utilized to decentralize the power of the patent office and eliminate patent review. The same technology could be used to crowdsource funding for an inventor's project, and venture capitalists, conceivably, could be part of the blockchain network and bid to fund. Many of the "boys' club" obstacles women inventors encounter could be eliminated in this private-yet-semi-public sphere.

V. STRATEGY: EXPLORING BLOCKCHAIN AS A REMEDY

As this paper has discussed, and hopefully demonstrated, the United States' laws, its government policies of education initiatives and intellectual property, and its entrenched biases against women working in spaces that are the traditional domain of men, have fused together to construct a nearly impermeable wall that has prevented most women inventors from accumulating wealth through their creative abilities. The gender patent gap is embedded in this amalgamation. With a vision looking toward what should exist – immediate protection of intellectual property, minimal cost for securing a patent, seamlessly appropriated funding to facilitate bringing an invention to market, and an entirely de-gendered process – and in keeping with Bunch's recommendation about "examining various tools for change …and determining which are most effective in what situations,"[158] perhaps the most sensible thing for women to do is find an innovation place of their own. I propose exploring the feasibility of adopting a distributed ledger technology (DLT), most commonly referred to as "blockchain," to launch and grow an intellectual property network for women inventors. This peer-to-peer infrastructure could diminish patriarchal interference by decentralizing the power of the patent office.

This chapter will begin with a simple explanation of how a blockchain works, followed by a defense of the "vision" problems it could solve. Much of this chapter will be speculative, as the technology is esoteric and recognized almost entirely for its association with the cryptocurrency called "Bitcoin." Therefore, most studies to date have focused on blockchain as a cyberfund extraction platform. On the one hand, this is beneficial because the technology was developed as a way to gather a new type of currency, so there was a financial incentive for people to participate and quickly refine the protocol. As a result, this new technology has gone

[158] Bunch, "Not By Degrees" 14.

through its growing pains and now is regarded as nearly "unhackable."[159] On the other hand, blockchain, again because of Bitcoin, is discussed primarily as a way to decentralize banking and financial sectors, and not many scholars have written about the potential for DLT as a transmission method for data in different types of industries or companionable applications. The section also will present a few presently un- or under- investigated potential drawbacks, as these could prove to be problematic in the near-term, though likely solvable in the future. To close the chapter, the paper will offer some comparisons between historical women's networks and the spaces in which today's women inventors can interact.

Introduction to Blockchain

Blockchain provides a method for decentralized connections between electronic devices (primarily computers); imagine it as way to bypass the locked-up-yet-exposed nature of our digital lives. This decentralization is achieved through encryption schemes associated with particular blockchain platforms. Consider a very basic form of encryption, the lock on the front door of most homes: that lock provides a barricade between objects inside (the food you want to eat) and objects outside (you). In order to "solve" the barricade, you must have in your possession a key with the correct configuration and you must insert it into the lock. The same idea applies to digital encryption, but in the case of blockchain, it is considerably more sophisticated. It relies upon "double-key encryption" to create privacy and authentication along the blockchain. Each user or "node" is assigned a public key and a private key, and privacy is assured when a sender of data encrypts a message using the public key of the intended recipient and sends it, and the receiver decrypts the message using her private key. The authentication

[159] Yan Chen, "Blockchain Tokens and the Potential Democratization of Entrepreneurship and Innovation," *Business Horizons* 61, no. 4 (2018): 568.

function is carried out when a sender encrypts data using her private key, but makes the message public. At this point, any other node can use the sender's public key to verify that the encrypted message was, in fact, created by the sender.[160] In addition, because of its digital properties, data can be added to any "block" that can accommodate a digital layer. It is this sort of digital malleability that might be the way patents could be handled.

Conceptually, the process would work this way: an inventor (she would be a "node") would have a file of patent applications (each application would be a "block" on the "chain") on her computer (this would be her "ledger"). Other inventors would have the same files on their computers, so those files would be considered to be "distributed." Every one of the blocks represented on this distributed ledger would have been cryptographically verified, and each time an inventor creates a new cryptographically verified "transaction" by submitting a new patent application (because of the digital layering capability of blocks, this application could include drawings and pictures germane to the submission), her computer sends a notification of authentication to each node. At the time all the other nodes resolve the encrypted verification, the new block is added to the end of the existing blockchain. Based on the laws written into the blockchain protocol at its inception by the chain creator, verification cannot be authenticated if any data in the new block is incorrect. In the case of the theoretical patent blockchain, the protocol would stipulate that any new block cannot have invention descriptions (or drawings or pictures) that already exist. The nodes would be aware instantaneously if any prior authenticated transactions for the same intellectual property (invention) exist in any other blocks. It the protocol is passed, any node can authenticate that the proposed invention does not yet exist, validate, add the applicant's patent, and update the blockchain.

