

Schiebinger gives us four case studies in the history of science, particularly in the 18<sup>th</sup> century, which demonstrate the ways in which science developed as a set of practices, a community, and a set of institutions which hindered women's equal participation, and defined the limited paths available to them for conducting scientific work. Her case studies are Marie Thiroux d'Arconville, Dorothea Erxleben, Dorothea Schlozer, and Caroline Herschel.

Through these examples, I want us to focus on a few common strands which represent recurring themes concerning women's participation in science. Schiebinger's examples are from the 18<sup>th</sup> century, but after covering these examples, we will then look at Keller's work on Barbara McClintock and Deegan's work on Jane Addams, two early-20<sup>th</sup> C women, and consider the ways in which these same themes appear two centuries later, sometimes in modified form, but in many ways depressingly similar.

The first theme to keep in mind is social expectations of women. This involves general beliefs about what kind of behavior is appropriate for women, or contrastingly what might cause scandal or censure. What is the intrinsic nature of women as opposed to men, and what kind of work is and is not consistent with their nature? What aspects of science are therefore not possible for women to successfully participate in, due to incompatibilities with women's nature? How do these expectations manifest and present barriers for women's entry into scientific practice and professions?

The second theme I want us to pay attention to is the gendered division of labor which crops up at various points in history in different ways. This is a structure of participation in scientific research in which women perform certain kinds of labor while men perform another kind. Sometimes this goes along the lines of social expectations for natural and appropriate gendered behavior, with women being limited to certain kinds of work like recording and calculations or assistant work. The scientific work we see women doing throughout history, including in our 20<sup>th</sup> century readings, is often hidden or less visible, and generally considered less central and less important to the progress of scientific discovery. This division of labor, along with the diminished importance of women's work, has contributed to the absence of women scientists from the historical record.

The third theme is the reliance throughout history on supportive patriarchs—that is, men of substantial resources and influence—to enable talented women scientists to gain education in and practice in scientific fields. This is also related to the former two themes: women needed supportive patriarchs to advocate for their education and career opportunities in an environment when women's participation in science was seen as inappropriate or when women were seen as unfit or incapable of creative scientific work; women also often found their opportunities to conduct scientific work as a result of their connections to their brothers, fathers, and husbands who were practicing scientists, and in this connection often undertook somewhat hidden assistantships. What does it tell us about women's access to scientific practices that these relationships of dependency were in place for women, whereby they had to rely on the good character of a male relation or friend to open doors for them? What does it suggest about the contingency and precariousness of women's place in science even when they were fortunate enough to gain access and practice science?

So with these three themes in your mind, let's look at the early years of science. During the 18<sup>th</sup> century, science began to change in terms of the locations and networks within which it was practiced. Science became increasingly professionalized, with academies and universities becoming the centers of research and conveyors of certification and credentials. At the same time, this public sphere was being defined in opposition to the closed, domestic sphere of the household and family where women were seen to be appropriately situated. In this evolving environment, women who practiced science had to struggle to enter the public sphere and pass through these gatekeeping structures.

During this time, the issue of whether women really ought to be permitted to circulate in the public realm, including in institutions of scientific education and research, was hotly debated. Some believed it was wholly improper for girls and women to rub shoulders with men at schools and universities, and tended to argue that women were not well-suited for creative intellectual work anyway.

One paradoxical person who thought this way was Marie Thiroux d'Arconville, a French aristocrat and anatomist. She believed that science fell outside women's sphere of competence. Bizarrely, she argued this while she produced the most detailed illustrations of female human skeletons from life that had been made at that time, and she produced research on putrefaction, or processes of decay. Even though she participated in scientific research, she did so from the privacy of her own home where she had a well-equipped laboratory. This largely relied on her privilege as an aristocrat who had access to equipment and books. She published anonymously to avoid criticism and scrutiny. For that reason, her work was often attributed to contemporary male scientists. And her illustrations of female skeletons, interestingly, presented a picture of women as intrinsically more delicate, confirming ideas at the time that women's natures were fundamentally different than men's on the basis of their anatomical differences. Marie Thiroux d'Arconville shows us that not only were there sometimes inconsistencies in people's stated beliefs and behaviors concerning women's place in society, but also the important point that beliefs about women's place and limitations were not confined to men. Women were just as capable of finding such claims plausible as men were. However, one has to wonder about the pressures on women like Marie Thiroux d'Arconville to remain out of the public eye and conform to norms and expectations. As Schiebinger suggests on page 250, Thiroux d'Arconville saw only two options for practicing openly as a woman scientist: If your work is good, you're ignored; if it is bad, you're hissed at. What kind of prospects were these as a way to spend your energy and be thought of by your peers?

