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Margaret Jacob and Larry Stewart, *Practical Matter: Newton's Science in the Service of Industry and Empire, 1687-1851*. Cambridge, Mass. and London: Harvard University Press, 2004. 201 pp. Figures, notes, acknowledgments, and index. \$35.00 U.S. (cl). ISBN 0-674-01497-9.

Review by Peter M. Jones, University of Birmingham.

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This volume is issued under the imprint of Harvard University's promising "New Histories of Science, Technology, and Medicine" series. Its two authors are well known for their contributions to our understanding of the development of early modern scientific culture. Readers will find the book addresses themes familiar both to economic historians and to specialists in the history of science, but it manages to do so without jargon and in clear, uncluttered prose. It strives to bring together areas of knowledge and distil broad-based conclusions. Whilst the book does contain some new research, the authors do not set out to open up fresh fields of enquiry. Readers whose interests focus mainly on the history of France will find it adopts a disarmingly de-centred approach. The link between science and the Enlightenment is retained—reinforced indeed—but it soon becomes apparent that specialists of the history of science and technology have long ceased to regard the Enlightenment as primarily a French phenomenon. Eighteenth and early nineteenth-century France features in the exposition chiefly as a bench-mark or as a vantage point for comparison.

The argument advanced is that industrialisation in the West had a great deal to do with the expansion in the eighteenth century of a scientific "knowledge economy." In certain favoured settings this development spawned, in turn, a hybrid social formation which can be described as an "industrial enlightenment". Both of these terms are derived from a recent work by the economic historian Joel Mokyr, and the authors broadly endorse his formulation even as they add colour, contingency, and detail to the picture. Put succinctly, the book starts with Newton's "matter" and explores the way in which it was put to "practical" use. The opening chapter traces the march of Newtonian science across the face of Western Europe and the gradual retreat of Aristotelian and Cartesian belief systems. The ready acceptance of the new physics in Britain is contrasted with its tardy acknowledgement in Italy. In France, the Jesuits fought a rearguard action against Newton despite the fact that Pierre-Louis Moreau Maupertuis had provided experimental proof of the theory of universal gravitation as early as 1737. Nevertheless, by 1750, the *savants* of Paris at least had accepted the new science; and they would soon discard Newton's argument for intelligent design. Joseph Priestley discovered as much when he visited the French capital with the Earl of Shelburne in 1774.

However, the adoption and application of Newton's natural philosophy made swiftest progress in Britain where churchmen found in it a handy pulpit weapon against religious enthusiasm. By the 1730s, claim the authors, this unimpeded process of assimilation was such that British prowess in mechanical science was already coming to be recognised in continental Europe. Britain, therefore, led the way towards a paradigm shift, that is to say a fundamental alteration "in the way Western cultures understood and approached physical nature" (p. 26). This claim, of course, begs questions about the nature of eighteenth-century British society, especially as Newton's own scientific idiom was scarcely experimental in its emphasis. These questions are explored and partially answered in chapters two and three. We learn how science escaped from the academy of the learned, how a public audience for mechanical demonstrations developed; indeed, how science across eighteenth-century Europe became a branch of elite and middle-class consumer culture. In every case, it seems that Britain led the way.

Although France embraced Newtonian physics also, and would go on to become the pre-eminent mathematical knowledge-generating country of the eighteenth century, its culture of scientific “practice” would not develop in tandem. By and large, French science stayed immured within the academy: a model which the authors suppose, probably rightly, to be a characteristic of absolutist regimes. The interface between natural philosophy and technology remained sharply etched with the result that French ministers, for whom the notion of a free-flow knowledge environment was political anathema, had to resort to artificial means of bridging the gap (technology transfer, even the interrogation of British POWs). But the late century political conflagration would change the perception of Newtonian science and its applications on both sides of the Channel. In France, thanks to the Revolution and more especially Bonaparte’s technocratic regime, “fine literature faded after 1800, to be replaced by discussions of land cultivation and industrial development” (p. 140). In other words, French scientific culture “caught up.” However, in Britain the century closed with something of a retreat from the forward positions achieved in the 1780s. In chapter four, the authors retrace the story made familiar by Jan Golinski.[2] Public equanimity in the face of the ever expanding knowledge economy evaporated the moment the experimental method was shown to have political as well as scientific applications.

The final chapter of this engrossing book pursues the theme of science “applied” into the early decades of the nineteenth century, albeit in a rather episodic fashion. The authors seem aware that their conclusions regarding the differential development of scientific culture across the West stand in need of empirical demonstration, particularly if the embedding of Newtonian science in day-to-day behaviour is to be granted an explanatory role in the advent of industrialisation. The same problem confronts Joel Mokyr’s otherwise plausible thesis. The difficulty, as they freely admit, is that it is by no means easy to show how a working knowledge of Newtonian physics was acquired and then incorporated into actual industrial practice. How many late eighteenth or early nineteenth century industrialists were also natural philosophers? Not many, although there were a few in Birmingham and the English Midlands. The chapter ends with an effort to address this question which takes the form of case studies of two cotton manufacturers in Manchester, and a rather more persuasive one of the Leeds woollens industrialist Benjamin Gott. For France, no research of an even remotely comparable nature has been undertaken, with the result that the authors are reduced to conjectures about the effects of changes to the education system. Even after the Revolution and the Empire, scientific culture in France remained a matter for governments, or so it would seem.

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## NOTES

[1] Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton and Oxford: Princeton University Press, 2002).

[2] Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (Cambridge: Cambridge University Press, 1992).

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