Christine Ladd-Franklin: A Leader for Women's Education

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ABSTRACT

Christine Ladd-Franklin was the first American woman to earn a PhD in mathematics, and yet had to wait 44 years to receive that degree. The purpose of this project is to research the life of this remarkable woman and her impact on others. This research was done by investigating her life using her personal journal, her published mathematics thesis, her published work in psychology, archived newspaper articles, and various other sources. Ladd-Franklin graduated from Vassar College in 1869 and attended Johns Hopkins University for graduate school. There she finished the requirements for a PhD in mathematics regardless of the fact that she needed special permission from professors to attend their classes. Despite the fact that her graduate thesis, "On the Algebra of Logic", was published in 1883, Johns Hopkins did not award degrees to women at that time. Thus it took 44 years after earning her PhD to receive the recognition. In addition to work in mathematics, Ladd-Franklin spent a year in Germany researching in two prestigious psychology laboratories where she developed her theory on color vision. She published her psychology theory on sensation in the book Colour and Colour Theories in 1929, just a year before she died at the age of 82. Along with Ladd-Franklin's academic achievements, her support towards the advancement of other women is equally impressive. She overcame many obstacles and used these experiences to help other women. Among her successes, Ladd-Franklin was the first woman professor at Johns Hopkins University. In the hope that women would have equal opportunities in university settings, she often lectured for no pay at institutions such as Columbia and Harvard. She also promoted women's higher education as a chair member on a committee for the Association of Collegiate Alumna where she started a fellowship which provided financial assistance for women to study abroad. In studying the barriers to women at that time and examining Christine Ladd-Franklin's own life, it is inspiring to see how her determination and bold attitude helped pave the way for herself and other women in math, science, and higher education.

Keywords: Mathematics, Women's Studies, History

INTRODUCTION

Christine Ladd-Franklin was born on December 1st, 1847, in Windsor, Connecticut [7]. She was the eldest, born into the prestigious Ladd family with parents Eliphalet and Augusta (Niles) Ladd [12]. Ladd-Franklin later identified her father, who was a merchant, as the source of her interest in mathematics [10]. From a young age, Ladd-Franklin was exposed to the injustices that women faced during this time period. Both Ladd-Franklin's mother and aunt were very active in the women's rights movement. They kept young Ladd-Franklin involved in the movement by bringing her to the women's rights talks they attended as she grew up [8].

Women at this time were facing oppression in many areas of life. For example, women still did not have the right to vote. Their role in society was strictly to be wives and mothers. Education was not valued among women unless in the context of making them better homemakers. While some men did not want females attending college simply based on sexism, others thought that they had the women's best interest in mind. Women were seen as fragile and therefore some thought that the rigor of men's higher education would be too much for them, even to the point of damaging their health. Ladd-Franklin's own father, who was a huge support of her intellectual pursuits, frequently expressed concern for her health [8].

Today in the United States, women's rights in education have come a long way towards equal opportunities, yet still it is less common for females to go into the math and science fields. A study on the ratio of women to men receiving bachelor degrees from 1980 to 2007 concluded that the percent of women receiving degrees has increased to over 60 percent. However, women in the math fields, including computer science and engineering, have never been the majority, and the number of women entering these fields showed a decline towards the end of the study [3].

Ladd-Franklin's struggles 150 years ago do not reach the level of oppression that some women still face today. In many countries, women still do not yet have an equal opportunity at education; they do not even have the right to speak up about wanting these opportunities. For example, 15-year-old women's rights activist Malala Yousafzai is speaking out about the injustices women in Pakistan face and is fighting for girls' rights to attend school. For doing

this, however, she was shot by a member of the Taliban on a bus ride to school in 2012 [5]. Malala is just one example of the horrible mistreatments females still face today. Even in places that do allow females to attend school, outright discrimination is prevalent in the school setting. For example, in Kuwait and Oman, women are required to have a 3.3 GPA to be accepted into engineering programs at the university level, while men only need a 2.8 GPA for acceptance [14]. These two examples illustrate that women are still fighting for their education.

