

## The Glass Universe:

### *How the Ladies of the Harvard Observatory Took the Measure of the Stars*

by Dava Sobel

New York, Penguin Books, 2017 332 pages \$30.00 (hardcover)

Reviewed by David Chuss

*Department of Physics, Villanova University*

In her prior works, *Longitude and Galileo's Daughter*, Dava Sobel has established a narrative style in which she skillfully weaves tales of major scientific breakthroughs with the human stories and the historical context in which they occurred. This is especially true for her latest work, *The Glass Universe*, in which she details the stunning contributions of women to the development of modern astronomy.

In *The Glass Universe*, Sobel chronicles the storied Harvard Observatory from its early days in the late nineteenth century under the directorship of Edward Pickering. During this period, photography was starting to play a central role in astronomy, enabling a precise and permanent record of the heavens to be captured for the first time. This, along with the advent of stellar spectroscopy, a technique for measuring the distribution of colors present in starlight, revolutionized astronomy into its modern incarnation as a multi-tooled science capable of probing beyond the phenomenology of the heavens to a more comprehensive physical understanding.

The title of the book refers to the approximately 500,000 glass plates that contain the photographs and spectra of the sky observed by the telescopes of the Harvard Observatory from 1885 to 1992. These plates, still in use today, provide a symbol for the historical advancement of astrophysics over this century. From the perspective of the Harvard Observatory, Sobel elucidates the development of the modern field of astronomy from a cultural standpoint. The creation of modern institutions that are central to the field, such as the American Astronomical Society and *The Astrophysical Journal*, are woven into the narrative,

connecting these events and people to the modern astronomical community. The role of the Harvard Observatory as a leader in the global astronomical community is also explored, as it evolved into its current incarnation, the Harvard-Smithsonian Center for Astrophysics.

The glass plates double as a metaphor for the central theme of the book, which is the struggle of the women of Harvard Observatory to be afforded the opportunity to contribute to this revolution to which they eventually would become an essential part. The narrative begins with Anna Palmer Draper, widow of astronomer Dr. Henry Draper, funding Pickering's efforts in memory of her late husband. Key to this effort were a group of women that were hired by Pickering as "computers" to analyze the early plates and to perform the tedious measurements and calculations necessary to extract quantitative information from these observations. As time progressed, many of these women, through perseverance, intellectual creativity, and passion, made revolutionary contributions to astronomy and earned the respect of their male counterparts.

Sobel's book provides important context for the scientific theories and methods taught in our classrooms and utilized in our laboratories. To appreciate the current state of astronomical knowledge, it is essential to understand this human struggle through which it was obtained. Without Henrietta Leavitt's discovery of the period-luminosity law for Cepheid variable stars, Edwin Hubble could not have utilized this cosmic ruler to determine that our universe is expanding. Likewise, Annie Jump Canon's system of

classification of stars by their spectra provided a key tool that is still utilized by modern astronomers. The revolutionary understanding of the dynamics of stars, brought about by Cecilia Payne-Gaposchkin's clever insights, connected contemporary concepts in physics with observations of stellar spectra for the first time. These contributions serve as foundations of modern astrophysics.

*The Glass Universe* serves as an essential and fitting tribute to these undeservedly lesser-known pioneers of astronomy. Sobel's book provides a key part of a wider contemporary effort to right this oversight by providing the long overdue recognition that these great astronomers deserve. Perhaps when future generations of astronomers learn their craft, the names Cannon, Leavitt, and Payne-Gaposchkin will be introduced as equals to those of Russell, Hubble, and Eddington.