

DAVID AUBIN, CHARLOTTE BIGG and H. OTTO SIBUM (eds.), *The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century Science and Culture*. Durham, NC and London: Duke University Press, 2010. Pp. xii + 384. ISBN 978-0-8223-4640-1. £16.99 (paperback). doi:10.1017/S000708741000141X

Although the title stresses observatories and astronomy, this book's contents roam far more widely. We are fixed neither to physical observatories nor to one discipline but take in the laboratory, the field and the theatre, and range from geodesy, cartography, meteorology, navigation, chemistry and physics to the popularization of science. These topics are linked by recurring themes, including the use of 'observatory techniques', the variety of spaces in which they have been undertaken or promoted and the cultural and political contexts in which they have been situated. Given the dominant rhetorical position of astronomy within science and the history of science, it seems surprising that this book is, as the editors say in their useful introduction, 'a first attempt at surveying the observatory's multiple roles in nineteenth-century scientific, economic, and cultural life' (p. 2). It provides an excellent starting point: as well as considering these sciences in their broadest contexts, this volume is impressive in presenting British, French, Italian, Russian, German, Swedish, colonial and American case studies.

Three chapters focus on individual observatories, making important points about their interaction with politics, patronage and nation-building. Simon Werrett considers Pulkovo Observatory under Tsar Nicholas I, arguing that it had two functions, both designed to convince the West of Russia's modernity. On the one hand it was, with limited success, an imperial observatory, aiding the management of vast territories. On the other it was, triumphantly, a showcase for the best equipment and techniques, although so dependent on Nicholas that it struggled to survive his death. Massimo Mazzotti focuses on the observatory of Collegio Romano, where Angelo Seechi's research programme in astrophysics and meteorology was a resource first within this Jesuit institution and subsequently for the new Italian nation. It aided control of the Pontifical States and the battle against atheism and materialism, but was later redefined as a distinctively Italian programme that helped consolidate the new nation.

Simon Schaffer's chapter on Paramatta Observatory asks, 'What techniques, exactly, made somewhere count as an observatory?' (p. 118). Thomas Brisbane's ambition was to develop meridian astronomy in Australia, producing reliable and precise knowledge that was accessible to astronomers all over the world, but Schaffer demonstrates the impossibility of doing this to the satisfaction of the London-based scientific community. Once there were grounds to doubt the integrity of any aspect of its creation or distribution, the whole enterprise collapsed. Also considering the differences created by local contexts, but with respect to an astronomical expedition, David Aubin introduces the case of the 1868 solar eclipse. Visible from Thailand, this event was of importance to both French science and Thai national identity in 'claiming symbolic capital' (p. 92) with regard to modern science and legitimate power. King Mongkut successfully demonstrated the worth of Western science to his subjects without rejecting traditional knowledge. The French astronomers gained state funding by presenting their work as a 'scientific struggle' (p. 108) with other European nations.

The 'observatory sciences' formed an essential part of military and naval enterprises, as three further chapters reveal. Guy Boistel outlines French methods and training in navigational astronomy, Sven Widmalm looks at science in the Swedish military and Martina Schiavon discusses geodesy in France and Algeria. Each demonstrates the wide reach of observatory techniques, their importance in rhetoric and as inspiration for other practices, the significance of military interests and values in their support, and their intrinsic importance to national and imperial projects. It is instructive to compare these different national contexts and the diverse, though overlapping, aims of men of science, governments and the military.

Moving to a very different space, Richard Staley considers the links between observatories and physical laboratories. The institutional success of astronomy made it an attractive model and the opportunities presented through astrophysics to share techniques, spaces and even cultural associations were grasped by two American experimental physicists, Henry Rowland and Albert Michelson. Staley's fairly technical discussion of Michelson's experiments contrasts with the approach of John Tresch, whose chapter considers Alexander von Humboldt's interpretation of the aesthetic and moral philosophy of Kant and Schiller. Tresch argues that for Humboldt objectivity in science was realized through communal activity and exchange, allowed through the medium of shared techniques and instrumentation.

Humboldt's inclusivity points the way to the three slightly shorter essays that conclude the book, each of which tackles aspects of the interaction between astronomers, observatories and the public sphere. Theresa Levitt focuses on François Arago, director of the Paris Observatory, and suggests that his attempts at popularization were fundamental to his republicanism. Charlotte Bigg considers the overlaps between popular astronomy and the new field of astrophysics. Finally, Ole Molvig analyses the foundation of the popular Berlin Urania in the context of its Humboldtian origins and the immediate politico-scientific context. These chapters highlight the fact that popularization was often an attempt to counteract specialization and professionalization but often, in fact, helped to create an ever sharper divide between scientific elites and their audiences. There is, however, too little attention paid to the changing and diverse nature of those audiences.

There are some interesting confluences between these and earlier chapters. For example, Tresch and Levitt see a significant change in science and its presentation to the public after 1848. For the former, this relates to a new rhetoric of mechanical objectivity, which links to professionalization and the exclusion of less elite contributors to, and audiences for, science. For Levitt, 1848 marks an end to attempts to create a broad and educated public that was fully incorporated into the state. Likewise, Staley and Bigg both tackle views of the new astronomy. As the former writes, many saw astrophysics as 'largely speculative and faddish' (p. 245) but, for the pioneers and, as Bigg shows, for many popularizers and audiences, it was exciting, inspiring and, ultimately, more profound. Bigg demonstrates that individuals like J. Norman Lockyer utilized this enthusiasm in building their field and their careers.

The contributors to this book are to be congratulated for putting together a thought-provoking and wide-ranging collection of essays. The editors should be thanked not only for bringing these together but for providing a thorough review of the field in their introduction and the excellent bibliography. They have ensured that scholarship from different countries has been included, not least in the fact that Aubin and Bigg have themselves translated two of the essays, as well as contributing their own chapters. It is to be hoped that there is more to come from these scholars and from others inspired by this collection.

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CHRISTOPHER CARTER, *Magnetic Fever: Global Imperialism and Empiricism in the Nineteenth Century*. Philadelphia: American Philosophical Society, 2009. Pp. xxvi + 168. ISBN 978-1-60618-994-8. \$35.00 (paperback).
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This is a fine monograph written by a specialist in the history of geophysical fields in imperial Britain. During that period, the scientific community developed considerable interest in meteorological phenomena and Earth magnetism. The book focuses specifically on the key individuals, events and political manoeuvres leading to the so-called 'Magnetic Crusade' (p. xv). The key idea is that in both Britain and the United States 'the interaction of science and state