

vides his assessment of Harrison's methodology and the essentials of his Clock B (including the materials, pendulum, suspension unit, grasshopper escapement, and remontoire).

Written on behalf of the team at Charles Frodsham & Co., the subsequent contribution is highly technical, certainly requiring prior knowledge, and explains the work undertaken by the team to finish Clock B between 2009 and 2012. After which point it was collected by Burgess and taken to Royal Museums Greenwich for testing – this lovely detail maintained a sense of reader involvement in the journey.

Betts then describes the testing of Clock B at Greenwich between 2012 and 2015. His introduction to this essay let the reader know what to expect and contextualized Betts' contribution within the rest of the book (page 81). I appreciated the admission by Betts of initial doubts concerning Harrison's statements, which maintained a sense of tension in the narrative. The information about what was involved in the testing was intriguing and the graphs were fascinating, but the publisher should have made them larger. The essay concludes by dismissing the suggestion that Harrison's design was too costly and time-consuming to be viable as a commercial product, as testing showed this was not the case.

Van Baak provides an explanation of the analysis undertaken on the clock's performance. I appreciated having access to the testing results, but they do assume technical knowledge. The introduction also helps to convey the relevance to the larger argument – that Harrison's claim that such a clock could keep time to 1 second in 100 days was accurate. Van Baak's statement of impartiality was noticeable and welcome – his role was to process data and he was not involved with the clock. It was insightful to read of the identification of eight ways in which Harrison's claim could be tested (page 103) and the confirmation of the decision to pursue option two. However, more of a conclusion would have made the entry stronger. What is termed the Conclusion is in effect a reference to the GPS cross-referencing and an acknowledgement of thanks.

The next two essays, by Hobden and Harrison respectively, are both highly technical, requiring a large amount of prior knowledge, and I would have appreciated a conclusion for each referring back to the relevance of the findings to the main argument. Hobden considers the mechanical theory and Harrison shares an analysis of the compensation mechanism in Clock B.

The last contribution, by McEvoy, provides an update on Clock B as an appendix. It was useful to know what happened next, but this would have been better as an epilogue. There was no overall conclusion to the book, which was a shame, given the quality of the introduction and the strength of the scene-setting. This is a great book, but I feel it could have packed an even stronger punch with a really tight conclusion bringing everything together.

I would recommend this book, but I feel that as a Royal Observatory Greenwich publication it should come with the caveat that it requires some prior knowledge to get the most out of it. That said, I like that one book concentrates on one clock and the historical horological problem, and that it does so by bringing multiple perspectives together in one place.

Dr Jane Desborough
Curator of Scientific Instruments
Science Museum, Exhibition Road,
London SW7 2DD, UK.

E-mail:

Jane.Desborough@sciencemuseum.ac.uk

***Orreries, Clocks and London Society*, by Tony Buick. (Springer, Cham, 2020). Pp. xxvii + 348. ISBN 978-3-030-61776-9 (paperback), 155 × 235 mm, GBP24.99.**

Written by Tony Buick, a chemist by profession with a keen interest in astronomy, this book provides an introduction to the history of orreries. Suited to a popular rather than a purely academic audience, the volume is intended to be a follow-up to his earlier publication *Orrery: A Story of Mechanical Solar Systems, Clocks, and English Nobility* (Buick, 2013).

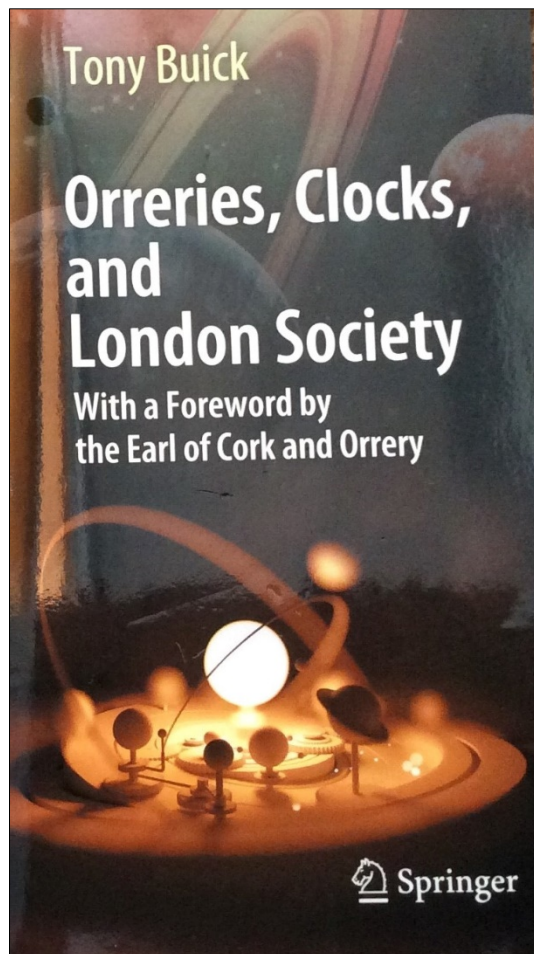
Requiring no prior knowledge, the present volume introduces the reader to the historical development of the orrery with some wider contextual information to ground the narrative. Its tone and language are appropriate for an educated reader, while still being accessible to non-specialists.