EARLY EDUCATION

At the time Ladd-Franklin was born, the concept of all-women colleges were beginning to be established in society based on the idea that colleges for women would not be as intense as those for men. As Ladd-Franklin grew up, she looked forward to hopefully, one day, attend an all-female college. This goal was inspired by Ladd-Franklin's mother's dedication to the fight against oppression. Unfortunately, at the age of 12, her mother passed away from pneumonia. After her mother's death, her father got remarried and Ladd-Franklin moved in with her grandmother so that she could study at Wesleyan Academy [8, 10]. This school was a distinguished high school and provided Ladd-Franklin the same education as the men on track to attend Harvard. Despite her change in family life, Ladd-Franklin remained motivated to pursue education and she graduated from Wesleyan Academy as valedictorian [7].

Upon hearing about Vassar, Ladd-Franklin had her heart set on attending this new all female college, where she had high hopes for meeting strong women. Despite Ladd-Franklin graduating at the top of her class, she had to convince her grandmother to allow her to attend college since, at the time, women typically started families after high school. Ladd-Franklin was able to persuade her grandmother to allow her to pursue higher education by pointing out that she was too unattractive to get married and would therefore need the means to provide for herself. She wrote in her personal journal about this, explaining:

"I have gained an important point with my grandmother. She says she thinks Auntie ought to send me to Vassar. She objected that at the end of four years I should be too old to get married. I assured her that it would afford me great pleasure to entangle a husband but there was no one [in] the place who would have me or whom I would have and out of this place I was destined never to go, gave her statistics of the great excess of females in New England and proved that as I was decidedly not *handsome my chances were very small. Therefore since I could not find a husband to support me I must support myself and to do so I needed an education. Grandma succumbed."* [15]

With her grandmother's support, Christine Ladd-Franklin attended Vassar just a few years after the school had opened in 1861 [2]. After her first year, she unfortunately had to take time off from college due to financial constraints. During her year off, she played piano, learned three or four languages, studied trigonometry, and collected 150 botanical specimens. She also translated "Des Madchens Klage" (The Maiden's Lament) for publication and was a schoolteacher as well as a music teacher [7]. During Ladd-Franklin's year off as well as throughout her life, she did much teaching, which brought her both great joy as well as great distress. During Ladd-Franklin's years at Vassar, she got her first teaching experiences as a tutor. Ladd-Franklin shares one experience she had with tutoring in the following journal entry:

"I have been an hour trying to teach Jenny her spelling lesson and now she cannot spell the first word! Where lies the fault? I am sure I have been patient, going over and over the lesson, quite as disagreeable to me as to her. At last I threw down the book and rushed away in tears of sorrow, not anger. Perhaps if she liked me she would try to please me, but she shows a deep aversion for me..." [15]

In 1868, Ladd-Franklin returned to Vassar with financial support from her aunt [7]. Ladd-Franklin was extremely excited to return to college because in her opinion she was not being productive in her time off. She writes of this in her journal saying, *"I ought, of course, to have accomplished very much in these two months that have passed, but truth compels me to say that I have been abominably idle."* [15] Upon returning to Vassar, Ladd-Franklin studied languages, astronomy, and physics. Ladd-Franklin wanted to study physics further, but at the time, women were not able to get sufficient time in laboratories [7, 10].

From examining sections of Ladd-Franklin's personal journal, it's clear she was questioning many social norms of that time period. She looked into controversies such as women's rights, racial discrimination, faith, and at times, her journal seemed to suggest she also faced a questioning of her sexuality. Ladd-Franklin was opposed to racial discrimination, which was a prevalent issue since the Civil War took place during her teenage years. In one journal entry during her time at Vassar, she wrote, *"The political status of our pastor has just declared itself, and I am suffering a real ostracism for my negro-worship."* [15]

Even at the age of 15, Ladd-Franklin was writing journal entries about how badly she wanted to change the world. Upon reflecting on this in her journal, Ladd-Franklin saw Harriet Beecher Stowe as a role model. Harriet Beecher Stowe was an abolitionist around Ladd-Franklin's time who wrote the book *Uncle Tom's Cabin* in 1852, which changed the way America viewed slavery [25, 13].

