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**Sobel, Dava. *The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars*. New York: Viking, 2016. 324 pp. \$30.00 hardcover (ISBN 9780670016952).**

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Reviewed by Aldemaro Romero Jr.  
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Women in science have been and are still facing numerous obstacles. According to the American Association of University Professors, despite the fact that 60 percent of all doctoral students (the main pipeline for academia) in this country are women, only 46 percent of assistant professors, 38 percent of associate professors, and 23 percent of full professors are female. On top of that, women faculty in colleges and universities in the United States earn on average 10 percent less than their male counterparts.<sup>1</sup> A number of studies have shown that women in academia suffer from lower expectations for intelligence, so when they coauthor papers with male counterparts the assumption is that the males were the ones who did the actual work.<sup>2</sup> According to a new report recently released by the College and University Professional Association for Human Resources (CUPA-HR) there is a significant gender gap at the top levels of higher education leadership. Women administrators in higher education earn 80 cents on the dollar when compared to men. And despite claims by institutions of higher education that they are egalitarian and politically correct, this disparity has changed little over the last fifteen years.

As we can imagine, discrimination against women in academia is not something new. Hypatia of Alexandria was the first woman scholar for which we have any records. She was a Greek mathematician, astronomer, and philosopher in Egypt, then a part of the Byzantine Empire. She served as the head of the Neoplatonic school at Alexandria. During a civil revolt Hypatia was singled out by

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1. National Science Foundation, National Center for Science and Engineering Statistics, *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2015*. Arlington, VA. Available at [www.nsf.gov/statistics/wmpd/](http://www.nsf.gov/statistics/wmpd/).

2. Sarah-Jane Leslie, et. al., "Expectations of Brilliance Underlie Gender Distributions across Academic Disciplines," *Science* 347, no. 6219 (January 2015): 262-265.

Christians for being a pagan and stoned to death. Her body was dismembered and her remains burned.

Now comes a book that although not as dramatic as Hypatia's story, is a bittersweet reminder of what women in academia have to endure. In *The Glass Universe*, Dava Sobel brings to the public eye the overlooked history of the women astronomers at the Harvard College Observatory around the turn of the twentieth century.

The story is about how the director of the Harvard Observatory from 1877 to 1919, Edward Charles Pickering, started to hire women to do the calculations needed in order to run the research at that facility. Obviously, that was well before actual computers came into existence. As Sobel recounts the story in this very well researched book, Pickering hired the Scottish émigré Williamina Fleming, a former teacher, as a maid after her husband abandoned her in a "delicate condition." However, Pickering recognized that Fleming's education and abilities were more suited for her to work at the observatory instead of as a maid. As soon as Fleming began to demonstrate her excellence at mathematical calculations, she was also given the responsibility of hiring dozens of other women to perform astronomical calculations.

The job was difficult not because mathematics has been stereotypically viewed as "not for women" but because it required workers to spend long, cold nights at the observatory and operate heavy telescope equipment, far from what was considered "womanly" at that time. In fact, that team of female mathematicians was called "Pickering's Harem" in a time when political correctness did not exist. Yet, the very fact that such a description was used indicates the view of women as scientists at the turn of the twentieth century. In a time when no electronic equipment existed, those calculations had to be done by hand for months, a really wearisome work.

Although Sobel is a woman, she does not use the narrative in her book to champion any feminist cause. On the contrary, her description of the facts is very sober and fair. This is not new for this author whose previous books on the history of the physical sciences include *Longitude*, *Galileo's Daughter* (for which she was nominated for the 2000 Pulitzer Prize for Biography or Autobiography), *Letters to Father*, *The Planets*, and *A More Perfect Heaven*. All these previous works display the same characteristics we find in this book: study of original documents, avoidance of judgment, descriptions of human behavior, and lack of historical relativism.

All that does not mean that Sobel's narrative is dull or colorless. It is through her well-written prose that the different characters in the story emerge with the impression from the reader that what you see is what you get. For example, Pickering comes across as a judicious and fair individual who respected women and provided them with the opportunities they deserved. That does not mean that he did not carry with him some of the flaws of his times. For example, he paid women less than he paid their male counterparts.

That is evidenced by some of the documents Sobel unearthed. In a journal kept by Williamina Fleming, one can read "He [Pickering] seems to think that no work is too much or too hard for me, no matter what the responsibility or how long the hours. But let me raise the question of salary and I am immediately told that I receive an excellent salary as women's salaries stand . . . Does he ever think that I have a home to keep and a family to take care of as well as the men? But I suppose a woman has no claim to such comforts. And this is considered an enlightened age!" Just to put things into context, Pickering was paying her \$1,500 a year while the male assistants were being paid a thousand dollars more.

Yet, Pickering was fully committed to the advancement of women in science. For example, the first PhDs in astronomy at Harvard went to women under Pickering's mentorship.

Thanks to Fleming and other women astronomers such as Annie Jump Cannon, Henrietta Swan Leavitt, Antonia Maury, and Cecilia Payne, hundreds of thousand of stars were detected, classified, and cataloged. Thanks for their tedious work, later astronomers such as Edwin Hubble were able to accurately measure for the first time the size of the universe.

It is interesting that this book comes on the heels of another story of women mathematicians—this time African-American—who were crucial as NASA employees who calculated orbital trajectories from the time of its creation to the Apollo 11 mission. The book *Hidden Figures*, by Margot Lee Shetterly, was made into a Hollywood movie in 2016. Like their Harvard peers, the story of these women had been neglected but that is no longer the case.

Sobel's book is excellent at providing good historical background and scientific explanations that anyone can understand while being entertaining. It is divided into three parts and fifteen chapters. In addition to 32 plates, the book includes sections for sources, a historical chronology of the Harvard Observatory, glossary, biographical blurbs of Harvard astronomers, assistants, and associates, remarks, bibliography and index.

*The Glass Universe* (a title that makes a reference to the fact that the photographic plates at that time were made of glass although one cannot avoid thinking of the glass ceiling as a metaphor) is a worthwhile read for being informative, well written, and pleasurable.