[160] John Prpić, "Unpacking Blockchains," *Policy and Internet* 7, no. 3 (2017): 3.

Immediate Protection of Intellectual Property

For any conventional database, the scalability, or capacity of the program to handle increasing data storage levels, is a concern and would be particularly important for one as potentially dense as an intellectual property filings collection. The primary drawback for a centralized database, as it grows larger, is the inherent decrease in processing speed. The decentralized nature of a blockchain assures infinite scalability because each new applicant requesting a block for verification of her intellectual property becomes a node, and a processor as well, along with all other node/processors on her blockchain. As with any emerging technology, improvements are rapid, and current blockchain protocols can process thousands of transactions per second and return a block verification to nodes within a matter of minutes.[161] Recall that current application-to-grant turnaround time at the USTPO is 23.8 months. A blockchain model of decentralized intellectual property registration could provide a woman with a two-year jump in presenting her invention to the market.

Blockchain Cost Savings

With the exception of owning an appropriately configured computer, there would be no cost to an inventor if she wished to join a public blockchain for intellectual property rights protection. The blockchain protocol, as originally developed, is an open-source application, and therefore, no purchase or member fees are collected. However, some business enterprises do take advantage of blockchain technology in their private environments, but these "private

[161] Shihab Hazari, "A Parallel Proof of Work to Improve Transaction Speed and Scalability in Blockchain Systems." (presentation, IEEE 9th Annual Computing Workshop, University of Nevada, Jan. 7, 2019). 916.

blockchains" generally are used for supply-line tracking or similar functions and are centralized in the sense that some person or department is responsible for granting access.[162]

A potential arrangement in which a patent applicant might be required to pay in order to have her intellectual property protected is a "hybrid blockchain,"[163] and it represents an attempt by a larger technology interest to generate income by means of consulting or contracting blockchain expertise. For example, if a few women inventors decided to band together and launch "Matents," their proprietary blockchain for intellectual property rights protection, they might take advantage of IBM Cloud's Blockchain Platform.[164] According to published pricing schedules, a "starter plan" requires a blockchain entity (in this case, it would be Matents) to pay a membership fee of $250 per month and a peer (in this case, it could be Sue) to pay a peer fee of $125 per month. If Sue decided to leave the blockchain after her invention was verified (her block would remain on the chain forever), Matents would pay no subsequent peer fee on her behalf to IBM, but would be obligated for the membership fee, even if Sue was the only peer, until the blockchain is abandoned (it is unclear from IBM's model pricing literature if contracts have one- or more year terms). Even if a prorated portion of the monthly membership fee were passed along with the monthly peer fee, the cost of obtaining a matent would be a fraction of the USPTO cost.

---

[162] Wang et al., "Survey on Blockchain for Internet of Things" *Computer Communications* 136 (2019): 20.

[163] Ibid.

[164] IBM Corp, "IBM Blockchain Platform." https://console.bluemix.net/docs/services/blockchain/howto/pricing.html#ibp-pricing. Accessed Feb. 8, 2019.

In this imagined blockchain network, intellectual property previously protected by another means would not be an issue, but in reality, a search for "prior art" would be conducted before an inventor adds her data to the chain. Though there is no legal requirement for an applicant to provide proof of validity,[165] inventors can mitigate the consequences of an infringement accusation if it is provided. These searches typically are done by a patent attorney, and generally completed within a couple of weeks. The search fees would be paid by the inventor, of course, but the projected cost of the search would be known prior to the start of the application process and the inventor could opt out of either the search or the application without incurring a cost.

A Solution to the Funding Challenge

Decentralization of the intellectual property rights protection system, in and of itself, could be an enormous boon to the "garage inventor." But perhaps the most intriguing aspect of blockchain in this milieu is the potential for access to funding. The potential is related to the function of "tokens," a form of digital currency, emulating part of the Bitcoin design. As discussed at the beginning of this chapter, the Bitcoin network digitized currency and decentralized its control through the blockchain infrastructure. Similarly, a chain protocol can be programmed to include digital tokens, which can carry some configuration of currency value, to blocks as they are verified and added to the blockchain (or simply as blocks themselves, as is the case in Bitcoin).[166] As an alternative to the token configuration, a blockchain can be designed with a native currency, usually referred to as a "cryptocurrency." As a funding vehicle, tokens

[165] Bhaven Sampat, "When Do Applicants Search for Prior Art?" *Journal of Law and Economics* 53, no.2 (2010): 400.

