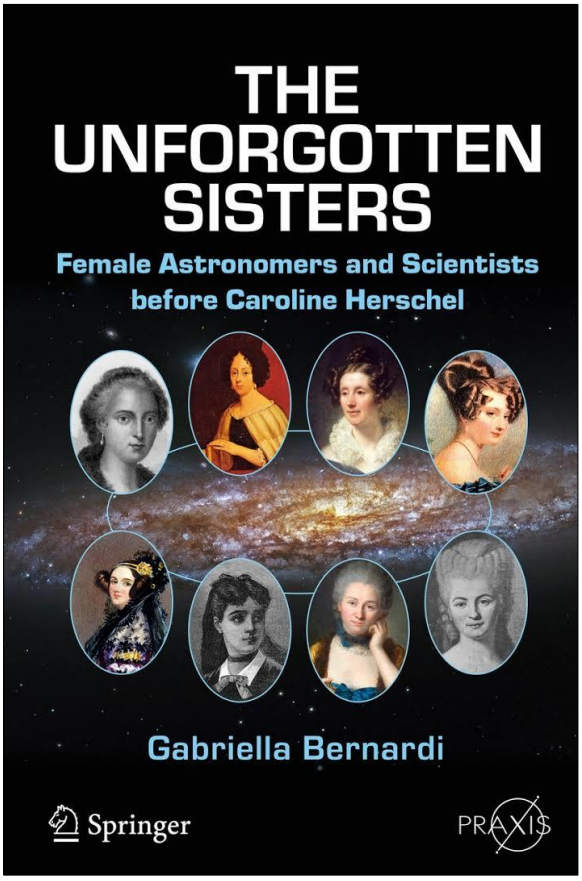
BOOK REVIEWS

***The Unforgotten Sisters: Female Astronomers and Scientists before Caroline Herschel*, by Gabriella Bernadi. (Springer International Publishing, 2016). Pp. 179. ISBN 978-3-319-26127-0 (eBook), ISBN 978-3-319-26125-6 (softcover), 155 × 234 mm, € 83.**

The Unforgotten Sisters traces the history of women engaged in mathematics and science, especially astronomy, from the twenty-third century BC to the nineteenth century AD. Gabriella Bernardi has degrees in physics and popular science and is a freelance journalist who specializes in astronomy. She does a masterful job in this book describing the hurdles women have historically faced as they pursued their interests in areas that were, for the most part, reserved for men. Numerous illustrations bring to life the women and the instruments they utilized in their work.



Although *The Unforgotten Sisters* contains actual letters of correspondence, the title Bernardi chose for this book comes from a fictional letter by Caroline Herschel that is written in poetic form by Siv Cedering. In it she describes some of her observations, calculations, and her work on the lenses and mirrors of the telescope that she and her brother, William Herschel, use to sweep the heavens. She then notes that:

> Sometimes when I am alone in the dark, and the universe reveals yet another secret, I say the names of my long lost sisters, forgotten in the books that record our science.

The book is divided into five major parts with a chapter devoted to each of the twenty-five women in chronological order. Timelines are given for each of the major parts, alerting the reader to well-known historical events and scientific discoveries that occurred during the same time period. Though not a distinctive topic, Bernardi discusses in unusual detail the historical context in which each of these women worked, their main area of expertise and any papers published, as well as records and citations of their observations and calculations. She livens up what could have become a dry presentation of historical facts with curious facts about these women, their families, and their individual circumstances.

Bernardi offers clear-cut examples of women in astronomy whose work has been unrecognized or almost forgotten over time. For instance, Maddalena and Teresa Manfredi, with the possible collaboration of another sister, Agnese, aided their brother Eustachio in the astronomical observations and mathematical calculations required for the 1715 publication of the *Ephemerides of Celestial Motion*. However, they never signed or took credit for any of their work. It is only in the preserved original manuscript—not the printed edition—that their brother states this work, including the required calculations, was completed with the help of his sisters.

Most of the women Bernardi includes in her book came from privileged backgrounds, with access to an education in science and mathematics historically denied to women. One such example, Sonduk, the first female monarch of Korea (from AD 634–637), developed a strong interest in astronomy at a young age. After she succeeded her father, her continued interest and means led to the construction of the oldest surviving astronomical Observatory in the Far East.

Quite a few of these early female astronomers studied privately with their fathers, brothers or husbands. However, if they went on to work 'professionally' with these men, their research was often incorporated with and credited to their male mentors. For instance, Maria Margarethe Winkelmann-Kirch was the first woman to officially discover a comet. As was the custom of the time, though, all her independently made discoveries were incorporated under the authorship of her husband, so her discovery of a comet in 1702 originally was credited to him.

