

2006); I. de Madariaga, *Ivan the Terrible: First Tsar of Russia* (2005); and A. Filjushkin, *Ivan the Terrible: A Military History* (2008). W. B. Lincoln, *Autocrats of All the Russias* (1981), is a remarkable large-scale study of the Romanovs, the 15 tsars and 4 tsarinas who ruled Russia between 1613 and 1917. A more recent study of the changes in the early modern period can be found in S. Dixon, *The Modernisation of Russia, 1676–1825* (1999); and Russia's early imperial expansion is examined in the important work by J. P. LeDonne, *The Grand Strategy of the Russian Empire, 1650–1831* (2004), and in B. Boeck, *Imperial Boundaries: Cossack Communities and Empire-Building in the Age of Peter the Great* (2009). A provocative reassessment of Russia's relationship to European intellectual and cultural history is M. Malia, *Russia under Western Eyes: From the Bronze Horseman to the Lenin Mausoleum* (1999).

On Peter and the reforms of his reign, an older outstanding biography, M. Klyuchevsky, *Peter the Great* (trans. 1958), may be compared with the briefer, more recent accounts in L. Hughes, *Peter the Great: A Biography* (2002); D. Wilson, *Peter the Great* (2009); and R. K. Massie, *Peter the Great: His Life and World* (rev. 2012). For a comparison of the cultural legacies of the two great czars of early modern Russia, see K. M. F. Platt, *Terror & Greatness: Ivan & Peter as Russian Myths* (2011). Peter's interest in western Europe is discussed in L. Hughes (ed.), *Peter the Great and the West: New Perspectives* (2001). An excellent account of Russian society, culture, and government in this era appears in the comprehensive, insightful study by L. Hughes, *Russia in the Age of Peter the Great* (1998), in which she neglects no aspect of Peter's rule. N. V. Riasanovsky, *The Image of Peter the Great in Russian History and Thought* (1985), examines the ruler's long-range cultural impact, while one aspect of his cultural revolution is examined in J. Cracraft, *The Petrine Revolution in Russian Architec-*

*ture* (1988). Accounts of Peter's campaigns in the Baltic and northern Europe can be found in J. R. Moulton, *Peter the Great and the Russian Military Campaigns during the Final Years of the Great Northern War, 1719–1721* (2005), and P. Englund, *The Battle That Shook Europe: Poltava and the Birth of the Russian Empire* (2003). For Sweden, and for Peter's great Swedish rival, an outstanding biography is R. N. Hatton, *Charles XII of Sweden* (1969). A number of important studies by M. Roberts and others have been cited in the section for chapter 3; for these years M. Roberts, *The Swedish Imperial Experience, 1560–1718* (1979), deserves mention. The Baltic shore is explored in S. P. Oakley, *War and Peace in the Baltic, 1560–1790* (1992).

#### Useful Web Sites and Online Resources

Resources on Ottoman and Islamic history are available in the Fordham University sourcebook cited earlier, where one can find an *Internet Islamic History Sourcebook*, [www.fordham.edu/Halsall/islam/islamsbook.asp](http://www.fordham.edu/Halsall/islam/islamsbook.asp). There is concise, well-organized information on early modern Prussia, Poland, Russia, and other European states at the wide-ranging British Web site, *History World*, [www.historyworld.net](http://www.historyworld.net), where readers will find valuable timelines as well as other interactive materials. There are also excellent links to a wide range of resources on the early history of Russia at Bucknell University's *Russian Studies Program*, [www.bucknell.edu/x983.xml](http://www.bucknell.edu/x983.xml).

## 6. THE SCIENTIFIC VIEW OF THE WORLD

### Histories of Science

An outstanding, broad-ranging study is B. L. Silver, *The Ascent of Science* (1998). A valuable new series on the history of modern science is available in D. C. Lindberg and R. Numbers (eds.), *The Cambridge History of Science* (2003–2006), a collaborative project that will eventually include eight volumes. Other excellent historical

accounts include R. Olson, *Science Deified and Science Defied: The Historical Significance of Science in Western Culture* (2 vols., 1982–1991), a far-reaching study ranging from prehistory to 1820; and P. Fara, *Science: A Four Thousand Year History* (2009).

