Herschel's stellar work proved to be an important stepping stone, bridging the work of his father William before him and stellar spectroscopy afterwards. But stepping stones are often forgotten: even though John was one of the most famous scientist/astronomers of his age, there is yet no definitive biography of him. In the absence of such a work, this book by Stephen Case of Olivet Nazarene University will stand as the most thoroughly researched book about the astronomical endeavours John Herschel.

"Witnessing the Great Eruption sharpened Herschel's interest in variable stars," writes Case, referring to the outburst of Eta Carinae that he observed from the Cape of Good Hope in 1837. "Herschel provided an extended account of this stellar outburst in his *Cape Results*, …" writes Case, but that was a full decade after the event! (p. 101). This highlights the entirely different observing and reporting strategy he employed nearly two centuries ago compared with today. Upon his return to England from the Cape in 1838, Herschel sided with Wilhelm Olbers about the existence of cosmic clouds, invoking the movement of such obscuring clouds to account for the variability of stars such as Eta Carinae. John Herschel was an observer *par excellence*, but this did not extend to developing accurate theories to explain those observations, another key reason that his work has been neglected in the past 150 years.

Another example of this was the enormous effort he expended on nebulae, but

> His own theories regarding these objects remained uncertain, as no measurable change was ever linked to mathematical law or physical cause. (p. 166).

By disdaining spectroscopy, what Case characterises as "… the goal and also the great challenge …" of ascertaining real changes in nebulae ended in frustration. (p. 157).

Case rightly identifies Herschel's primary scientific legacy as his work "… to standardize observations of magnitude, organize these data, and render them useful for other observers." He created great catalogues of variable and double stars, and nebulae. He thus "… set the ground-work for the astrophysics of the final quarter of the century." (p. 122).

For all his scientific work, the legacy of John Herschel resides as the greatest populariser of astronomy of the early nineteenth century. Case concludes the book by briefly looking at how this influenced nine other popularises of the subject in that century, including Agnes Clerke, Thomas Webb and William Whewell.

As an example of the florid Victorian prose that has long ago gone out of fashion, but which made him so admired to the public as their window on the Universe, here he is describing double stars with what Case characterises as 'rhetorical grandeur':

> We must admit that double stars must be accomplishing ends in creation which will remain forever unknown to man; and that we have here attained a point in science where the human intellect is compelled to acknowledge its weakness, and to feel that no conception the wildest imagination can form will bear the least comparison with the intrinsic greatness of the subject. (p. 203).

Case gives us a tremendous insight into a life of supreme dedication to astronomy in all its forms. With 67 pages of notes and bibliography, his meticulous attention to detail has produced the most valuable book ever published on Sir John Herschel.

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Kew Observatory & The Evolution of Victorian Science 1840-1910, by Lee T. Macdonald. (Pittsburgh, University of Pittsburgh Press, 2018). Pp. xii + 308. ISBN 978-0-8229-4526-0 (hardcover), 155 × 220 mm, US $45.00.

This institutional history of Kew Observatory by Dr Lee T. Macdonald (Research Facilitator at the University of Oxford's Museum of the History of Science) celebrates the development of British science before World War I.

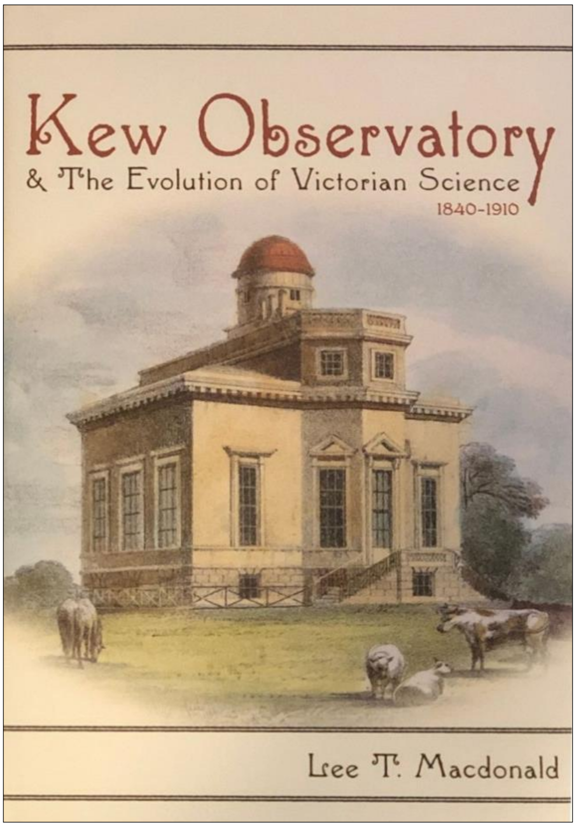
Kew Observatory was built as a private astronomical observatory for King George III so that he could observe the transit of Venus in 1769, but the author dispenses with the pre-1840 era in a few paragraphs.