Disappointingly, the early chapters of this book provide few specific details such as those

given above. However, this is not due to a lack of effort on the author's part, it is simply due to the fact that many of the ancient Babylonian, Egyptian and Greek manuscripts were destroyed or lost over time. Bernardi fills in, though, with interesting historical notes regarding ancient customs and astronomical knowledge. This book would be useful as a reference, but is confusing in places due to an incorrect usage of personal pronouns. A more careful edit would have made it easier to read.

The Unforgotten Sisters will be appreciated by anyone interested in the history of astronomy or women in science and mathematics. It will be of particular benefit to girls wishing to pursue a degree or career in astronomy as it highlights achievements made by women through sheer determination. All readers will come away with a high regard and an appreciation for each of these women and the individual challenges they faced while pursuing a greater understanding of all things astronomical.

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***The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars*, by Dava Sobel. (New York, Viking, 2016). Pp. xii + 324. ISBN 978067001952 (hardback), 160 × 235 mm, US$30.**

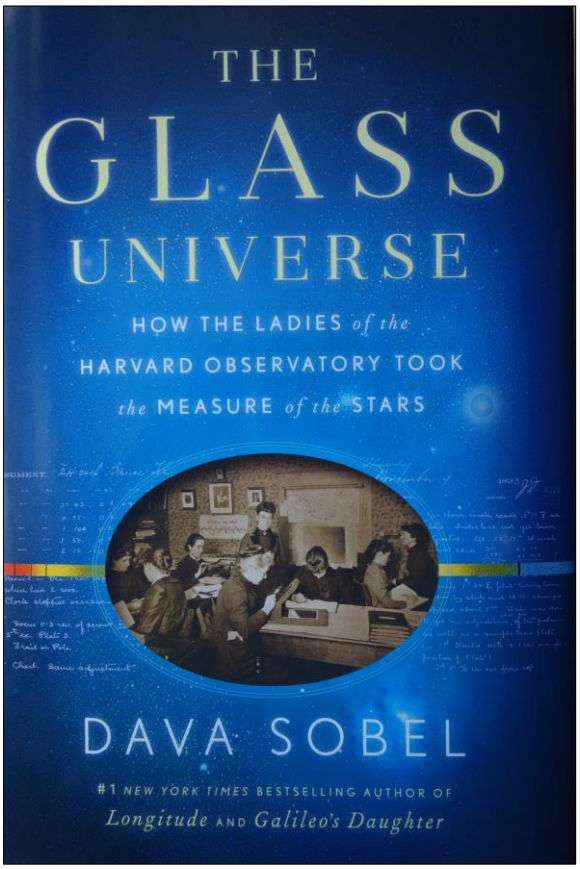
The popular science author Dava Sobel has produced some excellent books, and one that is questionable. My favourite one is *Letters to Father* from 2001, consisting of letters written to Galileo by his daughter. Her 1995 book *Longitude* unfairly maligned Great Britain's Astronomer Royal, Nevil Maskelyne, as a villainous character. She is back on solid ground with this book about the women who by virtue of their intelligence, dedication and largesse played a pivotal role in the development of astronomy at Harvard Observatory in the late nineteenth and early twentieth centuries.

Elements of the book were especially interesting to me as I knew several of the people Sobel writes about. These include Bart Bok, and Helen Sawyer Hogg, who officially opened my own observatory dedicated to asteroid photometry. The timeline at the conclusion of the book includes Dr Hogg's marriage in 1930 and her award of the Annie Jump Cannon Prize in 1950. However, the timeline is inconsistent as it notes the passing of some, but not all, women who feature in this book. Among these missing entries are Drs Hogg and Priscilla Fairfield, in 1993 and 1975 respectively. In 1921, Fairfield was one of the first women to receive a Ph.D. in astronomy. She began working at Harvard in 1923,

> … comparing the spectra and proper motions of giant and dwarf stars belonging to Draper class M, in order to more clearly define the line distinctions between them. (page 217).

Sobel tells us that Fairfield was able to pay her student assistants 30 cents an hour to help, thanks to a $500 grant from the National Academy of Sciences.

In 1928 Fairfield attended "… the largest and most global gathering of astronomers ever united." (page 223). This was in Leiden, where 243 delegates, including 14 from post-world war Germany, met to discuss all aspects of astronomy. Sobel informs us "The moment Miss Fairfield stepped off the train at the Leiden station, she attracted the attention …" of a certain Dutch astronomy student. Miss Fairfield



> … tried to fend off the amorous advances of her new suitor, who, at twenty-two, was a good ten years her junior. Bart Bok persisted, however, and at length overcame her misgivings. (page 224).

Miss Fairfield thus became Mrs Bok. This extract is given to show one of this book's great strengths—the interweaving of both professional and personal information, which provides texture to the great story Sobel offers us.

While she concentrates on the ladies of Harvard Observatory, Sobel necessarily must also delve into the careers of the men who ultimately ran the place. Among these is Harlow Shapley,