Another case study is Dorothea Erxleben, a middle-class German woman who practiced medicine and eventually, after many trials, earned an MD. Now, unlike Marie Thiroux d'Arconville, Erxleben did not have a lot of independent financial resources to, say, set up a laboratory in her own home. Nevertheless, she was lucky to have a father who insisted on providing her with the same education as her brother. Even then, she still had the disadvantage of being unable to attend the gymnasium (the equivalent of high school) due to expectations of feminine propriety. She was highly dependent on her brother's education. He would bring his lessons home from school for her and she studied with him as he prepared for his university exams.

Another benefactor she was fortunate to have was King Frederick II. She petitioned him to be allowed to attend university, and he granted her permission. Nevertheless, there was outcry when

she was admitted, with a great deal of public opposition. She was unable to finish her university degree for various reasons, but she practiced medicine later in life. And again, she met with fierce opposition. When a patient of hers died, she was accused of quackery in spite of the fact that she had extensive medical education, and it was suggested that she was not fit to practice medicine because she was often pregnant. Three licensed physicians called for her to be tried for malpractice, and even called her a witch! To quiet these challenges, she decided to sit her dissertation defense and gain her MD. Before she did so, she had to appeal once again to Frederick II, and get permission from the university rector.

A major issue in Erxleben's professional life (which was very public) was whether women entering these professions would prevent them from fulfilling their roles as wives and mothers. Erxleben believed women entering professional learning should not marry. But another case study given by Schiebinger brings this concern into greater focus.

Dorothea Schlozer, another middle-class German woman, was the first in her country to gain a PhD. Her opportunities were also contingent on her father's inclination to educate his daughter. However, she was educated in domestic arts as well, like sewing and cooking, and her education was undertaken not to make possible a public career but to make her a better candidate for a desirable marriage. When she passed her examination for her PhD, she did not attend her own degree ceremony to protect her modesty. And one newspaper celebrated her not for her intellectual achievement but for not showing in her manner or behavior that she was accomplished, for not being strange and unattractive the way learned women were stereotypically assumed to be. In Schlozer's case, we see again the importance for women of having relationships with patriarchs who are willing and able to educate you, and we also see the conflict being hashed out in philosophy, newspapers, and families between those who viewed women's education and women's proper role as wives, mothers, and housekeepers as compatible and those who viewed them as incompatible.

A case study which illustrates the division of labor that developed in science between men and women is that of Caroline Herschel, German astronomer and sister to William Herschel (though they both lived in England for many decades). Herschel served as her brother's assistant for most of her life, helping him with observations of the skies and making recordings. However, she was an astronomer in her own right. Caroline Herschel is a good example of how women did not have the same access to the necessary equipment for conducting scientific research, except through their male relations. Even then, William had her take notes and make calculations while he was observing the sky through his telescope, so Caroline had little opportunity to actually make observations of her own. While William was away on a visit to Germany, she took the opportunity to use his powerful telescope and discovered her first comet. Subsequently, she discovered 8 comets and 3 nebulae and published a *Catalogue of Stars*. Another example of such an arrangement of the division of labor, in which women served as assistants to men was that of Marie-Anne Paulze Lavoisier, wife of the chemist Antoine Lavoisier. Since it's part of our main project in this class to consider the way women scientists are remembered or forgotten, you might be interested to compare the Wikipedia pages for Caroline and William Herschel, or for Antoine and Marie-Anne Lavoisier. Of course, the men in these pairs did indeed publish more work and receive more honors, but the amount of the work attributed to them which depended heavily on the invisible assistant work of their wives and sisters, people who did not have the same opportunities to conduct original scientific research

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publicly, makes you wonder if the general patterns we follow for recognizing historical achievements during these eras are really appropriate for our modern values. Caroline Herschel, Marie-Anne Lavoisier, Dorothea Schloeder, Dorothea Erxleben, and Marie Thiroux d'Arconville were all remarkable individuals who receive relatively little recognition for their role in the history of science.

Now let's turn to our two examples from the late 19<sup>th</sup> and early 20<sup>th</sup> centuries: sociologist Jane Addams and cytogeneticist Barbara McClintock.