In 1869, Ladd-Franklin graduated from Vassar College and began teaching in Pennsylvania. In the 1870's, Ladd-Franklin attended math classes at Harvard and biology classes at Cornell, as well as published several papers for the *Educational Times* of London and for *The Analyst*. It is especially significant that Ladd-Franklin was taking classes at Harvard and Cornell because Harvard was an all male university and Cornell had just recently begun accepting women at that time [7, 10, 11, 6].

GRADUATE SCHOOL

In 1876, Johns Hopkins University was opened as the first research-based college in the United States. JJ Sylvester was the first mathematics professor hired there. Once Ladd-Franklin heard about the new prestigious university she wrote to Sylvester inquiring if she would be able to attend his lectures or if her gender would inhibit her chance to study at Johns Hopkins. Sylvester studied some of Ladd-Franklin's published mathematics work and was impressed. In 1878 Sylvester wrote to the President of Johns Hopkins stating that Ladd-Franklin should be admitted into Johns Hopkins even though she was a female. The President allowed her to enter the college as a student on a limited basis [9]. Ladd-Franklin needed special permission to attend her classes which was difficult because there were only a handful of professors that would allow a female in their classrooms. Additionally, some male students felt so strongly against allowing females into Johns Hopkins that they chose to stand during class rather than sit next to a female [24, 22].

In 1882, Ladd-Franklin completed all her Ph.D. requirements, but she was denied her degree because the board of trustees would not allow a female to be granted a degree [10]. Although she was not able to formally graduate, her graduate work was still published as part of a collection of works done by members of Johns Hopkins [11]. Her dissertation, "On the Algebra of Logic," worked with the idea of two premises and a conclusion and how to prove their validity in symbolic logic. For example, consider the statement, "If you do your homework and you eat your vegetables, then you can have dessert." In this statement *you do your homework* and *you eat your vegetables* are the two premises or, in other words, the two conditions needed to satisfy the conclusion, being *you can have dessert.* In symbolic logic, these sentences are translated to letters and symbols, which was a new mathematical concept at the time [9, 18]. Those sentences, consisting of premises and a conclusion, form together what is called a "syllogism". Christine Ladd-Franklin came up with a formula to combine multiple syllogisms called antilogism, which is still used today in logic [7].

POST-GRADUATE WORK

Ladd-Franklin would eventually be awarded an LLD from Vassar, the only honorary doctorate the college has ever given out [7]. That same year, she married Fabian Franklin, a mathematics professor at Johns Hopkins University who was six years her junior. In Fabian's words, *"As to how my wife and I first became interested in each other, strangely enough, it was through a long discussion we had together on the steps of one of the Johns Hopkins buildings, standing for hours on the steps, debating a point in logic."* [7, 8]

Ladd-Franklin's choice to marry could have negatively affected her career because at this time, married women were prohibited from holding official teaching jobs at the university. A great example of how this policy was so destructive was in the case of Maria Goeppert Mayer. In her situation she and her husband, a chemistry professor, moved as her husband would get a new job at a university and when Mayer tried to get a position at those universities, including Johns Hopkins, she faced discrimination. In every case, the college would refuse to hire Mayer as a full-time paid professor since her husband already had a position there. Although this in and of itself is an injustice, it is especially ludicrous because Maria Mayer would go on to be the first woman living in America to receive a Nobel Prize in physics [22].

Ladd-Franklin strongly believed that the world was missing out on the possibility of great discoveries by oppressing women. In an article by Christine Ladd-Franklin, published in *Publications of the Association of Collegiate Alumnae,* Ladd-Franklin praises the famous Marie Curie, a Nobel Prize winner in both chemistry and physics, for her work with radium [17, 21]. As Ladd-Franklin wrote in the article, *"The discovery of radium is not only changing our views of nature, but, if it is given its full significance, it should deal a final blow to the belief that women can not do great things in science; from this one case it might be inferred, with far better logic than has been traditionally employed against our sex, that women are quite as likely as men to make great discoveries -- indeed, that they are vastly more likely; for, out of the small number of women who have physical laboratories of their own, that one should make the great discovery of the time shows a far greater proportion of genius to opportunity that has ever been exhibited by men."*

Ladd-Franklin argues, in a logical fashion of course, that if women were currently doing great things while the conditions were unjust, imagine what women could do if they had equal opportunities [17].