[166] Chen, "Blockchain Tokens" 568.

work in whatever manner the inventor wishes and the blockchain allows. For example, if Sue has an invention she wishes to protect and produce, but knows she cannot possibly begin production without funding, she might elect to attach tokens to her block, along with a project timeline and needed–funds estimate. Interested investors, who are nodes on the blockchain and might or might not have their own intellectual property data protected, could buy (maybe even compete to buy) her tokens or portions of her tokens in anticipation of the value rising as the project nears completion and is introduced in the market. The anonymity of inventor and investor(s) eliminates gender bias by publishing project details only on the blockchain and many of the "boys' club" obstacles women inventors encounter could be eliminated in this private-yet-semi-public sphere.

Potential Drawbacks

If the United States government decided it wished to get out of its bureaucratic patent control function and do away with the policy and legal mechanisms that protect intellectual property, none of this discussion would be necessary. However, until that would happen, one trouble spot for a decentralized system via blockchain would be the prior art resident in the USPTO system since 1790. Would it be possible to digitize all those entries, descriptions, and drawings and add them to the open source blockchain? How would cases of infringement be handled if existing records did not migrate? What if the process showed many cases of infringement already existed in the USPTO system, which human patent reviewers did not discern? As patent law now stands, all of these cases would be entitled to infringement litigation.

Another potential problem could arise if an investor required an in-person appraisal of the proposed invention, or perhaps requested to see a working model. Who or what method would provide the identity of the inventor? Certainly this scenario is not unreasonable on the part of the investor, but it is contrary to the bias-free and private environment blockchain provides. Identity

management systems (IdM) for Internet-connected applications have been the subject of study for a couple of decades. Finding the best means to integrate IdM capabilities into blockchain is the goal of University of Cambridge researchers Dunphy and Petitcolas who write, "[t]he research challenge for DLT applications in IdM is therefore to explore the balance between centralization and decentralization to create interoperable and privacy-respecting IdM that mitigates the risk of placing too much trust in any single authority."[167] They also contend that failing to resolve such balance issues might bring to light additional and unforeseen "risks of too much decentralization."[168]

Thriving Women and Networks

Utilizing blockchain to create a bias-free system of resources for women inventors, conceptually, joins modern technological diffusion with what women, historically, have relied upon to make headway in the man's world: networking. Lisa Cook's scholarship posits there is strong evidence that a woman's knowledge and experience comes through and across her social networks,[169] and this important link can be seen in the relationship between Ellen Eglin, the capable but disregarded inventor, and Charlotte Odlum Smith, the woman–inventors' activist.[170] The resolve of women to help other women succeed, in turn, can be seen in some of today's

[167] Paul Dunphy, "A First Look at Identity Management Schemes on the Blockchain," *IEEE Security Privacy* 16, no. 4 (2018): 28.

[168] Ibid.

[169] See pages 17 and 18.

[170] See page 20.

crowdfunding operations, previously discussed in conjunction with "angel investors," as a more likely method for women inventors to secure funding than from traditional VCs.[171]

Granted, angel investors might produce a better outcome for women inventors than gender-biased venture capitalists, but as was noted, this type of funding generally is provided by family or friends, and this would ignore women with no such privilege.[172] As for the crowdfunding model, the small scale "contributions" made by donors rather than investors do not translate into significant capital and, in fact, are subject to significant reduction when the inventor pays her fee to the platform owner. In the case of crowdfunding platform ifundwomen.com, self-described as "a private community for you to connect with other female founders in the hustle," the platform cut is 5 percent of donor contributions.[173] Conversely, by attaching investment parameters and cryptocurrency tokens to a blockchain block, women inventors could tap powerful funding sources with no upfront costs and a built in opportunity to allow investors to bid up the value of the blocks' tokens.

[171] See pages 57-58.

[172] See page 57.

[173] "IFundWomen - FAQ." https://beta.ifundwomen.com/faq. Accessed 7/23/2018.

VI. CONCLUSION

Charlotte Bunch wrote in 1979, "the full implications of feminism will evolve over time, as we organize, experiment, think, analyze, and revise our ideas and strategies in light of our experiences."[174] This paper attempted to consider the merits of such a recommendation as it applies to the huge, historical gender gap in inventive patents. With few exceptions, and for no discernible reason save their prescribed role in society, women have missed out not only on having their creativity, resourcefulness, and ingenuity formally recognized, but also on the opportunity to parlay their intellectual and inventive abilities into personal wealth and independence at a time in the country's development when disparities could have been neutralized.