Ancient and medieval science is also explored in D. C. Lindberg, *The Beginnings of Western Science* (1992), cited for chapter 2. For the transmission of knowledge from the Islamic world, see J. Freely, *Light from the East: How the Science of Medieval Islam Helped to Shape the Western World* (2011). Other important perspectives on the long history of science appear in M. Serres (ed.), *A History of Scientific Thought: Elements of a History of Thought* (trans. 1995), and in the comprehensive analysis of the historical study of science by H. F. Cohen, *The Scientific Revolution: A Historiographical Inquiry* (1994). Readers may also wish to consult S. Shapin, *Never Pure: Historical Studies of Science as if It Was Produced by People with Bodies, Situated in Time, Space, Culture, and Society, and Struggling for Credibility and Authority* (2010), for discussion of how historians of science now stress the importance of the contexts in which scientific knowledge develops. For science's impact on society, see A. Ede and L. B. Cormack, *A History of Science in Society: From Philosophy to Utility* (2012). Readers will find an interesting account of the importance of visualization in scientific inquiry in J. D. Barrow, *Cosmic Imagery: Key Images in the History of Science* (2008). For individual scientists, one may consult the *Dictionary of Scientific Biography* (8 vols., 1970–1980) and, for new works in the history of science, the annual bibliographies published in *Isis*.

### The Scientific Revolution

For the fundamental reorientation of thinking about nature and the universe in early modern times, three older but still interesting introductions are H. Butterfield, *The*

*Origins of Modern Science* (rev. 1965); A. Koyré, *From the Closed World to the Infinite Universe* (1968); and A. R. Hall, *The Revolution in Science, 1500–1750: The Formation of the Modern Scientific Attitude* (rev. 1983). Recent works addressing the birth of modern scientific thought are S. Greenblatt, *The Swerve: How the World Became Modern* (2011), and S. Gaukroger, *The Collapse of Mechanism and the Rise of Sensibility: Science and the Shaping of Modernity, 1680–1760* (2010). These works may be supplemented by K. Park and L. Daston, *Early Modern Science* (2006), which is the third volume in *The Cambridge History of Science*. Other informative accounts include H. F. Cohen, *How Modern Science Came into the World: Four Civilizations, One 17th-Century Breakthrough* (2010); and W. Applebaum, *The Scientific Revolution and the Foundations of Modern Science* (2005). Of special interest are I. B. Cohen's *The Newtonian Revolution* (1980) and *Revolution in Science* (1985), an encyclopedic study of the transformation of scientific ideas. Useful shorter surveys of this era may be found in J. R. Jacob, *The Scientific Revolution: Aspirations and Achievements, 1500–1700* (1998); J. Henry, *The Scientific Revolution and the Origins of Modern Science* (rev. 2002); S. Shapin, *The Scientific Revolution* (1996); and L. Principe, *The Scientific Revolution: A Very Short Introduction* (2011). On the nature of revolutionary breakthroughs in science, a highly influential work has been T. S. Kuhn, *The Structure of Scientific Revolution* (1962, 2012), which challenges the belief in progressive, cumulative scientific advance and emphasizes the role of shifting cultural assumptions in the development of scientific knowledge. Kuhn has also written *The Copernican Revolution* (1957, 1985). Some historians of science have questioned traditional views of the scientific revolution, arguing that the changes in thought proceeded slowly and that most early modern scientists retained decidedly unmodern views of human knowledge. For

discussion of these issues, readers may turn to M. J. Osler (ed.), *Rethinking the Scientific Revolution* (2000).

For all aspects of technology and the practical application of science, one may consult C. Singer et al., *A History of Technology* (8 vols., 1954–1984). Three related books are S. Shapin and S. Schaffer, *Leviathan and the Air Pump* (1985); L. Jardine, *Ingenious Pursuits: Building the Scientific Revolution* (2000); and J. McClellan and H. Dorn, *Science and Technology in World History: An Introduction* (2006). Technology as a social force is explored in L. Mumford's classic study *Technics and Civilization* (1934, reissued 1963); O. Mayr, *Authority, Liberty, and Automatic Machinery in Early Modern Europe* (1986); and M. Hård and A. Jamison, *Hubris and Hybrids: A Cultural History of Technology and Science* (2005). A brief, informative survey on this topic appears in E. D. Brose, *Technology and Science in the Industrializing Nations, 1500–1914* (1998). Readers interested in the connection between European expansion and advances in science may consult L. Ferreiro, *Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600–1800* (2007).

A number of provocative studies relate the scientific revolution to the political and social ferment and economic developments in seventeenth-century England and stress the practical implications for a commercial society. Here two pioneer studies were R. K. Merton, *Science, Technology, and Society in Seventeenth Century England* (1970), and C. Webster, *The Great Instauration: Science, Medicine, and Reform, 1626–1660* (1975). An admirable synthesis is M. C. Jacob, *The Cultural Meaning of the Scientific Revolution* (1988), a work that has been revised and expanded in *Scientific Culture and the Making of the Industrial West* (1997). The applications of Newtonian science are examined in M. C. Jacob and L. C. Stewart, *Practical Matter: Newton's Science in the Service of Industry and*

*Empire, 1687–1851* (2004). Connections between early scientific writing and early modern literature are analyzed in E. Spiller, *Science, Reading, and Renaissance Literature: The Art of Making Knowledge, 1580–1670* (2004).