Ladd-Franklin hoped that future generations would not have to face this oppression, especially with the birth of her two children. Unfortunately her firstborn, a son, died as an infant, however her daughter, Margaret Ladd, was born in 1884, would later be an activist for women's rights, following in her mother's footsteps [12, 20]. Margaret also published the book, The Case for Woman Suffrage [20].

Even after starting a family, Ladd-Franklin's dedication to furthering women's higher education did not cease. In Ladd-Franklin's late thirties, she was involved with several organizations that provided fellowships for women to study abroad, which was something she felt passionate about. For example, Mary Frances Winston Newson applied for the Association of Collegiate Alumnae European fellowship, where Ladd-Franklin served as the committee chair, but was denied the scholarship. Ladd-Franklin saw her potential and personally sent Newson $500 in support of her studying in Gottingen. Mary Winston was then able to travel to Gottingen and would eventually earn her doctorate in mathematics. Ladd-Franklin even put together a fellowship program in 1897 for women who wished to remain studying in the United States called the Baltimore Association for the Promotion of the University Education of Women [10].

Through Christine Ladd-Franklin's involvement in various committees providing fellowships, she was able to provide opportunities for many women. To model these contributions, the Association for Women in Psychology today has a "Christine Ladd-Franklin Award" to honor Ladd-Franklin's struggle to open the door for women in higher education and to recognize strong females who follow in her footsteps [4].

As Ladd-Franklin was providing opportunities for other women, she was also opening new doors for herself. During Fabian's sabbatical year in 1891, the family traveled to Germany. Fabian and Margaret stayed in Gottingen, Germany, while Ladd-Franklin went to Berlin to pursue her interest in psychology. In Berlin, Ladd-Franklin studied at the lab of renowned psychologist Hermann von Helmholtz [7].

During this time Ladd-Franklin developed her own theory on color vision. Before doing this, however, she needed to study the two major color theories of the time: the Trichromatic Theory and the Opponent Processing Theory. Using the fundamentals of these two theories, Christine Ladd-Franklin developed a color vision theory based on the evolution of the eye. Her theory attempts to explain why people are more likely to be colorblind in red-green sensitivity. She classified the evolution of color vision in three phases, starting with black and white, then gaining blue-yellow vision, and finally red-green vision. Ladd-Franklin concluded that people are more likely to be color blind in the sensitivities that were most recently developed. Today her theory on the evolution of color vision is as a whole not accepted, and many parts have been proven wrong with today's knowledge [16]. However, it should be noted that in 1892, Ladd-Franklin presented her color vision theory to the International Congress of Psychology in London where Helmholtz, who developed the Trichromatic Theory, made a remark about how well Ladd-Franklin understood the subject, despite the fact that her theory contradicted his [12].

After returning from Germany, she began to pursue positions at the university level. Even though Ladd-Franklin studied mathematics in graduate school, she actually pursued both mathematics and psychology most of her professional life and interestingly enough, her work in color vision is what she is most known for. At Johns Hopkins University, Christine Ladd-Franklin was the first woman to teach in the Arts and Sciences, where she worked for no pay [25, 22]. Up until the 1910's, Ladd-Franklin lectured at Johns Hopkins, Columbia, University of Chicago, and Harvard often for little or no pay in an attempt to pave the way for women in the future [7, 25]. She even made the list of 1000 scientists published in the first edition of *American Men of Science*, as one of the 18 women included, but still could not get a paid teaching position [25].