Jane Addams comes slightly before Barbara McClintock in chronology, so let's start with her. In the late 19<sup>th</sup> century, the study of society was advancing at a fast pace. This was especially true in Europe where various schools of sociological thought utilizing scientific techniques like observation and statistics were developing. But the United States lagged behind somewhat. Empirical methods of social problems were not undertaken in a systematic way until the last decade of the 19<sup>th</sup> century. The first work of empirical sociology was Hull House Maps and Papers, published by the workers of a settlement house in Near West Side Chicago. Now, people usually associate the beginnings of American empirical sociology with the University of Chicago, starting around the 1920s, but some historians are now arguing that empirical social science started significantly before then in the work of Jane Addams and other women at Hull House settlement in Chicago and the black scholar W.E.B. Du Bois at the University of Atlanta. It's not an accident that these overlooked figures in the history of American social science are members of marginalized groups who, though successful in their careers, inevitably found themselves outside of established research institutions of power, influence, and resources. I am actually teaching the history of women at Hull House and W.E.B. Du Bois in my class on History of the Social Sciences, which focuses on the hidden figures in mainstream histories. This is being offered both this quarter and again in spring if you are interested in signing up and attending then.

So what I want to focus on with Jane Addams and the women at Hull House is two of our three themes. Let me remind you of those. The first was social expectations for women—their lives, their entry into public life, their domestic responsibilities. The second was the division of labor between men and women in the practice of scientific research. Those are the two most relevant ones for Jane Addams, but the third, just to remind you, was the dependence of women on patriarchs for access to education, research, and professional opportunities.

With regard to Jane Addams, as Deegan says in her brief biography, Addams struggled with social expectations of her for a long time in her early life. Her family tried to enter her into society, which I think means present her to possible marriage suitors, and she strongly resisted these attempts. She wanted to have a social impact, to do some good. At the same time, she felt an immense amount of pressure to remain within the constraints of feminine behavior and appropriate domestic roles for women. She managed to balance these two opposing pressures she felt—one being her deep desire to undertake public work, and the other being the strong wish not to violate the norms and expectations of propriety—by setting up a settlement house which offered services and various kinds of aid to the poor working class neighborhood surrounding it. The settlement was a place where educated, middle-class women went to live for periods of time while they devoted themselves to working among the impoverished working class. Settlement houses became very popular in the

United States as a result of the example of Hull House, with hundreds of similar settlement houses being set up across the country in the following decades. Settlement houses offered aid to working class immigrants by conducting detailed sociological analysis of the lives and conditions of the people, with the goal of applying this knowledge to develop more efficient forms of aid, lobbying and advocacy for fairer labor laws, education and centers for activities and organizations, and a host of other things.

This leads me to the second theme relevant to Jane Addams' case: the division of scientific labor. Women's roles in the early years of social science *had* to take place outside the university, simply because they couldn't gain employment in universities. Women who graduated with degrees in the emerging field of empirical sociology were subsequently denied a position in the academy. They therefore frequently sought sociological employment in settlement houses. These settlement houses had connections to sociology departments in universities, and were considered to be essential and central elements of sociological research. For example, Addams' connections to University of Chicago Sociologists George Herbert Mead and W. I. Thomas are well known. The University of Chicago even set up its own settlement house for the purpose of enabling the sociology department to undertake research, under the leadership of Mary McDowell, who had formerly been a resident at Hull House. Although settlement workers were considered important to the field of sociology, there was a clear division of labor, with women doing the practical, hands-on work, and men doing the scholarly professorial work in the universities. While women sociologists at settlement houses thought they were doing the most important work of reforming society, male professors often thought of them as people who would do the derivative work of applying and testing their academic theories, and gathering empirical data for them to theorise with.

One of the most important publications in early American empirical sociology was Hull House Maps and Papers, a detailed study by the women residents at Hull House of the inhabitants of their neighborhood. It contained focused chapters on crime, poverty, immigration, and occupation, and methodologies like neighborhood mapping, surveying, and basic statistics. These methods and ways of undertaking empirical research were groundbreaking when HHMP was published. This approach towards the city as an empirical field was one of the features of the University of Chicago's school of sociology decades later. Strangely, few of the recognized members of that school referenced HHMP or Du Bois' similarly groundbreaking work in Black neighborhoods. In fact, in an effort to render itself respectable as an academic discipline, sociology departments distanced themselves from settlement houses and the reform work women had been doing there from the 1920s onwards, and so their contributions to the development of empirical sociology is not part of the usual canonical history of American social science. What we find is a huge swathe of qualified, practicing sociologists who contributed innovative work in pushing the field forward being swept out of official histories and reclassified as non-sociologists as the field became more specialized, academic, and respectable. Because of the division of sociological labor, this group tended to be women, and so women are the ones being swept out of official social scientific history.