Using Bunch's "Model for Theory," the paper offered a description of what exists, pointing out that the underrepresentation of women in fields of invention is staggering. Though women make up more than half of the United States workforce, just under 8 percent of women hold inventive patents. Trying to think about why such a disparity survives requires digging for details, but in order to know which details to explore, it was necessary to decide which version of the disparity was the truth: are women who work in fields of invention not in the right place, or are fields of invention not the right place for women. Not naming the problem correctly has, it would appear, led to laws and policy enacted in an attempt to make fields of invention right for women, but advances have not been made. It also was important to recognize the fact that if women had had the right to own and earn income from their intellectual property since the inception of the patent system, women today might be on a level playing field with men,

[174] Bunch, "Not By Degrees," 13.

inventors or not, as the financial gains of prior generations benefit those who follow. To illustrate the ways the disparity was permitted to flourish, even in the face of the egalitarian intent of the original Patent Act, historical accounts of two women inventors showed gender and racial biases prevented them from capitalizing their own intellectual property. In another account, it was clear that when a woman did invent, it was to be kept from the public eye, because women weren't welcome in the public (business) sphere. By giving a description of the problem, Bunch wants a thinker to adjust her perception of reality as it exists. Here, the problem "women do not patent" has been adjusted to more accurately reflect the historical reality that "women have not been allowed to patent."

As for the analysis portion of Bunch's model, the paper explored current writings of scholars from several different fields. Sociological analysis settles on the "place isn't right for women" description, finding that gender bias in innovation workplaces is pervasive and multi-faceted, and influences corporate decision-making from the hiring process to job assignment. For example, men with engineering degrees are often assigned to engineering teams and able to work on patentable projects, whereas women engineers in the same firm work as engineering technicians, and do not take part in such projects. Public policy scholarship is interested in the patent process itself and finds that a significant number of women do enter fields of invention but cannot find success because the patent review and capital appropriation processes are biased against women. In a contrary interpretation, economic scholarship finds that women engineers might opt for "team" assignments rather than leadership roles due to being risk-averse. In addition, and because of the risk associated with speculative fields such as patentable innovation, women engineers may avoid seeking employment at such firms. Analysis of government policy finds that efforts to address what was termed a "STEM crisis," that is, a perceived shortage of

qualified technology and engineering workers, drove initiatives that initially included earmarks to aid in the recruitment of women to STEM, but were not in force longer than a few years. Education scholarship leans toward the "women aren't right for the place," but does not fault women. Rather, gendered thinking by a girl's parents is found to influence not only her college major and career choices, but also her attitude toward the need for success in her high school and college-preparatory classes. In fact, in many instances, girls are encouraged from a young age to avoid any type of career, STEM or otherwise, that would require time away from her family and interfere with motherhood.

In some way or another, most existing scholarship recognizes that the underrepresentation of women in fields of invention is problematic, but does not look to a root cause. Historical studies reach back and provide evidence that the problem evolved as protection of male privilege pushed women out of the public sphere and into the private sphere. Denying women education, property rights, and the opportunity to earn and keep wages, worked to exile women to the home and close them off from the business opportunities in the men's domain. Though the Patent Act was adopted as legislation guaranteeing women the protection of their intellectual property and inventions, existing laws and subsequent policy changes rendered even that opportunity unattainable. The broad view offered by the interdisciplinary scholarship adheres to Bunch's instruction to "focus initially on a phenomenon in a limited context and consider wide range of factors that may affect it,"[175] thereby generating an expanded analysis.

In deciding what should be done to bring about change – the vision component – Bunch states "the clearer we are about our principles… the more easily we can set our long term

[175] Bunch, "Not By Degrees," 14.

goals."[176] Of course Bunch is referring to theory, and rethinking a patent system is not about principles, really, but by replacing "principles" with "problems," this step works well. The paper attempted to elucidate the problems with the patent system, as it exists today. Of primary concern is the time involved when a woman submits a patent application to the USPTO and cannot know if she can or should go forward with production or financing for nearly two years. The cost of the application and review process is significant as well, and an impediment for inventors who cannot secure the tens of thousands of dollars needed. Women also meet with obstacles in securing development, production, manufacturing, and rollout funding that men do not. These are the practical, nitty gritty problems that can keep women inventors from patenting and that can be reimagined. The time and cost concerns are government policy and could be changed if an administration so desired. However, the capital funding obstacle stems from ingrained gender bias and the solution to this is a non–gendered patent system.