### Biographically Oriented Accounts

The contributions of the pioneer astronomers are described in many of the books already cited and in J. Repcheck, *Copernicus' Secret: How the Scientific Revolution Began* (2007); J. M. Caspar, *Kepler* (reissued 1993); and K. Ferguson, *Tycho and Kepler: The Unlikely Partnership That Forever Changed Our Understanding of the Heavens* (2002), an accessible double biography of two major scientists and their times. For Galileo one may read A. Koyré, *Galileo Studies* (1978); a study of his scientific activities is available in S. Drake, *Galileo at Work: His Scientific Biography* (1978), in which the author has reconstructed the scientist's instruments and examined his notebooks; the same author has written a concise biographical study, *Galileo* (2001). Among several recent biographies, J. L. Heilbron's *Galileo* (2010) stands out. Works that focus on his scientific methods and applications include M. Valleriani, *Galileo Engineer* (2010), and E. Reeves, *Galileo's Glassworks: The Telescope and the Mirror* (2008). The condemnation that Galileo received from the Church and other authorities is described in J. J. Langford, *Galileo, Science, and the Church* (rev. 1992), and revisited in A. Fantoli, *The Case of Galileo: A Closed Question?* (trans. 2012). M. White, *Galileo Antichrist: A Biography* (2007), places Galileo's controversial scientific claims in the context of the Catholic Church's response. Galileo's links to the culture of patronage are examined in M. Biagioli, *Galileo, Courtier* (1993); and helpful accounts of the wider culture in which he worked can be found in J. Renn (ed.), *Galileo in Context* (2001). For Newton, R. S. Westfall, *Never at Rest: A Biography of Isaac Newton* (1982, 1993), is a

biography of distinction; D. Berlinski, *Newton's Gift: How Sir Isaac Newton Unlocked the System of the World* (2000), is illuminating on the man and his accomplishments; and there are also notable biographies by G. E. Christianson (1984), A. R. Hall (1992), and J. Gleick (2003). W. Harper, *Isaac Newton's Scientific Method: Turning Data into Evidence about Gravity and Cosmology* (2011), discusses his methods, while E. Dolnick, *The Clockwork Universe: Isaac Newton, The Royal Society, and the Birth of the Modern World* (2011), considers the social settings for his discoveries. Newton's fascination with other forms of thought is described in the influential revisionist work of B. J. T. Dobbs, *The Janus Face of Genius: The Role of Alchemy in Newton's Thought* (1991), and in A. Janiak, *Newton as Philosopher* (2008).

### Science and Thought

Three informative studies of a key figure in the new science are P. Zagorin, *Francis Bacon* (1998), which is especially strong on Bacon's intellectual contributions; L. Jardine and A. Stewart, *Hostage to Fortune: The Troubled Life of Francis Bacon* (1998), which describes in detail all aspects of his complex career; and D. Desroches, *Francis Bacon and the Limits of Scientific Knowledge* (2006). A. J. Funari, *Francis Bacon and the Seventeenth-Century Intellectual Discourse* (2011), places Bacon in historical context, as does B. H. G. Wormald, *Francis Bacon: History, Politics, and Science, 1561–1626* (1993), which remains a major appraisal. Descartes and his influence are described in P. A. Schouls, *Descartes and the Enlightenment* (1989), while the broader world of rationalist thought in the seventeenth century is described in C. Braider, *The Matter of Mind: Reason and Experience in the Age of Descartes* (2012). For general biographies, readers may turn to H. M. Bracken, *Descartes* (2002); D. Clarke, *Descartes: A Biography* (2006); and two works by

A. C. Grayling, *Descartes: The Life of René Descartes and Its Place in His Times* (2005) and *Descartes: The Life and Times of a Genius* (2006). The complexities of Cartesian thought are examined from new perspectives in S. Bordo (ed.), *Feminist Interpretations of René Descartes* (1999).

The role played by women in the scientific revolution is skillfully explored in L. Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science* (1989), the title derived from Descartes. It may be read along with the same author's *Nature's Body: Gender in the Making of Modern Science* (1993, reissued 2004), focusing on eighteenth-century studies of plants and animals. For a broad perspective on women and science, see R. Watts, *Women in Science: A Social and Cultural History* (2007). Studies on new scientific understandings of gender and science's role in reinforcing gender categories can be found in K. P. Long (ed.), *Gender and Scientific Discourse in Early Modern Culture* (2010). Readers may also be interested in P. Fara, *Pandora's Breeches: Women, Science and Power in the Enlightenment* (2004). An important book by E. Harth, *Cartesian Women: Versions and Subversions of Rational Discourse in the Old Regime* (1992), compares the role of women intellectuals in the seventeenth and eighteenth centuries.

