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Book review: *Kew Observatory and the Evolution of Victorian Science 1840–1910*

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Macdonald, L. T.: Kew Observatory and The Evolution of Victorian Science 1840–1910, University of Pittsburgh Press, USA, 336 pp., ISBN: 9780822945260, USD 45.00, 2018.

The distinctive building that was Kew Observatory in Old Deer Park in west London, still barely changed from the painting on this book's cover, is perhaps most easily observed by those with a window seat when coming in to land at Heathrow from the east. Its scientific legacy continues to shine, as, even though it is now a privately owned residential building, it has reverted to its original name of the King's Observatory, conferred when it was established for King George III to observe the transit of Venus in 1769.

Lee Macdonald's new book does more than simply trace part of the history of this magnificent building and the work that went on there. Like all good scientific stories, that of the observatory is carefully placed in the context of the time, during which science was being both professionalised and nationalised. At the start of the period covered, the term "scientist" was not in common use, and those working in science were mainly former military men or gentlemen with private incomes or undemanding day jobs. Scientific education beyond the notorious Cambridge University mathematics course was in its infancy and there were only a few jobs for professional scientists. By the early twentieth century, an expanded higher education system was turning out hundreds of trained physicists and engineers to service technology such as the telegraph, and, later, the telephone and electricity networks. The changes that took place at Kew, its management and function, reflected these rapid societal developments, and are all discussed in this book, which provides the first attempt to understand its evolution as a whole. Other histories of Kew all discuss scientific progress through a discipline-specific prism – whether meteorological (Whipple, 1937), astronomical (Hutchins, 2008) or geophysical (Cliver, 2006), so this book gives a much more well-rounded picture.

Kew was a major player in the Victorian science world, with the other national science facilities such as Greenwich Observatory and, at the beginning of the twentieth century, the National Physical Laboratory (NPL). Interleaved with the rise and fall of these various institutions are the strong individuals running them, and their attempts to exert influence through the scientific management and funding structures of the time. The principal rivalry portrayed, and dominant in the first half of the time period covered by the book, was that between Edward Sabine, the former army officer who had gained scientific experience on magnetic surveying voyages, and who then led the "Magnetic Crusade" of which re-inventing Kew as a geomagnetic observatory formed a small part (Cawood, 1979), and George Biddell Airy. These two men came from diametrically opposed backgrounds, Sabine's that of a wealthy family and a long military career, whilst Airy rose from humble origins to become a leading professor at Cambridge and, subsequently, Astronomer Royal. Airy was director of the rival Greenwich Observatory and did not see why a new geomagnetic observatory was needed when he already ran a perfectly good one; he also had little time for meteorology due to its lack of foundation in theory. Macdonald documents the manoeuvring by these and other characters with unprecedented insight and detail, based on little-studied primary sources such as unpublished minutes of meetings.

Kew became recognised for its meteorological and magnetic observations, bringing innovations such as self-recording instruments using the new technology of photography, very soon after its invention, by its first Superintendent, Francis Ronalds (Ronalds, 2016). The magnetic traces from the huge solar storm recorded by Richard Carrington in 1859 survive to this day, allowing contemporary scientists to use it as an extreme example of future space weather events (e.g. Cliver, 2006). The atmospheric electricity record is the longest such time series in the world (Harrison, 2003), and its data now find utility in reconstructing air pollution before systematic measurements were made (Harrison and Aplin, 2002). Kew was also important in the development of solar physics and astrophysics. Though sunspots had been known since at least Galileo's time, the early nineteenth century provided much new research, such as identification of the 11-year solar cycle and the first measurements of the solar flux. The links between the Sun and the Earth, such as the remarkable correlation between the solar cycle and magnetic disturbances, were being identified by senior UK scientists, including Sabine, in the 1850s. This led to the invention of a new instrument under contract to the British Association for the Advancement of Science, the photoheliograph, for photographing sunspots, which also famously photographed the 1860 Spanish solar eclipse. Elizabeth Beckley, possibly only the second woman employed in science in the UK (after Caroline Herschel; Hoskin, 2002), was taken on as a "qualified assistant" to help with the photography. (A "Miss Clements" was also hired later to help with thermometer standardisation.)

As Kew's reputation developed during the 1850s it began to attract commercial work in standardising and calibrating scientific instruments, first for meteorological observations, and then diversifying to include navigational aids such as sextants and chronometers, and clinical instruments. This became a valuable addition to the observatory's precarious central funding and eventually a major part of its work. By 1885, income from standardisation almost doubled the grant received from the Gassiot Trust of the Royal Society, then the observatory's principal source of funding, with over 3000 clinical thermometers tested for the medical profession, for example. By this time, there were 14 full-time staff at Kew, 4 of whom worked full time on standardisation, and others part time. Macdonald argues that Kew acted as an exemplar in late nineteenth-century arguments for what a modern national laboratory should be, so much so that when the NPL was established in 1900, Kew was already doing much of its work, and was essentially renamed to become the NPL, with no initial change in site or staff. The NPL only moved to its current site in Teddington because of local objections to expanding Kew's site at Old Deer Park. Macdonald presents strong evidence for this continuity of vision, despite it being contrary to some histories, which argue that there was a change in attitude towards more government support for science in the twentieth century compared to the "laissez faire" Victorian approach. Though the standardisation work moved to the new NPL in 1901, Kew remained a centre for magnetic and meteorological observations until it was closed in 1980.

As well as providing a detailed picture of the evolution of science and its community throughout the nineteenth century, the book serves to highlight the surprising similarities between Victorian and contemporary approaches, in the "impact" Kew had through commercial work and the political wrangling between individuals, from the chairs of powerful national-level committees to the arguments made by the observatory's staff to improve their pay. Through Lee Macdonald's impressively thorough research, his book clearly presents the broadest and most detailed history of Kew Observatory to date, appropriately reflecting Kew's significance in the subsequent development of the UK's scientific landscape.

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