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James R. Jacob. *The Scientific Revolution: Aspirations and Achievements, 1500-1700.* Atlantic Highlands, N.J.: Humanities Press, 1998. xvii + 148 pp. $12.50 (paper), ISBN 978-0-391-03978-0; $39.95 (cloth), ISBN 978-0-391-03977-3.

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The Dual Conquest

James R. Jacob's compact introduction to the Scientific Revolution is sure to be a boon to teachers of survey courses seeking to find a way to include an accessible book on what the author calls the most important transformation in modern history. Highlighting six principal developments associated with the shift from old to new science, Jacob focuses on discontinuities: the abandonment of the concept of a finite, geocentric universe; of Aristotelian theories of physics and knowledge; of Galenic medicine; of scientific uncertainty; and of parochial research and restricted inquiry. In place of the antiquated assumptions came a new order, one characterized by a more modern picture of the solar system; by universal, quantifiable forces in physics and new theories in medicine; by a healthy skepticism undergirded by a belief in attainable scientific knowledge; by mathematical and instrumental safeguards for the scientific method; and by scientific societies that promote cooperative research. Although it is part of the Control of Nature Series, Jacob points out that "science in early modern western Europe was not just about the conquest of nature but about mastering both fallen humanity and stubborn nature to raise the level of civilized life, to build a new material and moral order" (p. xvii). Despite the different directions taken by scientists in France and England, Cartesians and Newtonians, Jacob maintains that both quested for moral order and arrived at a similar outcome.

Starting with "The Classical Legacy," Jacob limns the long-lived Greek bequest of an ordered, harmonious universe to the West and diagrams for the reader the Aristotelian cosmos and Ptolemy's models of planetary motion. The Scientific Revolution would begin when these pictures of the universe no longer sufficed. As the Stoics taught, if the universe is the product of a rational divine agency, then man must use his reason to discover natural law and live according to its rules. That pilgrimage for understanding was profoundly affected by Renaissance humanism and the printing press, but before assaying their effects, Jacob segues into a lengthy, lucid discussion of Paracelsus and the tradition of magic. Jacob sees Paracelsus as the bridge between ancient and new medicine, whose rebellious scientific influence spread parallel to the Protestant Reformation. Although Copernicus gets short shrift (merely a page) in Jacob's catalog of scientific iconoclasts, Giordano Bruno receives a fuller exposition, particularly for following Paracelsus in enunciating the theme of the Fortunate Fall and for "echoing the optimistic anthropocentrism of Florentine Neoplatonists" (p. 33). However, a revival of skepticism challenged that confidence and led to a crisis of despair, seen most notably in the work of Michel de Montaigne and Pierre Charron.

Jacob's third chapter explores territory familiar to even the most sketchily informed about the scientific breakthroughs of the sixteenth and seventeenth centuries. Accentuating the influence of Galileo and the trouble he got into with church authorities, Jacob credits Galileo's distinction between the primary and secondary qualities of physical objects with providing a skeptical link to the next generation of thinkers. However, the true luminary of the new science was Francis Bacon, to whom Jacob devotes eight pages of analysis, and whose "guarded but robust optimism" (p. 57) was rooted in acceptance of the Fortunate Fall. Whatever curse of labor might have resulted from the sin of Adam and Eve can be turned to humankind's advantage, if the pursuit of knowledge is undertaken for the right reasons. Jacob concludes that Bacon's legacy is both "deeply Christian (and) deeply statist" (p. 61), based on an alliance of knowledge and power.

Since philosophical evolution in France proved pivotal to modern science, Jacob undertakes to explicate the importance of Rene Descartes' use of mathematics to solve problems of nature with scientific certainty and his construction of metaphysical physics. The Cartesian nexus between science and ethics was meant to convince

people to lead moral lives, pursue virtue, and serve the public good. To Descartes, both military and scientific heroism best benefit the community, and, though he was no democrat, he insisted that reason was equal in all men.

