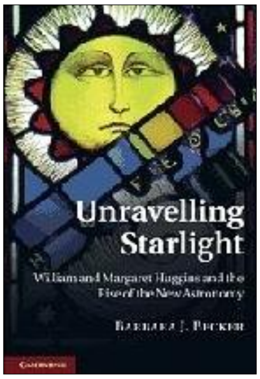
BOOK REVIEWS

Unravelling Starlight: William and Margaret Huggins and the Rise of the New Astronomy **by Barbara J. Becker (Cambridge, Cambridge University Press, 2011). Pp. xix + 380, ISBN 978-1-107-00229-6 (hardback), US$172.00.**



The rise of astrophysics has been the subject of considerable scholarship, ranging from the writings of David DeVorkin, Jack Meadows and others exemplified in the *General History of Astronomy*, to John Hearnshaw's detailed *Analysis of Starlight* (1986) and the special issue of this journal covering the first century of astronomical spectroscopy (Volume 13, July, 2012). Once considered an oddity among classical positional astronomers, in the twentieth century astrophysics came to dominate the field, revealing the nature of astronomical objects that the philosopher Auguste Comte famously declared would forever remain hidden to the human mind.

In the volume under review, Barbara Becker focuses on William Huggins, the man widely hailed as the founder of astronomical spectroscopy. It is a striking fact of history that Huggins (1824–1910) had no formal university education, and yet leapfrogged the professional astronomers of his time in expanding the theory and practice of astronomy to the new realm we now know as astrophysics. Becker examines how this happened in great detail, in the process providing a signal contribution to the history of astronomy.

Huggins could easily have remained in his father's business as a silk mercer and linen draper, never entering the field of astronomy. But instead, to the everlasting benefit of astronomy, he sold the business and pushed forward with his personal interests. Despite his lack of formal training, in 1856 Huggins built a rudimentary observatory in Tulse Hill, a suburb south of the Thames in London. He erected a new observatory at the end of 1862, which included an 8-inch Alvan Clark refractor he had acquired four years earlier. He began reporting startling results in 1864. What allowed him to obtain these novel results was spectroscopy, for Huggins's new observatory was "… the only work space of its kind in the world …" (page 58), with all manner of chemicals and chemical apparatus, batteries, Bunsen burners, and vacuum tubes spread around. With the help of his friend and neighbor William A. Miller (a Chemistry Professor at Kings College, who was skilled in laboratory spectroscopy), Huggins was able to set up not only an observatory, but an astronomical laboratory. This was the beginning of what a recent volume (David Aubin et al., *The Heavens on Earth*, 2010) dubs the "… observatory sciences …," analogous to broader laboratory sciences that historians have analyzed. Huggins and Miller proved to be an ideal team to bring spectroscopy into astronomy; and one of the themes of Becker's book is the necessity of crossing boundaries in creating a new discipline.

Chapters 5 and 7 detail Huggins' most famous discoveries: the gaseous nature of some nebulae, and stellar radial velocities. It is notable that both discoveries were made in the 1860s (1864 and 1868 respectively), very early in Huggins' investigations. Arguably, never again in his long career did Huggins match the fundamental nature of these discoveries, supporting the view (important even today for science policy makers) that new technology tends to yield its most fundamental discoveries early on. Becker's nuanced view of the discovery of nebulae shows that it was not as clear-cut as Huggins himself portrayed it more than three decades later in his personal retrospective on "The New Astronomy" (1897), often cited as the definitive description of his discovery. Becker sees Huggins' article as "… an alluring trap …" for the historian, and she looks beyond his description to argue that the discovery was likely much more complicated than pointing and seeing.

Huggins' discovery of stellar motion in the line of sight, today known as radial velocities, was perhaps even more fundamental than his determination of the gaseous nature of some nebulae, leading to a broad research program. In Huggins' time, however, the project was "… fraught with overwhelming mensurational and interpretive difficulties …" (page 104), a fact we tend to forget today when radial velocities are mass-produced. Becker uses observational notebooks to show how Huggins overcame these challenges, and how he had to persuade astronomers his measurements were real. For the star Sirius, for example, Huggins measured a velocity of 24 to 43 miles per second (the value today is about 6 miles per second). Much larger radial velocities of *galaxies* later became essential, especially with V. M. Slipher's work in the early 20th century, eventually leading to evidence for the expanding Universe. Stellar radial velocities continue to be essential to astronomical research, and have now been refined to such an extent they are one of the essential methods for detecting planets beyond our Solar System, as variations of stellar radial velocity due to perturbing planets are measured down to the meter-per-second level.

Throughout his long career Huggins occasionally followed up on his path-breaking work on nebulae and radial velocities, but more often he turned to other objects, including the Sun, planets, comets and novae, preferring to open new lines of research. In this he was aided by the Royal Society, which in 1871 equipped his observatory with a 15-inch refractor and an 18-inch reflector, with spectroscopic attachments. Huggins' relation with the Royal Society is another important theme of the book, illustrating how an amateur astronomer could break into the circle of the professionals.

In addition to the considerable published record (the *Scientific Papers* were compiled by Huggins and his wife Margaret in 1909), Becker makes excellent use of archives around the world; indeed, it is the use of this unpublished material that makes her study so valuable. In particular, in addition to unpublished correspondence, the Hugginses' observatory notebooks covering the years 1856 to 1901, now located in the Wellesley College Special Collections in the USA, detail for the first time the important role of Margaret Huggins.

