AC 2012-5419: PANEL DISCUSSION: OFF THE RECORD - UNTOLD STORIES OF WOMEN, SCIENCE, AND ENGINEERING

Dr. Cheryl B. Schrader, Missouri University of Science and Technology

Cheryl B. Schrader became Chancellor of Missouri University of Science and Technology, formerly the University of Missouri - Rolla, in 2012. She most recently served as Associate Vice President for Strategic Research Initiatives and as Dean of the College of Engineering at Boise State University. Dr. Schrader has an extensive record of publications and sponsored research in the systems, control and STEM education fields. She received the 2005 Presidential Award for Excellence in Science, Engineering and Mathematics Mentoring from the White House for an enduring, strong, and personal commitment to underrepresented engineering students and faculty; and the 2008 Hewlett-Packard/Harriett B. Rigas Award from the IEEE Education Society in recognition of her contribution to the profession. Dr. Schrader earned her B.S. in Electrical Engineering from Valparaiso University, and her M.S. in Electrical Engineering and Ph.D. in Systems and Control from the University of Notre Dame.

Ms. Janelle Brown
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Leslie Madsen-Brooks's work investigates the intersection of professional disciplinary knowledge with the public understanding of history and science. More specifically, she researches how women scientists working in museums, botanical gardens, zoos, and other natural history institutions democratized the public understanding of science in the United States in the nineteenth and twentieth centuries. She also studies how the lay public interprets the past and constructs historical narratives about the U.S., particularly on the Internet. Madsen-Brooks holds a Ph.D. in cultural studies from the University of California, Davis. She teaches U.S., women's, and public history at Boise State University, where she has served as a Mobile Learning Scholar, studying how students use technology to create digital public history projects. She has served as an informal science educator, exhibit developer, and program evaluator. She blogs about museums, public history, and digital humanities at MuseumBlogging.com.

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Patricia A. Pyke is Director of the STEM Station, a university-level science, technology, engineering, and mathematics (STEM) research and education initiative at Boise State University. She earned a B.S.E. degree in mechanical engineering from Duke University and a master's degree in journalism from the University of California, Berkeley.

Dr. Heidi Reeder, Boise State University

Heidi Reeder is a social scientist whose research interests include gender, communication, and pedagogy. Her articles have been published in top communication and social psychology journals including Sex Roles, Communication Monographs, and the Journal of Social and Personal Relationships. She is also an online contributor to Psychology Today. She earned a B.S. in communication from the University of Oregon, an M.A. in communication from Stanford University, and a Ph.D. in communication from Arizona State University. In 2007, she was selected as the Carnegie Foundation's Idaho Professor of the Year. Over the years, she has studied theatre and performance, including courses in London and Los Angeles, and has played a leading role in more than 20 theatrical productions.

A Panel Discussion on Off the Record: Untold Stories of Women, Science and Engineering

Abstract

Women throughout history have made groundbreaking contributions to the advancement of science and technology, yet many of their stories remain unknown outside of some academic circles. This session comprises a reading of a work-in-progress and subsequent panel discussion as part of an innovative project to bring some of these amazing stories to the stage. We will present dramatic readings of selected draft monologues which will be followed by a panel discussion spurred by questions from audience members. This will allow for a true give and take between the readers and the audience, will inform monologue development and effectiveness, and will address questions arising from participation in this experience. Our ultimate goal is to write a play featuring monologues about individual women scientists that may be performed in various venues by independent groups and that would be developed as part of a larger funded research project. By presenting stories about these women's accomplishments in a dramatic and accessible form, we hope to educate, enlighten and inspire.

Panel Format

This moderated panel will explore how narrative and story can be used to convey research-based historical and scientific information about women whose contributions to engineering and science changed fundamental paradigms of human experience, yet are little known to lay communities and even to many in academia. School children know the story of Alexander Graham Bell calling, "Mr. Watson, come here," when his prototype telephone succeeded. Women whose epiphanies in science and technology likewise changed our understanding of the world are missing from popular consciousness. Few outside of academics in fields of historical research know that recent scholarship has clearly positioned women as creators, not merely assistants, in fundamental scientific and technological work on nuclear fission, environmentalism, DNA, computer architecture and other concepts that have transformed humanity. Making these stories more visible will enable students, faculty and the general public to see more clearly the opportunities open to, and obstacles faced by, women in STEM (science, technology, engineering and mathematics) today.