Finally, Jacob examines the consummation of the Scientific Revolution in England, where all the foregoing intellectual enterprises were brought to fruition. He places Thomas Hobbes at the forefront of English political philosophy, himself a Leviathan for connecting scientific, religious, and political thought. To Hobbes, the only escape from the social disorder of the human predicament is through a contract with a sovereign powerful enough to coerce harmony. After some discussion of John Wilkins and the founding of the Royal Society in London, which Hobbes distrusted, Jacob spotlights Robert Boyle and his shift away from the absolutism of Hobbes to a new social idealism. Reveling in experimentalism, but always modest in his claims, Boyle "chose big subjects for investigation" (p. 119), though not with as much intensity as Isaac Newton. Jacob concludes with an assessment of Newton's synthesis and the triumph of mathematical demonstration. Newton deftly responded to his Cartesian critics and Hobbesist freethinkers by insisting that gravity, the law of universal attraction, was "tantamount to proof of divine Providence" (p. 127). Yet, Jacob points out, Newton himself produced a dual legacy of ambiguity, useful to Christianity and to those who opposed it.

My criticisms of Jacob's effort are few but important. An introductory book aimed at a broad audience needs a compelling opening, one that will not only engage the reader but set the tone for the entire work. Alas, the first few paragraphs of Chapter One, "The Classical Legacy" augur boredom, laced with the speculations of early Greek philosophers like Anaximander and Leucippus. The birth and death dates of people are given in parentheses, but so are explanatory asides and definitions, such as "the sun, moon, and planets move around the celestial sphere at different speeds (the sun revolves around the earth once a year; the moon once a month)" and "superlunary (above the moon)." Multiplying the parenthetical profusion is the use of APA style in-text citations rather than Chicago style footnotes or endnotes. Although in-text citations no doubt keep publishing costs down, they corrupt our humanities students' own writing endeavors. History professors are trying to teach proper scholarly documentation to the very undergraduates for whom this survey is intended. Numbed by all these parentheses, many students will turn off Jacob before getting to the best central chapters of the book.

They might also be dissuaded from enjoying the real pleasures of Jacob's crystalline analysis by the occasional multisyllabic eye-popper and by the author's reluctance to distinguish between the superstars of science and the supporting players. There are simply too many lesser luminaries included in the litany of contributors to science, names like Jacques Rohault and Frederick Clodius, mentioned once and then abandoned. Students will insist on knowing whom they must recognize and who is peripheral.

Jacob excuses himself in the interest of brevity from much discussion of medical progress or technological advances during the key centuries under scrutiny, but he makes no apology for excluding material about scientific women, despite an avalanche of recent scholarship available at the time of his book's publication. None of the standard books which address the culture of science and its impact on females is even included in the bibliography. He might have incorporated at least one author whose work recognizes outstanding women in the history of science, such as Margaret Wertheim or Margaret Alic, and one who asks why women were proscribed as a group from the scientific community, for instance David Noble or Londa Schiebinger.[1]

The other omission is science in seventeenth-century Europe outside of England and France, "the two main centers of the Scientific Revolution" (p. xvii). Jacob briefly sketches individuals who blazed new trails early on, like Danish astronomer Tycho Brahe, German mathematician Johannes Kepler, and Italian physicist Galileo Galilei, but their achievements are not placed in the national or regional framework afforded England and France. A reference to Roy Porter and Mikulas Teich's The Scientific Revolution in National Context, which contains individual chapters on Poland, Spain, Bohemia, the Low Countries, Scotland, and Sweden, would be most appropriate, as would mention of A. C. Crombie's comprehensive three-volume Styles of Scientific Thinking in the European Tradition or Science and Empires from the Boston Studies in the Philosophy of Science.[2] Nor is there any consideration of the cosmopolitan university world that produced so many of the giants on whose shoulders Isaac Newton admitted that he stood.

Notes

[1]. See Margaret Wertheim, *Pythagoras' Trousers* (New York: 1995) and Margaret Alic, *Hypatia's Heritage* (Boston: 1986); David Noble, *World Without Women* (New York: 1992) and Londa Schiebinger, *The Mind Has No Sex: Women in the Origins of Modern Science* (Cambridge, Mass.: 1989) and *Nature's Body: Gender in the*

Making of Modern Science (Boston: 1995).

[2]. Roy Porter and Mikulas Teich, eds., *The Scientific Revolution in National Context* (Cambridge, U.K.: 1992); A.C. Crombie, *Styles of Scientific Thinking in the European Tradition* (London: 1994); *Science and Empires: Historical Studies about Scientific Development and European Expansion*, edited by Patrick Petitjean, Catherine Jami, and Anne Marie Moulon (Boston: 1992).

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