

scholar to a new systematizing and comparative agenda under Hans Sloane which encompassed specialists without professional or landed backgrounds.

Chapter 2, 'The theorist and the thermometer', focuses on Michael Combrune and his *Essay on Brewing* of 1758. This is the earliest brewery text known to have been modelled after a natural-philosophical treatise, to discuss thermometry and to have been written by an active commercial brewer. It provided a model for future publications, and popularized both the use of the thermometer and tie-ins between publications and private commercial instruction. However, it largely disappointed readers on both sides of the divide between theory and practice.

Chapter 3, 'Brewery instructors in public and private', explores the theory-minded instructors who sprang up in Combrune's wake and the obstacles faced by non-brewing authors. In the 1770s, chemist Humphrey Jackson found success by employing partial disclosure in his publications, and by appealing to universal chemical laws as a source of authority for non-brewers. His career reflects important intersections of the cultures of polite knowledge making and trade included within the Society of Arts, the Royal Society and the nexus of public and projector interests which saw him address ship-worm and scurvy as well as brewing.

Chapter 4, 'The value of beer', explores how John Richardson (one of Jackson's disgruntled former customers) successfully couched quantitative gravimetric interpretations of beer strength within economic issues valued by brewers. He balanced the need for openness and secrecy by combining published generalities with privately proffered advice. Richardson also successfully promoted a philosophical instrument, the saccharometer, although he was not able to establish a monopoly over the technology and soon alienated the reviewing press. He and ensuing authors increasingly made a case for brewers being able to combine practice and theory in a way which non-brewers could not.

Chapter 5, 'Chemists, druggists and beer doctors', explores how, in the nineteenth century, these dynamics collided with public fears about the adulteration of food and drink. Just as industrialization distanced consumers from production, chemical-minded brewers appeared distanced from concerns about 'purity'. Chapter 6, 'Professors in the brewhouse', shows how the introduction of professors into the brewery was an attempt to bridge this gap. It proved largely unsuccessful but influenced later authors, including chemist Thomas Thomson, who redefined brewing as an industrial process underpinned and innovated by chemical literature. He was one of a new breed of turn-of-the-century professionalizers who helped bring about greater scientific disciplinaryity. Chapters 7, 'Treatises for the trade', and 8, 'Analysis and synthesis', discuss the appearance of brewing in later nineteenth-century treatises and periodicals, and how discussion of current research moved to commercially oriented trade publications.

In crafting this book, Sumner faced many challenges – including the limitations of focusing on one type of source, and the difficult balance to be found between recognizing and overstating well-known dichotomies and narratives. However, he explicitly addresses these issues, and repeatedly seeks to redress them through context and analysis. Rather than attempting a comprehensive brewing history, he aims to explore the theme of credibility through important but lesser-known chemists and publications which preceded the 'microbiological turn' in late nineteenth-century brewing.

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BEN RUSSELL, *James Watt: Making the World Anew*. London: Reaktion Books, 2014. Pp. 280. ISBN 978-1-78023-375-8. £17.95 (hardback).
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Biography has never been the same since 1918, when Lytton Strachey defended his new approach in *Eminent Victorians* by lambasting traditional versions that were 'as familiar as the *cortège* of the undertaker' and carried the same air of 'slow, funereal barbarism'. In his own bid to revise the genre, Ben Russell retains the conventional chronological unfolding of events in James Watt's

life, yet at the same time transforms his subject into a lens for exploring ‘the hows, whys and whats of making things’ (p. 19) while Britain became increasingly industrialized. Covering the period from roughly 1760 to 1820, *James Watt: Making the World Anew* examines the development of the steam engine in the context of shifting craft practices across a wide range of industries, including chemistry and blacksmithing, as well as the manufacture of pottery and precision instruments.

This book about doing casts a fresh light on British industrialization. Explicitly distancing himself from accounts of an industrial Enlightenment characterized by the creation and circulation of useful knowledge, Russell focuses on things; rather than the familiar Lunar Society, he describes networks of artisans. Centring on Watt, he explains how men in foundries, fitting shops and factories transformed abstract ideas into tangible products that were useful or desirable and hence marketable. According to eighteenth-century commentators across Europe (strangely, Russell frequently quotes from Daniel Defoe, who died before Watt was born), Britain owed its wealth neither to original inventions nor to scientific achievements, but to the superior practical skills of the nation’s workmen. Taking advantage of local raw materials, they improved techniques of production, organization and marketing to feed the booming economy with an unprecedented plethora of material goods.

Curator of mechanical engineering at London’s Science Museum, Russell is admirably sensitive to the risks of squeezing Watt into modern categories and so converting him into multiple cardboard pioneers – prototype engineer, chemist, entrepreneur – although he never questions the reality of the Industrial Revolution, a label coined in the late nineteenth century and now contested. To borrow his own metaphor, Russell slices the Watt cake horizontally rather than vertically, unifying his life by refusing to label him with a specific identity and instead portraying him in terms of his behaviour, as a man who not only thinks but also does. To reinforce the merits of this approach, Russell frames his book by depicting Watt’s workshop, which was acquired by the museum in 1924 when his Birmingham house was demolished. Its shelves lined with sculptures, minerals and bottles of chemicals, this ‘shrine to making things’ (p. 9) is packed not with drawings of steam engines, but with hammers, mirrors, thermometers and compasses, along with all those sundry projects that never quite got finished but were bound to come in useful one day.

