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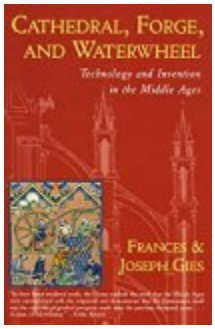
Frances Gies, Joseph Gies. *Cathedral, Forge and Waterwheel: Technology and Invention in the Middle Ages.* New York: Harperperennial, 1995. 357 pp. $15.95 (paper), ISBN 978-0-06-092581-9.



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In certain periods of history, and it remains to be seen if the late twentieth century is among them, cities provided the favored locus for the development of technical innovations. During those periods when cities were the preeminent centers of culture, commerce, and learning they were also the hosts to an era's most advanced technology. The millennium spanning from A.D. 500 to 1500 in Western Europe witnessed a complete cycle of de-urbanization and re-urbanization. This cycle had a profound effect on the nature of technological innovation. Conversely, the techniques of farming, construction, milling, and transportation played a crucial role in this cycle of urban rebirth.

Until now pieces of the history of medieval technology have been thinly strewn across a hundred journals in a dozen languages, with only a few authors having attempted the daunting task of synthesis. Frances and Joseph Gies exhibit unusual temerity in having chosen to shoulder the project of painting the "big picture" of medieval technology. Their courage appears all the greater in that they aim the results of their labors at that increasingly neglected audience, the educated lay person and the intelligent undergraduate. Urban historians seeking a one-volume summary of the technological basis for the rebirth of the city in the Middle Ages will welcome the Gieses' excellent overview

It is not clear if the authors intended their book to serve as a university textbook, but it will do so nicely. Thanks to Frances and Joseph Gies, we now have a reliable, affordable, and reasonably up-to-date work upon which a medieval technology course could be based. Their book could adequately supplement any course covering the material bases of the early-modern city.

The book's scope is the thousand years from the fall of the Western Roman Empire to the discovery of the New World. The authors divide the book into seven chapters into which they arrange most of their material chronologically. Although the book is not aimed primarily at urban historians, the detailed index makes urban topics immediately accessible. For instance Paris has fourteen entries, London nine, and Venice twenty-one.

The authors begin *Cathedral, Forge, and Waterwheel* with a brief history of ideas concerning the supposed nature of the Middle Ages, tracing the current, popular notion of the "Dark Ages" back to the Enlightenment (p. 1). They continue with a historiographic survey of medieval technology, beginning with Jerome Cardan's *De subtilitate* (1550) and continuing through the work of Marc Bloch, Lynn White, jr., and Robert S. Lopez (p. 3). The authors complete their survey of interpretations of medieval history by introducing the reader to the historiographic revolution that Joseph Needham precipitated when he began publishing his series, *Science and Civilization in China* (Cambridge, 1954). Much of what makes the Gieses' book better than previous works is its incorporation of Needham's ground-breaking research on Chinese science and technology into a survey of western technology. The Gieses openly acknowledge the European debt to China, writing for instance, that "scores of major and minor inventions were introduced from China and India, often through the medium of Islamic North Africa and the Near East" (p. 15). The work of Needham and his colleagues at Cambridge University informs almost every chapter of *Cathedral, Forge, and Waterwheel.*

The authors continue with a chapter on "The Triumphs and Failures of Ancient Technology." In this survey of Roman technology the Gieses exhibit the magisterial sweep of their knowledge by delving to the very roots of Roman material culture. They argue that "Roman Civilization achieved a high level of culture and sophistication and left many monuments, but most of its technology was inherited from the Stone, Bronze, and early Iron Ages" (p. 17). Such a broad overview could be very useful to students who have never had a course in ancient civilizations.

The authors place Roman technology in a global context by acknowledging the contributions from beyond the Empire. For example, they note that Roman builders borrowed the hypocaust (a system of supplying radiant heat through the floors of villas and baths) from India (p. 27). They place Rome's accomplishments in perspective by noting, for instance, that while Rome had no effective draft harness for the horse, China had one by the second century B.C. (p. 32). Such well-chosen examples continually remind the reader of the world beyond the Roman Empire.

A chapter on "The Not so Dark Ages: A.D. 500-900" effectively continues to debunk the notion that little happened in those four hundred years. The authors discuss warfare, textiles, agriculture, and the ways in which long-distance navigation and trade spurred urban growth in northwest Europe. Using archeological research published as recently as 1990, the authors describe how "specialized trading settlements called 'emporia' and 'gateway communities' sprang up near the North Sea and Channel coasts" in the seventh and eighth centuries (p. 43). Among these emporia were Southampton and Ipswich. At that time London was only a "beach market" on the banks of the Thames, "serving mostly local traders, farmers, and fishermen, who sold their wares directly from their boats without benefit of docks, shops, warehouses or middlemen" (p. 43).