Briefly, on our third theme, which is the dependence of women on male patriarchs, Hull house gave Jane Addams and other women a great deal of independence and employment stability. The settlement was so successful and so famous that its workers did not have to rely on generous patriarchs. They were actually using the land and buildings of a real estate developer and

philanthropist Helen Culver, but Jane Addams' creation of this institution and her expansive connections across various sectors of American and international society meant that, with her as their matriarch, the women residents at Hull House had less need for male patriarchs. They had created a strong network of connections of their own.

Moving onto our most recent example, Barbara McClintock was a scientist working on the genetic composition of maize in the early twentieth century. She graduated from Cornell with a PhD in botany, and conducted research in Cornell, the University of Missouri, and CalTech. She collaborated with a number of fellow scientists during her career and had a strong reputation for being a highly capable researcher.

For example, she collaborated with Lewis Stadler in investigating the mutagenic effects of X rays on maize. Speeding up mutations in maize plants gave McClintock an opportunity to research the plant's genetic structure and the corresponding physical changes such genetic changes were inducing. This was how she made her famous discovery about the causes of variegated coloring of maize plants. Researchers in California had discovered that variegation was the result of certain fragments of genes "getting lost" in the process of DNA replication. McClintock intuitively understood that the cause was what is called a ring chromosome. A ring chromosome is an abnormal chromosome which has lost a section at one or more of its ends. It then loops round so that its ends fuse together. This interferes with the process of replication and so that chromosome gets lost in the process of replication.

She also collaborated with T. H. Morgan in CalTech, where she studied a small body adjacent to the nucleolus of chromosome 6. She discovered that this small body was somehow responsible for organizing the materials that are put into chromosomes, and it is now called the nucleolus organizer region. In spite of her obvious talent and growing reputation as a top-rate geneticist, McClintock was unable to secure a permanent academic position. She had a National Research Council Fellowship and a Guggenheim Fellowship, during which she made these discoveries, but when these fellowships ended and she needed employment, she couldn't find one. This was of course related to the fact that she was a woman.

As Keller tells us, the crash had just happened and jobs were scarce, but positions were still being found for McClintock's male colleagues, some of whom were less qualified and experienced than she was. She had a good reputation in research and a strong network of researchers who tried to find her a position at the University of Missouri, Johns Hopkins, and Iowa State, but the answer would come back that the directors refused to appoint a woman. The discrimination was so clear that other women geneticists like her collaborator Harriet Creighton took the hint and went into teaching positions at women's colleges—not bad positions at all, and valuable work, but not necessarily what everyone wanted especially if their strengths and passions lay in laboratory research.

Now McClintock was about to leave genetics because she had no income on which to live. But luckily for her, she had—and this brings us back to one of our themes—an influential and established patriarch who found a way to support her. First, her colleague T. H. Morgan requested a salary from the Rockefeller Foundation for her to work in a lab at Cornell under the supervision of Rollins Emerson. They declined, and eventually Emerson had to ask for general research funds with

which he quietly paid McClintock a salary. Once again, we see a talented woman's ability to practice science dependent on her associations with men.

Another aspect of McClintock's story touches upon our recurring themes. In terms of gender expectations, McClintock was unusual. She appeared boyish and unkempt—according to contemporaries, she looked and acted more like a boy than a girl. A most interesting point Keller makes about McClintock's gendered behavior is the way people responded to her attitude towards discrimination. Rather than gracefully accepting her place and being grateful for the personal efforts made by her patriarchs, McClintock was quite blunt about her frustration with the blatant injustice and immorality of her treatment. She proceeded with a sense of entitlement to be assessed and rewarded for her work and her talents, and this certainly violated the general expectations of female delicacy and softness that even her supportive male colleagues implicitly carried. Instead of being grateful for the efforts they made on her behalf, she was angry that male colleagues who were less accomplished and less capable than her were being given positions that she was being denied. She insisted on pointing out this disparity and its injustice, and this was not socially acceptable or comfortable for her colleagues. They responded to her expression of entitlement to that to which she was entitled as a demonstration of her “personal difficulties” and “a chip on her shoulder.” In addition to the institutional barriers McClintock faced, it seems she also had to navigate her colleagues' thwarted expectations of how people of her gender should behave.