The vision is big and so is the suggestion. Blockchain technology is in its infancy, with changes, advances, new applications, and new concerns swirling about. However, the biggest concern about any connected technology is its security, and blockchain, through its double-key encryption method, has proven to be virtually impenetrable by hackers or virus. It also checks all the boxes on the vision list: it could provide nearly instantaneous verification and authentication of intellectual property and inventions; it could, depending on the blockchain design, be free of cost to access; it could be designed to connect inventors with investors and even provide a currency method to facilitate immediate funding. These considerations pale, though, to the egalitarian network it could provide for women inventors who would be able to transact business

[176] Ibid.

in a gender-bias free environment rather than in front of a gender-biased venture capital review board populated by members of the patriarchal old boys' club.

As a centralized power structure, the United States patent system works for certain classes of inventors but not all inventors. And although blockchain might better facilitate and encourage invention and innovation for women around the globe, Ford Motor Company did not launch Uber and Hilton did not launch AirBnB. It is impractical to expect the unwieldy government–controlled patent system will morph into a decentralized, inclusive hub, simply because it is not in the government's preferred interest: the upward distribution of wealth. Bunch believes that for a strategy to be effective, sound decisions must be made with regard to which "sectors of society can best be mobilized to carry out which types of actions."[177] Perhaps women inventors, believing in the effectiveness of knowledge transfer networks, can unlock blockchain's power and create a new version of egalitarian intellectual property protection.

[177] Bunch, "Not By Degrees" 14.

VII. BIBLIOGRAPHY

"A Woman's Brains." *The Morning Call*. November 20, 1892. https://cdnc.ucr.edu/cgi-bin/cdnc?a=d&d=SFC18921120.2.181&srpos=27&e=------189-en--20-SFC-21--txt-txIN-a+woman%27s+brains-ARTICLE---1892---1.

AFL-CIO. "Engineers." Accessed November 21, 2018. http://dpeaflcio.org/professionals/professionals-in-the-workplace/scientists-and-engineers/.

American Institute of Mining Engineers. "Engineering and Mining Journal." *Engineering & Mining Journal*, (1884): 118–19. https://catalog.hathitrust.org/Record/000052973.

Anft, Michael. "The STEM-Crisis Myth." *Chronicle of Higher Education* 60, no. 11 (2013): A30–33.

Apostol, Jane. "Harriet Russell Strong: Horticulturalist, Conservationist, and Feminist." *California History* 85, no. 2 (2008): 50–65.

Baker, Dean. "Is Intellectual Property the Root of All Evil? Patents, Copyrights, and Inequality," Paper presented at the Economics, Institutions and Policies in the Age of Inequality Conference, University of Utah, September 2018.

Bass, Brooke Conroy. "Preparing for Parenthood?: Gender, Aspirations, and the Reproduction of Labor Market Inequality." *Gender & Society* 29, no. 3 (2015): 362–85.

Basso, Matthew, Laura McCall, and Dee Garceau-Hagen, eds. *Across the Great Divide: Cultures of Manhood in the American West*. New York: Routledge, 2001.

Beishline, Lou Jean. "Perceptions of Women in Engineering Programs Regarding Parental Influence on Academic Choice." Dissertation, Marywood University, 2009.

Blackstone, Sir William. *Commentaries on the Laws of England: In Four Books, With an Analysis of the Work*. Edited by J.E Hovended. 19th ed. Vol. 1. 4 vols. London : S. Sweet, 1836. http://galenet.galegroup.com.proxy.lib.ohio-state.edu/servlet/MOML?dd=0&locID=osu_law&d1=19000292301&srchtp=a&c=1&an=19000292301&df=f&s1=coverture&d2=2&docNum=F3700207964&h2=1&vrsn=1.0&af=RN&d6=2&d3=2&ste=10&stp=Author&d4=0.33&d5=d6&ae=F100207963.

Booth, Alison, Lina Cardona-Sosa, and Patrick Nolen. "Gender Differences in Risk Aversion: Do Single-Sex Environments Affect Their Development?" *Journal of Economic Behavior & Organization* 99 (2014): 126–54.

Bourdieu, Pierre. *Masculine Domination*. Stanford, Calif: Stanford University Press, 2001.

Chen, Yan. "Blockchain Tokens and the Potential Democratization of Entrepreneurship and Innovation." *Business Horizons* 61, no. 4 (2018): 567–75.

"Circular A-110 Revised 11/19/93 As Further Amended 9/30/99," May 24, 2017. https://www.whitehouse.gov/omb/circulars_a110.

