

Book Review

by Nalayini Davies, 2 January 2017

The Glass Universe – The Hidden History of the Women Who Took the Measure of the Stars

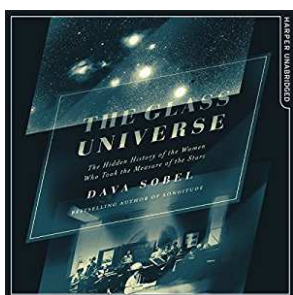
Dava Sobel

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Fourth Estate, Harper Collins Publishers, London, United Kingdom

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This is another masterful science history book by Dava Sobel of *Longitude* fame. It spans a period starting 15 November 1882 when Edward Pickering joined the dinner party of Dr and Mrs Henry Draper up to the middle of the 20th century. The book's strength lies in Sobel's use of first hand sources – letters, personal correspondence, work and personal journals, articles, science papers and a variety of publications and memoirs. It transports us to the late 19th century through to the mid 20th century and brings to life this remarkable period in astronomic

history, allowing the readers to get the sense of participating in the experience as events unfold. This was a period in which astronomy advanced by leaps and bounds, and included the development of the photographic observation techniques of spectroscopy and photometry, numerous fundamental advances in scientific knowledge, the emergence of astrophysics as a discipline and the establishment of fundamental astronomic/educational institutions (e.g. AAVSO, IAU, NSF UNESCO).

Figure 1: An illustration of Harvard's "computers" at work (Credit: Daniel Pudles)



All of this was achieved because of the foundation work completed by a group of skillful women engaged to realise Edward Pickering's vision. This was to continue the budding work of Henry Draper (following his untimely death) which aimed to discover the chemical composition of stars through stellar photography and spectroscopy. The women were referred to as "computers" and they

took the observations made by their male colleagues and plotted the brightness and position of the stars then analysed the data to establish spectral types by applying mathematical formulae. Over time, their work expanded to taking observations, publishing papers and even taking on leadership roles. The work was mostly funded by two major benefactresses, Anna Palmer Draper (widow of Henry Draper) and Catherine Wolfe Bruce. *The Glass Universe* is a homage to this extraordinary group of women – the astronomers who worked with 8 x 10" glass plates and continued to challenge the glass ceilings they encountered and the heiresses who funded their work to achieve Pickering's vision.

Sobel observes that observational work of data gathering and data analysis of celestial objects is not an exciting area of astronomy. She recalls the words of the acting Director of the Harvard Observatory, Arthur Searle: "*the work of an astronomer is as dull as that of a book-keeper, which it closely resembles. Even the results reached by astronomical work, although they relate to more dignified subjects than the ordinary affairs of trade, are far less interesting than the result of book keeping*". Sobel goes on to say: "*the work demanded both scrupulous attention to detail and a large capacity for tedium*", but what some of the more skillful members of this group achieved through their work was an exceptional and enduring scientific contribution to our understanding of the stars and, through that, the universe.

These female computers were allocated less challenging tasks and were paid substantially less than their male counterparts. Although this may have prevented them from reaching their full potential, it did not stop them from achieving great things. Williamina Fleming catalogued 10,000+ stars, developed a system to classify stars, discovered 50+ gaseous nebulae including the Horsehead nebula and over 300 variable stars and 10 novae. Henrietta Leavitt discovered the period-luminosity relationship in Cepheid variable stars (now referred to by the American Astronomical Society as Leavitt Law in her honour) which was the distance marker/"standard candle" tool for the discoveries by Edwin Hubble of the existence of galaxies outside of the Milky Way and the expansion of the universe. Annie Cannon classified over 350,000 stars, discovered over 300 variable stars, a spectroscopic binary and 5 novae, developed the well-known OBAFGKM Harvard classification scheme which was adopted as the stellar taxonomy by the IAU. Antonia Maury's system of stellar morphology helped Ejnar Hertzsprung in being able to distinguish different magnitudes and ages of stars as he developed his stellar evolution tool, the H-R diagram. Cecilia Payne, later to become the first woman Professor at Harvard, discovered the abundance of hydrogen in stars as part of her PhD thesis (which is considered to be the best ever by some). The far sightedness of the benefactresses was just as impressive. Their generous financial support was equivalent to small fortunes given the value of money at the time. Anna Draper supported the Harvard project for almost 30 years and contributed over \$250,000 and left a further \$150,000 in her will. Catherine Bruce's gifts to astronomy exceeded \$175,000 while the Bruce Medal she established still endures.

Although *The Glass Universe* emphasises the contributions of the women of that time, for me, Edward Pickering, with his vision and his enlightened attitude to women, shines through as the unintended hero of the book. He was a visionary who saw potential and merit regardless of gender and was able to entrust work to his colleagues and then trust their judgement, give credit without prejudice about their gender or lack of academic status and be willing to listen to the views of others. His ability to assemble the financial resources and an effective team of astronomers and then harness and focus their energies resulted in achievements that went far beyond what he or any of his team members could have achieved by themselves. This book provides an excellent, unintended case study on leadership and management, while the collective legacy of this team in observing, classifying and cataloguing over half a million stars, over many decades, is unrivalled.

Sobel's extensive research, attention to detail, ability to tell these remarkable stories in her own inimitable style, makes *The Glass Universe* an enjoyable read. This book could also provide a valuable perspective to variable star observers interested in the early history of their chosen field. Even though, like many in the astronomic community, I am already familiar with many of the stories covered by the author, I found this book both engaging and inspiring.