Now I want to spend a few minutes discussing some of the overarching points Schiebinger makes in her final chapter about what these case studies of women's experiences in scientific research show us about the possibility of value-neutrality or value-freedom in science. Schiebinger suggests that, regardless of claims of impartiality of scientific method (which we will examine closely later in the quarter), science cannot be value-free while certain groups are systematically excluded from it institutions and networks. There are several reasons for this.

Firstly, the exclusion of certain people will create problems of evidence. Throughout her book, Schiebinger focuses on “the woman question”—which was the social debate concerning whether women are fundamentally different to men, and in what ways, and did this affect the kinds of practices they were appropriate and suited for, including intellectual work and scientific professions. Now what we see going on is that scientific evidence was gathered and used to “prove” the unsuitability of women for undertaking scientific research. But at the same time, the very people in whose interest it would be to bring forth evidence to the contrary—i.e. women—were denied access to research resources and their claims were considered illegitimate, on the basis of the thesis that they were unsuitable for scientific research. The structure of exclusion therefore insulated this specific scientific hypothesis from dissenting voices and from refutation. Robert Merton made a similar complaint about the growing anti-Semitism in Germany which excluded Jews from positions in science while at the same time, scientific theories were proliferating concerning Semitic races and their differences and inferiority. And the exclusion of Black people from research institutions in the United States meant that lazy and unempirical theories of Black people's inferiority and incapacity to become civilized remained common until well into the twentieth century. W.E.B. Du Bois in fact originated empirical social science in the United States precisely as part of his life's ambition to overturn the racist status quo in theories of culture and society, and had to overcome many obstacles

just to have his pioneering research recognized. That's another thing you can learn about in my History of Social Science class in the Spring if you're interested. So systematically excluding groups of people from the construction of collective knowledge will end up allowing that collective knowledge to serve as an instrument for ideologies that sustain structures of power.

The second barrier to science being value-free when such systematic exclusions exist is the kind of expressive culture or what Schiebinger and other feminist theorists call "voice" that gets privileged when only a subsection of society can participate in building a body of knowledge. John Stuart Mill argued that not only should women do science, but that they should do it in such a way that utilizes and embraces their own style of expression, with the input of their own experiences which were, of course, very different to those of men. The problem was that, because science had been so exclusively the dominion of men, female voices and concerns seemed alien and irrelevant to the processes of science. So when women spoke adamantly on "the woman question," their male counterparts accused them of being self-serving or failing to be impartial. The same issue confronts feminist epistemologists today. When feminists critique science, their work is accused of being politically motivated and therefore not impartial and not reliable. So the institutions, practices, and bodies of knowledge of science, which have exercised and been influenced by power relations for centuries, are assumed to be *impartial*, while the feminists seeking to point out that bias are accused of being the ones who are introducing partiality into objective methods. This topsy-turviness acts as the second barrier to science's value-freedom.

The third is the way that systematic exclusion of women from science has generated and continues to generate systematic neglect of certain problems or questions. The example Schiebinger uses is that, although Kant is considered central to higher education in the humanities, scholars pay very little attention to the frankly appalling things he had to say about women and non-white races. This issue of the sexism and racism at the heart of the points of view of the "great thinkers" in the western canon is pushed to the side, and various categorizations are employed to justify ignoring it—for example, Kant's sexism belongs to his "pre-critical writings." The same neglect is found of attempts to analyze obstacles to women's education made by Dorothea Erxleben, and Anna von Schurmn before her, and Amalia Holst after her. And our main project in this class—to write a Wikipedia page for a woman in the history of science, is influenced by the absence of sufficient attention and coverage of women scientists on their online knowledge resource. One main reason for this bias, it is suspected, is that the editors of Wikipedia are mostly men. In fact, women constitute at most 20% but potentially as low as 8% of editors on Wikipedia. Without women editors, we don't see women's issues or perspectives being included.

OK, that is all for this week's lecture. Leave comments or questions if you have them. Or bring them up in your next discussion session. Or both.