For Pascal, one may read H. M. Davidson, *Blaise Pascal* (1983); J. R. Cole, *Pascal: The Man and His Two Loves* (1995), which offers debatable psychological interpretations of the writer's life and work; and J. Connor, *Pascal's Wager: The Man Who Played Dice with God* (2006). There is a perceptive, brief study of Pierre Bayle by E. Labrousse, *Bayle* (trans. 1983), while T. Ryan, *Pierre Bayle's Cartesian Metaphysics: Rediscovering Early Modern Philosophy* (2009), explores his contributions to the era's philosophical legacy. Skepticism is further explored in R. H. Popkin, *The History of Skepticism from Savonarola to Spinoza* (rev. 2003). Montaigne, its sixteenth-century exemplar, is studied in excellent

biographies by D. M. Frame (1965) and H. Friedrich (trans. 1991), which may be compared with G. Hoffmann, *Montaigne's Career* (1998). More detailed explorations of his political thought and notions of free will are found in B. Fontana, *Montaigne's Politics: Authority and Governance in the Essais* (2008); R. Scholar, *Montaigne and the Art of Free-Thinking* (2010); and F. Green, *Montaigne and the Life of Freedom* (2012). Judicious, balanced biographies of the seventeenth-century Dutch philosopher are S. Nadler, *Spinoza: A Life* (1999), and M. D. Rocca, *Spinoza* (2008). A recent resurgence of interest in Spinoza has spawned several outstanding studies, including R. Goldstein, *Betraying Spinoza: The Renegade Jew Who Gave Us Modernity* (2006); B. Adkins, *True Freedom: Spinoza's Practical Philosophy* (2009); M. Kisner, *Spinoza on Human Freedom: Reason, Autonomy and the Good Life* (2011); S. Nadler, *A Book Forged in Hell: Spinoza's Scandalous Treatise and the Birth of the Secular Age* (2011); and S. James, *Spinoza on Philosophy, Religion, and Politics: The Theologico-Political Treatise* (2012). The cultural influence of Spinoza and other skeptical thinkers is analyzed in the wide-ranging work of J. I. Israel, *The Radical Enlightenment: Philosophy and the Making of Modernity, 1650–1750* (2002). A provocative book exploring the relationship of rationalism to Western thought from the seventeenth century into the modern era is E. Gellner, *Reason and Culture: The Historic Role of Rationality and Rationalism* (1992).

For the political thought of the period, an overview is provided in F. L. Baumer, *Modern European Thought: Continuity and Change in Ideas, 1600–1950* (1977). On Locke, one may read J. Dunn, *Locke: A Very Short Introduction* (rev. 2003); J. Lowe, *Locke* (2005); and R. Woolhouse, *Locke: A Biography* (2007). There are also useful accounts of Locke's work and impact in K. L. Cope, *John Locke Revisited* (1999); P. Vogt, *John Locke and the Rhetoric of Modernity*

(2008); P. Anstey, *John Locke and Natural Philosophy* (2011); and L. Ward, *John Locke and Modern Life* (2010). Hobbes is studied in two notable books by A. Martinich, *Hobbes: A Biography* (1999) and *Hobbes* (2005); and in R. Tuck, *Hobbes* (1989), a brief appraisal. New approaches to Hobbes are found in P. Zagorin, *Hobbes and the Law of Nature* (2009); B. Gert, *Hobbes: Prince of Peace* (2010); and Gordon Hull, *Hobbes and the Making of Modern Political Thought* (2009). Useful for French thinkers in these years is N. O. Koehane, *Philosophy and the State in France: The Renaissance to the Enlightenment* (1980). Two important studies of modern conceptions of individual identity also discuss the intellectual history of this era: C. Taylor, *Sources of the Self: The Making of the Modern Identity* (1989), and J. Seigel, *The Idea of the Self: Thought and Experience in Western Europe since the Seventeenth Century* (2005). A more recent contribution to this literature is U. Steinvorth, *Rethinking the Western Understanding of the Self* (2009).

#### Useful Web Sites and Online Resources

Resources on European science in the sixteenth and seventeenth centuries can be found at Rice University's *Galileo Project* at <http://galileo.rice.edu/index.html>, an excellent site that focuses on Galileo but includes many other valuable materials and links. Additional information on early astronomy and other sciences is available at Cornell University's public astronomy site, <http://curious.astro.cornell.edu/history.php>. There are useful materials and helpful links on seventeenth-century science at the Web site of the *Newton Project*, at Imperial College, London, [www.newtonproject.sussex.ac.uk](http://www.newtonproject.sussex.ac.uk). The history of early modern philosophy, including bibliographic materials and links to sites on Bacon, Descartes, Spinoza, Bayle, and others, can be explored through the excellent *Stanford Encyclopedia of Philosophy* at <http://plato.stanford.edu/>.