Dividing Watt’s life into successive chunks of around fifteen years, Russell tracks his burgeoning career. At the same time, he introduces us to Matthew Boulton and other important collaborators, provides a historical tourist’s guide to key sites of Watt’s activities – London, Glasgow, Manchester, Birmingham – and offers fascinating surveys of trades that now seem unrelated but were then underpinned by similar techniques and strategies. Thus for Watt and Boulton the task of mass-producing standardized engines seemed, in advance, identical to that of improving efficiency in manufacturing buttons. Far from being trivial commodities, buttons were important as high-fashion items, and modern steel was deemed so chic that glass was polished as a cheap imitation. The solution to supplying demand was Adam Smith’s division of labour: a single button might go through fifty different processes, many of them simple enough for a small child to carry out. But engines proved far more problematic, involving successive refinements and patent disputes before the business was passed on to the next generation, who transformed this eighteenth-century innovation into the prime driver of Victorian industry.

‘Womb-to-tomb’ biographies may not be fashionable among academics, but they can help counter-balance retrospective hagiography and misleading interpretation. As Russell makes clear, innovators inherit from their predecessors rather than foreseeing the direction taken by their successors. Chapter headings such as ‘Inventive, creative genius’ reveal where Russell’s sympathies lie, but he insists that Watt should not be classed among the thermodynamicists who followed him, because for him a steam engine was a piece of chemical apparatus, not a machine that performs work. Stressing the importance of antiquity, he illustrates how classical influences are apparent in the design of

Josiah Wedgwood's medallions, Boulton's silverware and the Palladian architecture of Soho House. More surprisingly, Russell assesses the impact of the old on steam engines. As increasing attention was paid to their aesthetic appearance, these icons of modernity might incorporate Greek columns with ornate capitals, be styled to follow the Gothic revival, or be decorated with Egyptian motifs.

As Russell describes in his final chapter, 'Life after death', Watt helped to ensure that he would be remembered as a lone heroic inventor, the engineering equivalent of Britain's scientific genius, Isaac Newton. But even iconic figureheads are not always perfect: the neophyte Newton mistakenly trained his telescope on Venus instead of a comet, and Watt produced a dud dividing plate with only 359 marks (instead of 360) on its circumference. According to nineteenth-century mythology, the steam engine was born when a kettle boiled, but the real-life Watt sometimes despaired of ever making it work satisfactorily. 'Of all things in life, there is nothing more foolish than inventing', he wrote to his impatient partner John Roebuck, who accused him of 'letting the most active part of your life insensibly glide away' (p. 89).

Celebrated for his industrial inventions, Watt himself now belongs to Britain's heritage industry. Russell has provided a refreshingly original insight into the life and activities not only of this national hero, but also of his many less famous colleagues who together transformed traditional craftsmanship into industrial innovation.

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BRIAN GEE (ed. ANITA McCONNELL and A.D. MORRISON-LOW), **Francis Watkins and the Dollond Telescope Patent Controversy**. Farnham: Ashgate, 2014. Pp. xxvi + 392. ISBN 978-1-4094-6643-7. £85.00 (hardback).
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While patenting was on the rise in Georgian Britain, it was still not the norm. Nonetheless, some patents were vigorously and successfully defended. One of the most significant of these cases concerned John Dollond's 1758 patent for an achromatic lens, an innovation that revolutionized the production of telescopes and made the Dollond firm, particularly as Peter Dollond enforced his father's patent. While this particular patent and the prosecutions arising from it have frequently been cited and discussed in the history of science and technology, this new account adds considerably to previous work by exploring the facts in detail and correcting some misconceptions.

Brian Gee's book derives from an aspiration to develop models of the relationship between makers and users of scientific instruments in order to understand the importance of instrument-makers in the history of science. To that end, Gee spent many years working towards a comprehensive account of Francis Watkins (1723–1791) and the firm he founded. While the wider project was incomplete at the time of Gee's untimely death in 2009, the chapters in this volume were already drafted and have been brought together and edited for the Scientific Instrument Society.

As the early chapters show, Francis Watkins followed a familiar trajectory for an instrument-maker. Coming from a Welsh family, he moved to London in the 1730s and was apprenticed to various opticians before setting up his own business. Once established, the firm sold optical, electrical and other instruments, as well as model steam engines, in which Watkins was a notably early player. The book's concluding chapters document the firm's transformation into Watkins and Hill, which survived into the mid-nineteenth century and had an important role in the expansion of school and university education, before its decline and takeover over by Elliot & Sons.

The meat of the book, however, is in its central chapters on the patent controversy. Commercial disputes of all sorts were common in the London trade. By the early 1750s, indeed, Watkins was already involved in battles around new types of telescope, and a decade later his association with the Dollonds would find him embroiled in the industry's most far-reaching dispute. As background, Gee offers a good account of earlier attempts to develop lenses free of chromatic aberration, which was