The panel will be moderated by engineering educator Cheryl Schrader, who will briefly introduce the motivation behind the overall project and the team's companion research on public perceptions of women in the history of science and engineering.[1] Each of the panelists – history, social science and engineering researchers who also wrote these draft monologues – will speak for four to five minutes in the persona of a woman scientist, engineer or inventor from the historical record. These five draft monologues synthesize the details and distinctive voice found in primary and secondary source documents with the larger concerns of a woman's life and scientific details of her work. The panelists will present in monologue style, similar to the format in Eve Ensler's play, *The Vagina Monologues*[2].

The five historical women engineers and scientists who are currently planned as "panelists" are:

- **Lillian Moller Gilbreth**, who was the first person to integrate psychology with engineering to improve human efficiency and was the first woman inducted into the American Society of Mechanical Engineers, the Society of Industrial Engineers and the Society of Women Engineers;

- **Emily Warren Roebling**, who played an essential role in building the world famous Brooklyn Bridge after her husband and chief engineer, Washington Roebling, became gravely ill;

- **Lady Mary Wortley Montagu**, who took on the medical establishment of her day (1700s England) to bring smallpox inoculation to Britain;

- **Alice Eastwood**, curator of botany at the California Academy of Sciences who saved botanical type specimens during the San Francisco earthquake in 1906 and popularized conservation in California; and

- **Rosalind Franklin**, a renowned X-ray diffraction specialist who conducted research that played a critical, but largely unrecognized, role in the discovery of the structure of DNA.

This selected group of historical women includes primarily Western (European and North American) women from the Enlightenment to the present day who represent a breadth of scientific fields. Because of the ease of access the team has to their archives, we have begun this project by investigating the lives and works of Western women; however, we anticipate uncovering the achievements of non-Western women as well. Additionally, in choosing these women we employ a broad definition of who might be considered an engineer or scientist. For example, Lady Montagu might not meet the conventional modern definition of "scientist" since she did not "discover" the technology of inoculation. One must recognize that by even using the term "scientist" we are being anachronistic when referring to anything prior to the 19th century. "Scientism" – the ideology that places faith in the idea that science and technology can solve all the problems of humanity – is an outgrowth of the Enlightenment and is rooted in the late 18th and early 19th century. A longer-term goal of our research is to expand the awareness of women's contributions to science and technology to the pre-modern era. By narrowly defining what should be considered technologies, and what should be considered scientific discovery, discriminatory science education practices have served males more effectively than females.[3] Women's agency largely has been ignored in conventional accounts of Western sciences and technologies; and one of the goals of this project is to challenge that conventional view.

"Panelist" Background and Draft Monologue Teasers

Lillian Moller Gilbreth by Janelle Brown[4-7]

Lillian Moller Gilbreth was a pioneer in modern management. Born in Oakland, California, in 1878, she was an introverted child who loved poetry, excelled at academics and earned a Ph.D. in industrial psychology from Brown University. Along with her husband Frank Gilbreth, she developed time and motion studies to improve workplace efficiency. Many of these techniques were first tried at home using the Gilbreths' twelve children as subjects; the story of their

unusual household is told in the book and movie, *Cheaper by the Dozen*[4]. Gilbreth, who died in 1972 at the age of 93, was the first woman inducted into the Society of Industrial Engineers and the American Society of Mechanical Engineers. Besides working with many companies on appliance and product designs, she consulted for the government during World War II, taught at Purdue University until she was 70, and gave lectures all over the country.

... One of my favorite projects was designing a desk for display at the 1933 Chicago World Fair. I worked with IBM on that one. And then there is the trash can, the one with a pedal you step on to open the lid? That's mine. I also designed the first shelves inside refrigerator doors – until I came along, there was just a flat wall on the inside, and good luck keeping track of the mustard and mayonnaise! I did market research for Johnson & Johnson to help women make better spending choices. At Macy's, I worked as a salesperson so I would really understand working conditions, and what changes would improve efficiency. And of course I was always especially interested in homemakers. I believed "homes should be happy places in which individuals can achieve fulfillment and a degree of freedom. Wives and mothers are entitled to share in this fulfillment, but this happy situation can be attained only if the responsibilities of the home are shared and efficiently handled"[5].