Cook, Lisa D. "Inventing Social Capital." *Explorations in Economic History* 48, no. 4 (2011): 507–18.

Dehghani, Morteza, Kate Johnson, Joe Hoover, Eyal Sagi, Justin Garten, Niki Jitendra Parmar, Stephen Vaisey, Rumen Iliev, and Jesse Graham. "Purity Homophily in Social Networks." *Journal of Experimental Psychology: General* 145, no. 3 (2016): 366–75.

Dobyns, Kenneth W. *A History of the Early Patent Offices: The Patent Office Pony*. Fredericksburg, Va.: Sergeant Kirkland's Museum, 1997.

Drover, Will, Matthew S. Wood, and Andrew Zacharakis. "Attributes of Angel and Crowdfunded Investments as Determinants of VC Screening Decisions." *Entrepreneurship: Theory & Practice* 41, no. 3 (2017): 323–47.

Du Châtelet, Gabrielle Emilie Le Tonnelier de Breteuil, and Judith P Zinsser. *Selected Philosophical and Scientific Writings*. Chicago: University of Chicago Press, 2009.

Dunphy, Paul. "A First Look at Identity Management Schemes on the Blockchain." *IEEE Security and Privacy* 16, no. 4 (2018): 20-29.

Elliott, Maud Howe. *Art and Handicraft in the Woman's Building of the World's Columbian Exposition, Chicago, 1893*. 320 p. Chicago: Rand, McNally, 1894. http://www.archive.org/details/arthandicraftinw00elli.

Faria, Ana Paula, and Natália Barbosa. "Does Venture Capital Really Foster Innovation?" *Economics Letters* 122, no. 2 (2014): 129–31.

Federici, Silvia Beatriz. *Caliban and the Witch*. New York, NY: Autonomedia, 2004.

Florida, Richard, and Donald F. Smith. "Venture Capital, Innovation, and Economic Development." *Economic Development Quarterly* 4, no. 4 (1990): 345–60.

Folbre, Nancy. *Greed, Lust and Gender: A History of Economic Ideas*. Oxford; New York: Oxford University Press, 2009.

Forness, Norman O. "The Master, The Slave, and The Patent Laws: A Vignette of the 1850s." *Prologue* 26 (1994): 48–53.

Greenhalgh, Christine, and Mark Rogers. *Innovation, Intellectual Property and Economic Growth*. Princeton: Princeton University Press, 2010.

Guilford, J. P. "The Structure of Intellect." *Psychological Bulletin Psychological Bulletin* 53, no. 4 (1956): 267–93.

Halldenius, Lena. "Mary Wollstonecraft's Feminist Critique of Property: On Becoming a Thief from Principle." *Hypatia* 29, no. 4 (2014): 942-57.

Hazari, Shihab. "A Parallel Proof of Work to Improve Transaction Speed and Scalability in Blockchain Systems," Paper presented at IEEE 9th Annual Computing and Communication Workshop, University of Nevada, January 2019.

Henderson, L.W. "US Patent and Trademark Office Proposals to Speed Up the Patent Process." *IEEE Antennas and Propagation Magazine* 44, no. 6 (2002): 152-62.

Himmelweit, Susan. "Making Visible the Hidden Economy: The Case for Gender-Impact Analysis of Economic Policy." *Feminist Economics* 8, no. 1 (2002): 49–70.

Hira, Ron. "Not Enough U.S. Engineers?" *Issues in Science & Technology* 23, no. 4 (2007): 6–9

Horn, Laura, Xianglei Chen, and Clifford Adelman. *Toward Resiliency: At-Risk Students Who Make It to College*. Washington, DC: U.S. Dept. of Education, Office of Educational Research and Improvement, 1998.

Hunt, Jennifer, Jean-Philippe Garant, Hannah Herman, and David J. Munroe. "Why Don't Women Patent?" Working Paper. National Bureau of Economic Research, March 2012.

Irwin, Mary Ann, and James Brooks, eds. *Women and Gender in the American West*. 1st ed. Albuquerque: University of New Mexico Press, 2004.

Jaffe, Adam B., and Joshua Lerner. *Innovation and Its Discontents : How Our Broken Patent System Is Endangering Innovation and Progress, and What to Do About It*. Princeton, N.J.: Princeton University Press, 2006.

"Jensen Huang." Forbes. Accessed March 20, 2019. https://www.forbes.com/profile/jensen-huang-1/#3ae7b4213a6c.

Johnson, G. G. "Feminism and the Economic Independence of Woman." *Social Forces* 3, no. 4 (1925): 612–16.