Rather than putting forward an argument as such, Buick presents a discursive journey from the astronomy of the ancients to present-day projection devices.

In terms of the overall structure, the narrative would benefit from a more explicit Introduction and Conclusion. The divisions of the chapters is fine, but they could perhaps be reordered and some of the content redistributed between them.

The opening chapter is intended to introduce the rest of the story by providing an overview of the prior history of the orrery. Buick poses the question as to what constitutes an

orrery, taking into account that the name 'orrery' was applied later than the first such models (page 1), which I felt was valuable, and then provides an overview of ancient interest in astronomy to suggest that prior history. Far too general to serve as an academic account of ancient astronomical thinking and practice, it is as to be expected from a popular book – itemising some familiar milestones and examples of technology such as the sundial, astrolabes, water clocks, the Antikythera Mechanism and so on. It ends with a section on the development of mechanical clocks from the Renaissance to the eighteenth century, which sets up the next chapter.



The next entry is dedicated to the renowned eighteenth-century clockmaker, George Graham. The biographical information, of which I personally felt there was slightly too much given that this is covered amply elsewhere in the secondary literature, is followed by reference to Graham's maker networks and connections such as Thomas Wright and John Rowley (page 56). This aspect is important because, as is well-documented elsewhere, even the top makers were reliant on the network in London and beyond for their successes and this must be acknowledged.

After a section on Graham's achievements, Buick considers the existence of 'proto-orreries' (page 77–78). I liked his contemplation of early mechanical astronomical models and felt this tied in nicely with his introductory consideration of what constitutes an orrery. This discussion is used as a way of introducing some of the candidates for inventor of the orrery (before such models were called orreries) such as Stukeley and Hale, but for Buick Graham is the key player. The chapter ends with a section on Rowley and his role as a supplier to the Earl of Orrery (whom the models were later named after) among others.

This leads the reader into the subject of the next chapter which considers the 4th Earl of Orrery himself and the astronomical model that bore his name. I would have expected more information about this, given that there was so much preceding it, but the chapter quickly turns to astronomical clocks and then homemade modern orreries (page 136).

The next chapter introduces the mathematics of gearing and a consideration of how much orreries can illustrate given their mechanical limitations. This is followed by a look at where readers might buy orreries and how they could even make their own (page 199). I would have liked to have seen this information incorporated into other relevant chapters as the modern aspects felt a little disjointed alongside the historic aspects here.

Buick then considers London as a 'clockmaker's city' in the eighteenth century and its make-up in terms of providing contextual background to the orrery story. I liked the references to Fleet Street and coffee houses (page 235–239), but would have liked to have seen this brought together in an earlier chapter (such as the one on George Graham and his networks).

The following chapter considers some of the environmental, political, intellectual and economic factors which influenced life in eighteenth-century London. While a huge subject that is not possible to cover in a single chapter, it was interesting to read Buick's thoughts on how these factors also influenced thinking in astronomy and therefore orrery design. I would have liked to have seen more focus on this later aspect with some detailed worked-through examples to see how these influences manifested themselves in designs.

The last chapter looks at modern planetaria, how they developed, and their roles in education. I appreciated how Buick brought the discussion up to the present day with his consideration of the study of gravitational waves and his questioning of how a planetarium might represent them.

The book ends with a postface, which contains Buick's final reflections.

Overall, this is a useful introduction to the development of the orrery and its historical context. It is intellectually accessible and does not require prior knowledge. However, it would benefit from a more explicit Introduction to outline what the reader can expect and a Conclusion to refer back to points made in the Introduction and draw the story together and to a close. I also think that some of the content could be condensed and redistributed to make the overall narrative stronger. Reference to other recent publications on London's instrument makers would not only help to situate this narrative within wider discussions, but would also help to tighten the content.