I know I said I didn't like to blow my own horn. That's not entirely true. I am proud of what I accomplished. I've always believed that you could design the most fantastic machines, you could create the most incredible structures, but it is the people – like you – who matter most. Things are moving so much faster today, there are opportunities everywhere. I would say to you: "Grasp them. Grasp them and Go." …

<u>Emily Warren Roebling by Pat Pyke</u>[8-13]

Emily Warren Roebling maintained her image as a proper Victorian woman while achieving physical, intellectual and professional accomplishments more typical of the masculine gender. Born in 1843 in upstate New York into a prominent but not especially well off family, young Emily reveled in horsemanship and mathematics. When her husband, Washington Roebling, chief engineer on the monumental Brooklyn Bridge project, was crippled by the bends only three years into the 14 year project, Emily immersed herself into civil engineering, bridge construction and advanced mathematics. She became the *de facto* project manager on the bridge construction site and represented her husband in technical, business and civic matters. Emily Roebling was a popular speaker and the first woman to address the American Society of Civil Engineers. An adventurer and lifelong learner, she traveled internationally, and earned a law degree from New York University in 1899.

Please bring my brush, Margaret. I must tidy my hair before I speak to the civil engineering society tonight. On this fair spring day I fancied harnessing my fine team for a jaunt about town. I know some think it improper that I drive my carriage so swiftly, while the coachman rides in back. So please help me re-pin my hair and fix my hat before I go. After all the rumors and gossip I have endured, would it not be a shame if an unruly lock hinted at impropriety? You know I have always been a proper and respectable wife.

Can you believe that even now, ten years after the grand opening, rumors still persist that I, Emily Warren Roebling, was the chief engineer on the great Brooklyn Bridge? The eighth wonder of the world, they call it! Soaring towers 276 feet above the water! The tallest man-made structures in all of North America! By far the longest bridge anywhere in the world! Yet the wonder behind the bridge, my brilliant husband Washington, the real chief engineer, has rarely been seen in public since his illness struck 20 years ago. The rumors began those last few years of construction when I was on the bridge almost every day, fielding questions from bridge trustees and assistant engineers and sketching diagrams to explain design concepts to them...

Lady Mary Wortley Montagu by Heidi Reeder[14-18]

Lady Montagu was born into a wealthy family in London in 1689. Despite her nobility, she led an eventful life: she eloped, championed women's rights, divorced and had many affairs, and became a successful writer and poet. Her travels led her to Turkey where she discovered the local procedure for smallpox inoculation. Eager to protect her children from the fate of her brother who died from the disease, as well as her own survival but disfigurement by it, Lady Montagu fought with the medical establishment to bring inoculation to England. After many years of opposition, in 1722 she finally convinced her country to begin the practice. Her dying words in 1762 are reported to have been: "It has all been most interesting"[14].

… If you know my writing you may have imagined me as elegant, and even beautiful. But while my writing has brought me much recognition and inner satisfaction, it could do nothing for my external visage. Not even the potent inoculation could bring back what was once fair. Thankfully, it's only my face that's wretched. My feet, on the other hand, are quite exquisite.

I suppose I should feel that it was worth it. To see not only the suffering of others, but to experience visions of my own death and that of my brother – well, it makes one's decisions quite clear. What my countrymen saw as a risk to do, I knew was perilous not to. How blind and self-centered the English physicians were, while in 1717 the Turkish people had been inoculating their own for years...

Alice Eastwood by Leslie Madsen-Brooks[19-26]

Alice Eastwood became assistant curator of botany at the California Academy of Sciences in 1892 and remained involved with the institution until her death in 1953. Her post at the California Academy of Sciences gave Eastwood a broad platform from which to evangelize

about horticulture, native plants, and conservation in California more generally. Eastwood gained fame among scientists for risking her life to rescue the Academy's botanical type specimens from the quake-sparked fire of 1906, but her regional impact was cemented by her engagement with a devoted following of amateur women botanists who successfully lobbied local and state politicians about conservation issues. If we were to draw a network of American amateur and professional botanists – male or female – during the first half of the twentieth century, Eastwood might be its heart.