Like two other books reviewed in this issue of the *JAHH*, this one has much to say about the role of Sir John Herschel in British science. Macdonald identifies Herschel's approach to research as one in which "… data should be gathered for the purpose of putting theory to the test." (p. 55). He tells us that

> … between 1839 and 1843 Herschel supervised William Birt in a project ... to reduce meteorological observations with a view of verifying the existence …

of atmospheric waves (ibid.). In 1842 Birt "… sought a testimonial from Herschel in support of his application for the 'curatorship' of Kew Observatory." (ibid.). Herschel agreed and, concerned that the observatory would be closed by the British Association for the Advancement of Science (BAAS), he wrote to the geophysicist Edward Sabine that "… the Association ought not, except on *very* urgent grounds, throw up the observatory." Macdonald notes dryly that a "… sign of the authority that Herschel commanded …" in this letter "… reads almost like a military order." (p. 56).

It was just one of many instances where the authority of Herschel was sought by various people over three decades to shape the nature of the research at Kew Observatory. By 1871 "Herschel had been the one dissenting voice against the Royal Society taking over its management …" (p. 132), but when he died that same year Kew quickly passed from the control of the BAAS to the Society. Perhaps Herschel would ultimately have been pleased, however, because Kew spent its last active years (1912 to 1980) as a meteorological observatory. Sadly for historians of science, it is now just a private dwelling.



Herschel maintained to the end that government funds for science must be used to assist "Private individual experimental research …" and secondarily data reduction (p. 66). This reflects the Victorian view of science that modern science has entirely rejected. One of the most important contributions of this book is to show at the granular level how that transition occurred in a very specific research environment.

Macdonald lovingly examines each decade up to 1910 with meticulous care, delighting in the on-going struggle for control of Kew between rivals Sabine and the Astronomer Royal George Airy. The author delineates every relevant meeting, personnel change, and behind-the-scenes machination that transformed Kew into the premier site in Great Britain for calibrating and certifying scientific instruments. These included telescopes, which technicians at Kew first began to test and verify in 1889. This started with just 99 telescopes, but by 1900 some 1,345 of them were tested, rising to 4,288 in 1912. Most were used by the British Army and the Admiralty.

Kew is best known in an astronomical context for the solar photography it helped pioneer, and "Secondary sources suggest that Herschel was the central driving force in initiating the Kew sunspot photography program." (p. 90). He was the first, in 1839, to "… advocate photography as a means of recording sunspots." (p. 91). It has been widely believed that an 1854 letter he published in the BAAS *Annual Report* was key in getting such a program started at Kew, but Macdonald digs deeper and suggests that Sabine may have been "… informally lobbying Herschel for his support …" before that. Macdonald identifies the original initiative as originating in 1852 from Sabine and John Welsh, the superintendent at Kew. The author found a letter from Welsh to Sabine written in April 1852 that "… is the first recorded suggestion that photography be used as the main method in a regular ... patrol of solar activity." (p. 91). Macdonald identifies the Kew photoheliograph as having "… a great influence on solar astronomy throughout the rest of the nineteenth century." (p. 99).

I would like to have seen a more thorough explanation of the purpose of certain scientific data collected at Kew. In the 1840s, for example, we are told observations of atmospheric electricity were made at Kew, but their purpose is not clear. Kew was also a "… magnetic observatory that could rival Greenwich …" (p. 77), but the meat of the physics is missing. This book is obviously not the place for technicalities, but a little more detail about the data and how they was used would have been welcome.

Macdonald has used archival material never before studied to write an important book on British science. He rightly calls for more book-length histories of scientific institutions for the purpose of challenging "… existing assumptions about these institutions and about the history of science." (p. 248). The book concludes with 55 pages of notes and a bibliography.

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