Reference

Buick, T., (2013). *Orrery: A Story of Mechanical Solar Systems, Clocks, and English Nobility*. New York, Springer.

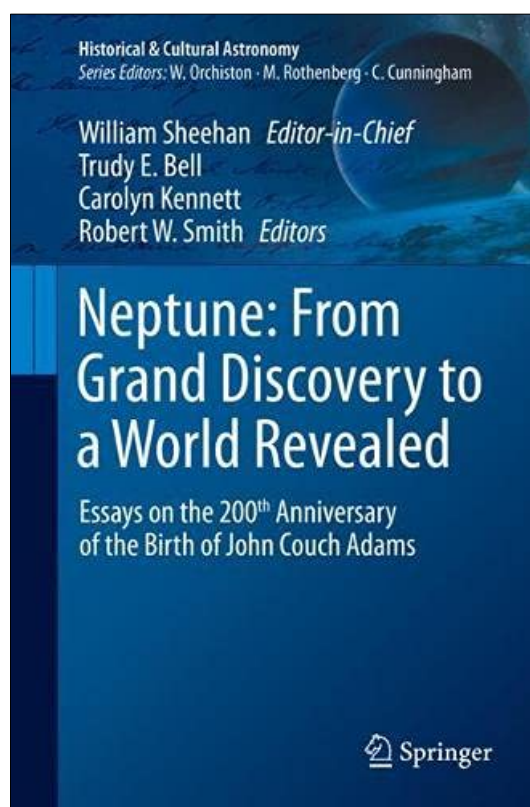
Dr Jane Desborough
Curator of Scientific Instruments, Science
Museum, Exhibition Road,
London SW7 2DD, UK.
E-mail:
Jane.Desborough@sciencemuseum.ac.uk

***Neptune: From Grand Discovery to a World Revealed. Essays on the 200th Anniversary of the Birth of John Couch Adams*, edited by William Sheehan, Trudy Bell, Carolyn Kennett and Robert W. Smith (Cham (Switzerland), Springer, 2021). Pp. xxxi + 403. ISBN 978-3-030-54217-7 (hardback), 160 × 240 mm, US\$139.99.**

This volume is a monument to collaborative scholarship on a topic of considerable importance that reaches well beyond its subject, the planet Neptune. Five of the ten chapters are authored or co-authored by the meticulous and indefatigable William Sheehan, two by historian Robert Smith, and the remaining three by Brian Sheen and Carolyn Kennett on John Couch Adams, James Lequeux on Le Verrier, and Davor Krajnović on the German side of the story. Additional contributions as co-authors come from Clifford Cunningham, Kenneth Young, and Richard Baum. Co-editors Trudy Bell and Carolyn Kennett have successfully ensured the volume coheres. All are experts on Neptune's history and have written on aspects of the subject in the past. On the occasion of Adams's 200th birthday in 2019, they now take a new look at Neptune's discovery using both primary records and new secondary research. The result is a triumph of Neptune studies, and in a broader sense a significant contribution to the history of celestial mechanics and to the study of personal,

cultural, and institutional roles in science.

The discovery of Neptune has long been one of the great sagas in the history of astronomy, replete with controversy encompassing theory and observation, discovery and credit, personality and social environment. The outlines of the story are well known. On 1 June and 31 August 1846 the Paris astronomer U.J.J. Le Verrier presented papers with his calculations for the elements of a new putative planet and predictions of where it should be found based on residuals in the orbit of Uranus. Not having access to a proper telescope at Paris Observatory, he wrote Johann Gottfried Galle, among others, and on 23 September Galle and his student



Heinrich d'Arrest found the planet within an hour using the 9.6-inch (24-cm) Fraunhofer refractor at Berlin Observatory, pictured on page 206.

That much is certain. But the plot quickly thickens as the British enter the scene: the young Cambridge mathematician John Couch Adams had made a series of unpublished predictions, notably in September and October 1845, almost a year before Le Verrier. The Director of the Cambridge University Observatory, Reverend James Challis, had at first failed to follow up on these predictions of his countryman. He only began to search for the planet beginning in July 1846, and spotted it with the 11.75-inch Northumberland Refractor on 4 and 12 August, but did not realize it was a planet and therefore made no ann-