I think our work is valuable. In a moment I want to share with you a birthday letter I received from my good friend Agnes Chase, who studies grasses at the Smithsonian. You may remember hearing that so many years ago, between the great earthquake and the fire that followed it, I hitched up my skirts, climbed the banister of the ruined staircase to the sixth floor of the Academy, and used a rope to lower our most valuable botanical specimens to safety. I hired a horse and cart and spent the next few days shepherding the type specimens around the city, always ahead of the fire, even as my own house and the rest of the collection at the museum burned. As for my losses – "my own destroyed work I did not lament, for it was a joy to me while I did it, and I had the same joy in starting it again"[19].

Saving the collections was both my pleasure and my duty, but I will say I enjoyed the fame their rescue brought me. But back to Agnes's letter about our work … She wrote, "I recall especially how thrilled I was in the spring of 1906 when the men here were all talking about how Alice Eastwood had saved the precious types in the California Academy Herbarium. At that time women were not admitted to the august Botanical Society of Washington, so we rejoiced not only that the types were saved but that you saved them. And not only do we admire your work. Your unfailing kindness and helpfulness to other botanists has endeared you to all of us."[20]

All of the attention I received during those years allowed me to predicate my return to the Academy on two conditions: I had "to be liberally supported and given a free rein."[21] *And because they granted me both support and independence, with help from many botany enthusiasts like you I have rebuilt this collection to be among the best in the world…*

Rosalind Franklin by Lynn Lubamersky[27-33]

A renowned X-ray diffraction specialist, Rosalind Franklin pioneered photographic techniques that revealed the fundamental structures of molecules. She worked at King's College in London beginning in 1951 on a study of the structure of DNA, but after two years was forced to leave because of conflicts with the lab's director, Maurice Wilkins. Unbeknownst to Franklin and prior to her departure, Wilkins shared her unpublished data and a crucial photograph with Francis Crick and James Watson. This unattributed work helped the scientists construct a model of the double helix structure of DNA, for which they won the Nobel Prize in 1962. Franklin's

contribution was forgotten until she was caricatured in Watson's 1968 bestselling book, *The Double Helix*[31]. Franklin died in 1958 at age 37, never knowing the role that her data played in one of the most important scientific discoveries in history.

… I was fiercely proud of my accomplishments, especially of the sharpest image of DNA ever produced in a photograph I labeled Photograph 51. I presented these startlingly clear helical photographs at a colloquium Watson attended, but I was never acknowledged. Maurice Wilkins actually gave Watson a copy of that photo and ***that*** *data allowed Watson, Crick, and Wilkins to produce the model of DNA that won them the Nobel prize in 1962, four years after I died of cancer.*

The thing that I find most galling is that even after my death, I not only got no credit for my data, I was even slandered. In Watson's best-selling book, The Double Helix, written a decade after my death, he was so cheeky as to say that "I was AWARE of her data more than she realized."[31] *He called me Rosy because he knew how much it stuck in my craw, and he said that I was fired rather than that I quit. He wrote that "clearly Rosy had to go or be put in her place. The former was obviously preferable because, given her belligerent moods, it would be very difficult for Maurice to maintain a dominant position that would allow him to think unhindered about DNA…. The real problem then, was Rosy. The thought could not be avoided that the best home for a feminist was in another person's lab."*[31] *That's what he wrote! So I'm really pleased that I'm able to speak with you tonight, off the record as it were, to set the record straight.*

Discussion

Following the draft monologues, the panel moderator will lead a discussion and invite audience participation to enable attendees to reflect on their experiences and on how and why those in academia can incorporate historical narratives into their courses. This project is timely, as our national leaders have prioritized scientific and technical literacy for our nation, with emphasis on women and others underrepresented in science and technology. This small taste of draft monologues will begin to immerse the ASEE audience into the lives of women who made transformational technological contributions. Overall, this project intends to inspire engineers and scientists to explore the history of women within their own disciplines and communities, so that stories of women throughout many periods of history and cultures are brought to life and no longer remain *off the record*.

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