One of the most valuable chapters for teachers seeking to inject a global perspective into the history of the Middle Ages is "The Asian Connection." The authors take pains to remind us that although the revival of the European economy and the re-urbanization of Europe are often described as a "Renaissance" of classical antiquity, some of the most crucial technological innovations came from beyond Europe. These imports include the almost magical trio, cited first by Cardan and later by Francis Bacon, of gunpowder, the printing press, and the magnetic compass. The physical configuration of early-modern cities, the nature of their intellectual life, and the potential of Europeans to begin a program of overseas expansion depended more upon inventions borrowed from Asia than any revival of Roman technology.

More germane to the interests of the urban historian is the fifth chapter, "The Technology of the Commercial Revolution: 900-1200." The Gieses build upon the work of Robert S. Lopez, who codified his idea of "The Commercial Revolution of the Middle Ages," in a book of the same name, published in 1976. The authors follow Lopez in arguing that long-distance trade in luxury goods produced "an economic surge in which the Italian cities were the energetic leaders" (p. 105). Though the relative significance of trade of luxury versus staple commodities is still unresolved, the Gieses add a valuable perspective to the trade wares and Crusades in the Near East. They argue that the most significant gains of the military victories over the Muslims were "hardly noticed at the time ... access to Islamic learning and technical knowledge" (p. 106). One is delighted to read that "the principal European gain from military success was thus not the expulsion of the infidels, but the opportunity to mix with them" (p. 106). The Gieses did not appear to be consciously trying to break new ground or to be trendy, but their synthesis supports the conclusions of cutting-edge scholarship such as Maria Rosa Menocal's *The Arabic Role in Medieval Literary History* (Philadelphia, 1987) and her *Shards of Love: Exile and the Origins of the Lyric* (Durham, N.C. 1994). Without pursuing any grand ideological agenda, but by simply focusing on technology instead of the rhetoric of the victors, the Gieses have arrived at the same conclusions of some of the most progressive historians of our day.

The sixth chapter, "The High Middle Ages: 1200-1400," describes the continuing expansion of the commercial revolution and the consequent growth of cities. The authors explore the environmental impact of land reclamation and deforestation. They note that "the growing pressures of construction and industry brought Europeans for the first time to a consciousness of the forest's limits" (p. 171). In the course of discussing the medieval city, the authors maintain their global perspective noting for instance, that "in the prosperous thirteenth century, European cities began for the first time to rival in size and importance those of the classical world and contemporary Asia" (p. 186).

In their concluding chapter, "Leonardo and Columbus: the End of the Middle Ages," the Gieses continue to avoid the tired explanations of a "Renaissance" of ancient

learning, instead choosing to elaborate upon the ways in which "the full-rigged ship was suddenly bringing together Europe, Africa, Asia, and the brave New World together in a cultural collision unique to human history" (p. 238).

This fine book is made even better by the authors' use of illustrations. Anyone who has browsed several histories of medieval technology will recall with frustration the frequency with which the same dozen or so images are reused and recycled. The Gieses offer a pleasant respite from the grainy, dog-eared snapshots of the plow and water wheel. They present the reader with refreshingly unfamiliar images from archives across Europe. Notable examples include: "Building the Tower of Babel," from the British Library's Bedford Hours (p. 195) and a detail of Andrea da Firenze's "Triumph of Saint Thomas" which reveals an image of Averroes (Ibn Rushd) on the walls of Santa Maria Novella in Florence (p. 101). These images are supplemented with clear drawings of complex devices, such as the horizontal waterwheel (p. 33), and the authors' own photographs. The authors exploit the economies of modern offset printing to reproduce images and they are careful to ensure that each is legible.

I am so grateful for a useful textbook that I would prefer not to mention its few shortcomings, but I must note them. The Gieses, like any synthesizers of a vast body of scholarship, had a difficult choice to make: to rely on secondary sources and finish the book in their own lifetimes or to begin the Herculean task of primary research in a dozen fields and never produce a book. Fortunately they chose to finish their book. By relying on secondary sources, mostly books rather than articles, and often upon synthesists like Lynn White, jr., R. J. Forbes, Charles Singer, and others, *Cathedral, Forge, and Waterwheel* remains at one or two removes from the most recently published journal articles. Sinologists may quibble that the authors relied too much on Needham and Islamicists may regret the Gieses did not consult Ahmad Y. al-Hassan and Donald R. Hill's *Islamic Technology: An Illustrated History* (Cambridge, 1986). Other specialists will no doubt find a piece of recent scholarship missing.

With fourteen books to their credit, the Gieses understood the dilemma of attempting to synthesize a vast body of knowledge into one volume. They accepted the trade offs their strategy would require. As a result, the graduate student writing a seminar paper will find in the notes to *Cathedral, Forge, and Waterwheel* only a beginning of a bibliography. But the authors' purpose was not to produce an annotated bibliography or a review essay, but to identify "the main technological elements that entered significantly in to the medieval European history, their known and probable sources, and their principal impacts" (p. 16). Frances and Joseph Gies have accomplished their stated purpose admirably. Anyone needing a survey of medieval technology will be in their debt for a decade or two to come. Historians of European cities will find *Cathedral, Forge, and Waterwheel* a useful introduction to the technological dimensions of urbanization before the Industrial Revolution.

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