Kahler, Annette I. "Examining Exclusion in Woman-Inventor Patenting: A Comparison of Educational Trends and Patent Data in the Era of Computer Engineer Barbie®." *The American University Journal of Gender, Social Policy & the Law* 19, no. 3 (2011): 773–98.

Kerber, Linda K. *Women of the Republic: Intellect and Ideology in Revolutionary America*. Chapel Hill: Published for the Institute of Early American History and Culture by the University of North Carolina Press, 1980.

Khan, B. Zorina. "Married Women's Property Laws and Female Commercial Activity: Evidence from United States Patent Records, 1790-1895." *Journal of Economic History* 56, no. 2 (1996): 356–88.

———. *The Democratization of Invention: Patents and Copyrights in American Economic Development, 1790-1920*. Cambridge: Cambridge University Press, 2009.

Kolmar, Wendy K., and Frances Bartkowski, eds. *Feminist Theory: A Reader*. 4th ed. New York: McGraw-Hill Higher Education, 2013.

Le Moyne, Pierre. *The Gallery of Heroick Women*. Translated by John Paulet Earl of Winchester. London: Printed by R. Norton for Henry Seile, 1652. https://quod.lib.umich.edu/e/eebo/A47665.0001.001/1:8.5.4?rgn=div3;view=fulltext.

Lincoln, Mrs. D.A. *Mrs. Lincoln's Boston Cook Book: What to Do and What Not to Do in Cooking*. Boston: Roberts Brothers, 1896.

Macdonald, Anne L. *Feminine Ingenuity: Women and Invention in America*. New York: Ballantine Books, 2010.

Marovich, Lisa. "'Let Her Have Brains Too': Commercial Networks, Public Relations, and the Business of Invention." *Business and Economic History* 27, no. 1 (1998): 140–61.

Matloff, Norm, and Jeff Flake. "Should Foreign STEM Graduates Get Green Cards?" *U.S. News Digital Weekly* 4, no. 20 (2012): 14-18.

Maxwell, Lee M. *Save Womens Lives: History of Washing Machines*. 1st ed. Eaton, CO: Oldewash, 2003.

Milli, Jessica, Barbara Gault, Emma Williams Baron, Jenny Xia, and Meika Berlan. "The Gender Patenting Gap." Institute for Women's Policy Research, July 2016.

———. "Equity in Innovation: Women Inventors and Patents." Institute for Women's Policy Research, December 2016.

Moody, J. Carroll, and Alice Kessler-Harris, eds. *Perspectives on American Labor History: The Problems of Synthesis*. DeKalb, IL: Northern Illinois University Press, 1989.

Morris, Anne E., and Susan M. Nott. *All My Worldly Goods: A Feminist Perspective on the Legal Regulation of Wealth*. Aldershot; Brookfield, USA: Dartmouth, 1995.

Murray, Fiona, and Leigh Graham. "Buying Science and Selling Science: Gender Differences in the Market for Commercial Science." *Industrial & Corporate Change* 16, no. 4 (August 2007): 657–89.

Nadeau, Pierre. "Venture Capital Investment Selection: Do Patents Attract Investors?" *Strategic Change* 19, no. 7/8 (2010): 325–42.

Office, U. S. Government Accountability. "Science, Technology, Engineering, and Mathematics Education: Strategic Planning Needed to Better Manage Overlapping Programs across Multiple Agencies," no. GAO-12-108 (January 24, 2012).

Oliver, Melvin L, and Thomas M Shapiro. *Black Wealth, White Wealth: A New Perspective on Racial Inequality*. New York; London: Routledge, 1997.

"Opportunities For Women." *Los Angeles Herald*. March 23, 1909. https://cdnc.ucr.edu/cgi-bin/cdnc?a=d&d=LAH19090323.2.122.68&srpos=118&dliv=none&e=-------en--20--101--txt-txIN-Harriet+AND+Strong-------1.

Phillips, Willard. *The Law of Patents for Inventions; Including the Remedies and Legal Proceedings in Relation to Patent Rights*. Boston: New York: American Stationers' Company, 1837. http://hdl.handle.net/2027/uc2.ark:/13960/t5s75h31n.

Poletti, Therese. "NVIDIA Forges More Partnerships With Automakers for Self-Driving Tech." MarketWatch. Accessed July 10, 2017. http://www.marketwatch.com/story/nvidia-forges-more-partnerships-with-auto-makers-for-self-driving-tech-2017-06-27.

"Progress Report on Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education." Office of Science and Technology Policy, March 2016.

Prpić, John "Unpacking Blockchains." *Policy and Internet* 7, no. 3 (2017): 1-7.