When Ladd-Franklin was in her 70's, the 19th amendment passed in 1920 which gave women the right to vote [1]. During this time, Ladd-Franklin had several articles published in *The New York Times* that addressed women's rights. One in particular criticized the American Academy of Arts and Letters for not having any female members. In it she wrote, *"Isn't it rather absurd that an American Academy of Arts and Letters should be an exclusively male Academy of Arts and Letters?...It is a long time since other organizations have found any reason for not admitting women. The scientific societies, for instance, have not only admitted them but have treated them with all deserved honor...Does not the Academy of Arts and Letters (which ought if anything to be further advanced in the humanities than the plain scientists) feel that it is rather old-fashioned?"* [19]

In 1926, Johns Hopkins celebrated it's 50th anniversary and Christine Ladd-Franklin finally received the Ph.D. she completed in 1882. Her response to this was: *"Of course I've been a doctor for a long time. I was given an LLD years ago, but I thought I'd like to have my PhD now. And I insisted that it should be given for the work I did at Johns Hopkins, not what I've done since."* [23] Ladd-Franklin didn't stop there. In 1929, at 81 years old, Christine Ladd-Franklin published the book *Colour and Colour Theories* which described her color vision theory. One year later, Ladd-Franklin passed away at the age of 82 from pneumonia [7].

Over the course of her lifetime, Ladd-Franklin showed an interest in a wide variety of academia and social issues, much of which impacted the world. Strong and vocal females, such as Christine Ladd-Franklin, are the

reason women have the rights they have today in the United States. She fought hard for equality and access to education for women. She was writing to newspapers and schools, studying around the world, teaching herself and teaching others, being involved in fellowship committees, working for no pay, writing theories, and publishing papers, all to pave the way for women in higher education. Because of all these accomplishments, Christine Ladd-Franklin was able to touch the lives of many women... then and today.

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Christine Ladd-Franklin and Fabian Franklin Papers, Columbia University Rare Book and Manuscript Library, New York City, NY. Biography: Career Focus: Symbolic logic; mathematics; theories of color vision; sexism in the academy.Â It would be some years, though not unproductive ones, before Christine Ladd would continue her formal education. Between 1869 and 1876 she continued her own form of self-study by attending courses at Washington College, Jefferson College, and Harvard.Â The Association for Women in Psychology established the Christine Ladd-Franklin Award in 1992. The award is given annually to a member who has made significant and sustained contributions to the Association. by Kelli Vaughn (2010). Christine Ladd-Franklin's and Victoria Welby's correspondence with Charles Peirce. January 2013. Semiotica 2013(196).Â The unpublished Peirceâ€“Ladd-Franklin correspondence provides equally important insights into the development of theories of logic and meaning, science and reasoning, and language and intelligence. Taking Ladd-Franklin's contributions into account puts the received historiography on modern logic, semiotics, pragmatism, and linguistic philosophy in a new light. She was also a pioneer in women's rights in higher education and scientific research. Discover the world's research. 17+ million members. Christine Ladd-Franklin (December 1, 1847 â€“ March 5, 1930) was an American psychologist and logician. Christine Ladd-Franklin was born in Windsor, Connecticut to Eliphalet Ladd and Augusta Niles. In 1869 she graduated from the newly opened Vassar College, where she studied linguistics and physics. After graduation, as women were not granted much access to labs and observatories, she turned to mathematics, which did not require any apparatus. For instance, in 1877 she published a synopsis of Christine Ladd-Franklin, American scientist and logician known for contributions to the theory of colour vision. She earned an A.B. at Vassar College, Poughkeepsie, N.Y., in 1869 and then studied mathematics at Johns Hopkins University, Baltimore. Although she held a fellowship, 1879â€“82, and.Â Encyclopaedia Britannica's editors oversee subject areas in which they have extensive knowledge, whether from years of experience gained by working on that content or via study for an advanced degree. See Article History. Alternative Title: Christine Ladd. Christine Ladd-Franklin , nÃ©e Christine Ladd , (born Dec. 1, 1847, Windsor , Conn., U.S.â€”died March 5, 1930, New York , N.Y.), American scientist and logician known for contributions to the theory of colour vision . Britannica Explores. In 1882, Ladd married Fabian Franklin, a member of the Johns Hopkins mathematics department. They had two children, but only a daughter survived into adulthood. Ladd-Franklin continued working on symbolic logic as well as the field of physiological optics. This latter area carried her into research in the optics of color vision, an area in which she worked for thirty-seven years.Â Throughout her life she championed the cause of graduate education and academic employment for women. For 17 years she helped to administer the Sarah Berliner fellowship to support recent Ph.D. women in their research. Christine Ladd-Franklin died of pneumonia in New York City on March 5, 1930. References. Lamb, Evelyn.