This points to another salutary feature of the book: it is important not only for the new historical details it reveals, but also for the broader themes it illuminates. True to her title, for example, in Chapters 10, 12 and 15 Becker demonstrates the essential role of Margaret Huggins as a working partner with her husband, a working relationship that seems even more substantial than Caroline Herschel's role with her brother William. Margaret was Huggins' junior by a quarter century; she was 27 and he was 51 when they married in 1875. Yet by all accounts it was a happy marriage, all the more because of Margaret's serious interest in astronomy. More than a partner, Becker argues that Margaret helped shape the research agenda of the Tulse Hill Observatory, in particular when it came to photographic spectra, since Margaret had photographic skills even before she met William Huggins. Together they pioneered the use of the dry-gelatin photographic plate as applied to spectroscopy.

Becker also draws attention to the largely-forgotten but recently-resurrected work of Ludwik Fleck on the changing boundaries of scientific disciplines, arguing that Huggins' work can best be seen in the context of his "thought collectives," circles of specialized and peripheral individuals that interact in complex ways. Huggins the outsider, she argues, gathered close associates, but in order to be successful also had to break into the larger collective of professional groups such as the Royal Society. She is attentive to social issues, including how an 'amateur' astronomer could make such fundamental discoveries and how he became accepted in the world of professional astronomy. While Becker does not characterize her book as a comprehensive definitive biography, it is something much more, a nuanced biography that illuminates broader themes in science. For this reason, it will be of interest not only to historians of astronomy and astrophysics, but also to historians and philosophers of science in general.

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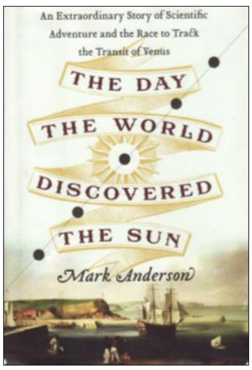
***The Day the World Discovered the Sun. An Extraordinary Story of Scientific Adventure and the Race to Track the Transit of Venus*, by Mark Anderson (Boston, Da Capo Press, 2012). Pp. [x] + 280, ISBN 978-0-82038-0 (hardback), US$26.00.**



The 2012 transit of Venus was the last chance for those of us alive at the time to see one of these rare astronomical events. While these transits now hold little scientific interest for most (but not all) professional astronomers, the eighteenth and nineteenth century transits played a crucial role in elucidating that fundamental yardstick of Solar System astronomy, the 'astronomical unit'. But the 1761, 1769, 1874 and 1882 transits were more than mere scientific endeavours, for attempts to observe them often involved international intrigue, tedious travel, debilitating diseases—even death—not to mention those cursed clouds at the very time of the transit.

That the historic transits of Venus were far more than just scientific events is brilliantly portrayed in Mark Anderson's new book, *The Day the World Discovered the Sun*, which deals only with the 1761 and 1769 transits. Since this book is primarily aimed at a scientifically-literate yet lay audience, it focuses on a small number of well-known characters: James Cook and Charles Green, Father Maximillian Hell and Joannes Sajnovics, Nevil Maskelyne and Robert Waddington, Charles Mason and Jeremiah Dixon, and one of my 'favourites', Jean-Baptiste Chappe d'Auteroche. Chapter by chapter, Anderson not only recounts the details of their respective transit expeditions, but also the associated background circumstances, and he does so in a charming and entertaining way, as evidenced, for example, by his account of the lead-up to Chappe's observation of the 1761 transit:

> By morning, however, the 4:30 sunrise had brought a dark veil. Clouds loitered. As the increasingly cloudy and sleepless night progressed, Chappe paced the observatory floor. His assistants, whom Chappe had woken earlier in the night, left their master alone—knowing they'd only be needed if clear skies returned …
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> Soon after dawn, Chappe heard a commotion outside. Tobolsk's governor, the local archibishop, and some nobles had assembled at the new observatory to take in the heavenly spectacle. The first light of day shone upon the French visitor whose anxiety grew with each troubled glance at the clouded-over sky …
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> As the dawn's blush gave way to early morning light, an easterly wind peeled back the top layers obscuring the sun. And with the increasing transparency, the mood both inside the observatory and in the nearby tent lightened. "The clouds began to exhibit a whitish colour, which grew brighter at every instant," Chappe wrote. "A pleasing satisfaction diffused itself through all my frame and inspired me with a new kind of life." (pages 46-47).

As the books nears its end, in Chapter 14 (titled 'Eclipse') Anderson briefly discusses the different values for the solar parallax that resulted from the various 1769 transit expeditions, before in his final chapter ('Epilogue') discussing other observations of the two eighteenth century transits and the resulting personal clashes as reputations were queried and egos bruised. He then ends by examining some of the consequences of these two transits and their associated astronomers, before discussing briefly the 2012 transit.

Between pages 231 and 240 is one of the most valuable features of this book, a 'Technical Appendix' where Anderson explains clearly and concisely the mathematics involved in converting contact observations of the 1769 transits into a value for the solar parallax and ultimately the astronomical unit.

Finally, Anderson provides 27 pages of notes and references, which readers will find very useful if they wish follow up on interesting areas of the book.

When I was asked to review this book, I thought "Not another book on historic transits of Venus." So you could say that I was less than enthusiastic! But Mark Anderson has produced a well-researched and beautifully-written book that was a pleasure to read.

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