Quam-Wickham, Nancy. "Rereading Man's Conquest of Nature: Skill, Myths, and the Historical Construction of Masculinity in Western Extractive Industries." *Men and Masculinities* 2, no. 2 (1999): 135–51.

Quinn, Gene. "The Cost of Obtaining a Patent in the US| Patents & Patent Law." *IPWatchdog.Com | Patents & Patent Law* (blog), April 4, 2015. http://www.ipwatchdog.com/2015/04/04/the-cost-of-obtaining-a-patent-in-the-us/id=56485/.

Radjou, Navi, and Jaideep C. Prabhu. *Frugal Innovation: How to Do More With Less*. New York: Public Affairs, 2014.

Rosser, Sue V. "The Gender Gap in Patenting: Is Technology Transfer a Feminist Issue?" *NWSA Journal* 21, no. 2 (2009): 65–84.

Sampat, Bhaven. “When Do Applicants Search for Prior Art?” *The Journal of Law and Economics* 53, no. 2 (2010): 399–416.

Schiebinger, Londa. “Feminine Icons: The Face of Early Modern Science.” *Critical Inquiry* 14, no. 4 (1988): 661–91.

Smith, Charlotte, and D. C. Patent Centennial Celebration. *The Woman Inventor*. Washington, D.C., 1891. http://archive.org/details/Womaninventor1Smit.

Spade, Joan Z., and Catherine G. Valentine, eds. *The Kaleidoscope of Gender: Prisms, Patterns, and Possibilities*. Fifth Edition. Los Angeles: Sage, 2017.

“Sparks From the Wires.” *Daily Alta California*. October 9, 1884. California Digital Newspaper Collection. https://cdnc.ucr.edu/cgi-bin/cdnc?a=d&d=DAC18841009.2.33&srpos=4&dliv=none&e=-------en--20--1--txt-txIN-Harriet+AND+Strong+AND+patent-------1.

Stanley, Autumn. *Raising More Hell and Fewer Dahlias: The Public Life of Charlotte Smith, 1840-1917*. Bethlehem PA: Lehigh University Press, 2009.

———. “Scribbling Women as Entrepreneurs: Kate Field (1838-96) and Charlotte Smith (1840-1917).” *Business and Economic History* 21 (1992): 74–83.

Strasser, Susan. *Never Done: A History of American Housework*. New York: Pantheon Books, 1982.

United States Office of Management and Budget. “A Budget for a Better America,” 2019.

———. *Efficient, Effective, Accountable: An American Budget : Budget of the U.S. Government*, 2018.

United States Bureau of Labor Statistics. “Report 1071,” November 2017.

———. “Consumer Price Index Statistics from Historical Statistics of the United States, 1975.” https://data.bls.gov/cgi-bin/cpicalc.pl.

———. “Employed Persons By Detailed Occupation, Sex, Race, and Hispanic or Latino Ethnicity.” Accessed November 18, 2016. http://www.bls.gov/cps/cpsaat11.html.

United States Government Accountability Office. “Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends.” Washington D.C., October 12, 2005.

Walcerz, Douglas. “Report on the Third Year of Implementation of the True Outcomes Assessment System for Project Lead The Way,” 2007.

Wang, Xu, Xuan Zha, Wei Ni, Ren Ping Liu, Y. Jay Guo, Xinxin Niu, and Kangfeng Zheng. "Survey on Blockchain for Internet of Things." *Computer Communications* 136 (2019): 10–29.

Woodworth-Ney, Laura. *Women in the American West*. Cultures in the American West. Santa Barbara, CA: ABC-CLIO, 2008.

Woolf, Virginia. *A Room of One's Own*. New York, NY: Harcourt, Brace and Company, 1929.

Xu, Yonghong Jade, and Cynthia L. Martin. "Gender Differences in STEM Disciplines: From the Aspects of Informal Professional Networking and Faculty Career Development." *Gender Issues* 28, no. 3 (2011): 134–54.

Yoder, Brian L. "Engineering By the Numbers." *Journal of Engineering Education* (2015): 1–47.

Zhou, Haibo, Philipp G. Sandner, Simon Luca Martinelli, and Joern H. Block. "Patents, Trademarks, and Their Complementarity in Venture Capital Funding." *Technovation* 47 (2016): 14–22.

Zinsser, Judith P. *Émilie Du Châtelet: Daring Genius of the Enlightenment*. New York: Penguin Books, 2014.

———. *Selected Philosophical and Scientific Writings*. Chicago: University of Chicago Press, 2009.