



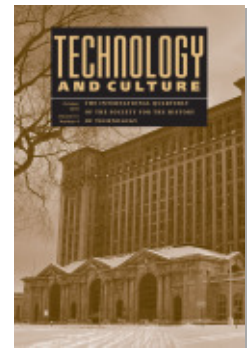
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Roger D. Simon

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The Machine in Context

Merritt Roe Smith's *Harpers Ferry Armory and the New Technology: The Challenge of Change*

ROGER D. SIMON

In 1978 Merritt Roe Smith won the prestigious Frederick Jackson Turner Prize from the Organization of American Historians for his *Harpers Ferry Armory and the New Technology: The Challenge of Change*, published the year before by Cornell University Press.¹ It was the first time this prize had gone to a book in the history of technology, and the award generated considerable enthusiasm among members of the Society for the History of Technology who felt that SHOT operated at the margins of the larger professional community. Mel Kranzberg later wrote that the prize “marked the recognition by the larger field of American historians that a book on the history of technology was truly a contribution.” At a session of the 1979 SHOT meeting devoted to both *Harpers Ferry Armory* and Anthony Wallace’s recently published *Rockdale*, Glenn Porter observed that both books attracted wide attention and would have an enduring influence because they “successfully consider technical change in its wider social context.” *Harpers Ferry Armory* represented a “real breakthrough” because it attracted the attention of historians not otherwise interested in technology. Porter’s prediction of the significance of *Harpers Ferry Armory* has proven accurate. The book remains in print and has influenced several areas of scholarship. Within the SHOT community, it has been viewed as a model of what a history of technology should be.²

Roger D. Simon, professor of history at Lehigh University, specializes in urban and labor history. His most recent book is *Philadelphia: A Brief History* (2003). He wishes to thank his colleagues John K. Smith and Stephen H. Cutcliffe for their comments.

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1. The OAH awards the Frederick Jackson Turner Prize annually for the best first book in U.S. history. *Harpers Ferry Armory* also won the Pfizer Award, the premier book prize of the History of Science Society.

2. Melvin Kranzberg to John M. Staudenmaier, 1 April 1983, as quoted in Staudenmaier, *Technology's Storytellers: Reweaving the Human Fabric* (Cambridge, Mass., 1985),

Roe Smith candidly admits that he actually started out to write a narrow, internalist account of the achievements of the inventor John Hall. Like many historians, Smith's initial interest in the topic came out of personal experience. He grew up in the small town of Towanda in eastern Pennsylvania. His father was an avid hunter and had a modest collection of guns. As a new graduate student at Pennsylvania State University, Smith proposed to Philip Klein a research project on the Pennsylvania gunmaking tradition, but Klein steered him to John Hall. (Klein and Hugo Meier, a founder of SHOT, co-directed Smith's dissertation.) Smith won a predoctoral fellowship to the Smithsonian Institution's Museum of History and Technology, where his mentor, Edwin Battison, curator of mechanical engineering, told him right away that all the Harpers Ferry Armory records had been destroyed. Undaunted, Smith rooted around in the archives for months before turning up a treasure trove of materials, notably the complete outgoing and incoming correspondence of the Ordnance Department, and not only with Harpers Ferry, but with Springfield as well. In addition, with a tip from a specialist in Treasury Department records, he discovered the complete Harpers Ferry payroll accounts from 1815 to 1854. Smith supplemented the Ordnance files with those from other War Department offices; the Springfield Armory records, which include a voluminous correspondence with Harpers Ferry; and a number of other manuscript collections. A close reading of the footnotes (and kudos to Cornell University Press for providing real footnotes) shows how Smith pieced together his story from letters and documents spanning years and even decades.

After completing his dissertation, Smith sent it to Eugene Ferguson at the University of Delaware, who commented extensively, but primarily along institutional lines. It was one of the anonymous readers for Cornell University Press, later revealed as Charles Dew of Amherst, who steered Smith to the work of British labor historian E. P. Thompson, notably his seminal 1967 article on time-discipline. This caused Smith to rethink large portions of the manuscript and return to his research notes and to the archives. The resulting book manuscript significantly broadened the focus.³

Smith addressed questions that were at the forefront for both historians of technology and labor historians. The "new technology" in the title refers to the manufacture of metal components with interchangeable parts, together with all the techniques this required, such as jigs and fixing points, gauges, and especially power-driven machine tools—in short, what came to be known as the "American system of manufactures." But "new technology"

244n13; Porter quoted on 165 and 188. Several reviewers commented on the importance of the prize; see, for example, Eugene Ferguson, review of *Harpers Ferry Armory and the New Technology* in *Science*, n.s., 196 (24 June 1977): 1432–33.

3. Telephone interview with Merritt Roe Smith, 5 April 2010. Smith's Penn State dissertation, completed in 1971, was titled "The Harpers Ferry Armory and the 'New Technology' in America, 1794–1854."

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also refers to the introduction of orderly management practices and workforce regulations. The “challenge of change” then takes on a dual meaning: the enormous technological challenge of figuring out how to make interchangeable parts, and the resistance from both the skilled gunsmiths and the civilian managers to the whole project of making such parts. Smith deftly interweaves four major themes throughout the book: the effect of place on the course of technological change; the role of both workers and managers; the quest to manufacture interchangeable parts, including the dissemination of the incremental technical knowledge achieved; and the role of the federal government in supporting technical innovation. A key element of the book’s analytic method is its comparative framework between Harpers Ferry and Springfield, in terms of productivity, costs, management, and technological innovation. This enables Smith to fully assess the significance of place.

The locale of Harpers Ferry, in Smith’s account, is not passive: it has agency, a great deal of it, and it shaped all aspects of this story. George Washington himself selected the site in the 1790s; his explicit rationale was that an inland location would be impervious to attack, but the real reason was that his friends had an interest in the Potowmack Canal Company. It was a poor choice. Recurrent epidemics and floods forced the armory to shut down periodically. The remoteness led to a stultifying cultural environment. The place could not even be called a village at first, and that was about the most it ever became. There was never a newspaper; there was not even a regular church until 1825, and although others followed, they all struggled. And, as indicators of the weakness of a modernizing middle class, there was no serious temperance movement until the later 1840s and no regular public school until the 1850s. Harpers Ferry was remote from sources of supplies, notably iron, which raised its production costs. A small clique of interrelated local families, whom Smith labeled a *junto*, controlled both the community and the armory for much of its history. With considerable success, they used the armory and its workers to enrich themselves, and as a source of patronage, contracts, voters, and customers.⁴

Ironically, what may have at first appeared to be Harpers Ferry’s most important advantage turned out to be one of its greatest weaknesses. It was located near the center of the Pennsylvania-Kentucky gunmaking tradition, and the first gunsmiths recruited were highly skilled craftsmen; some had

4. In *Networked Machinists: High Technology Industries in Antebellum America* (Baltimore, 2006), David R. Meyer has taken issue with the significance of Harpers Ferry’s isolation, both in terms of access to materials and its rural culture, at least early in the century, but he relies heavily on Smith’s research in other areas. Smith did not provide any population figures, a small weakness. In 1850 the census count for the Ferry was 1,747, including 87 free people of color and 109 slaves; the total for Jefferson County was 10,476. See *Seventh Census of the United States, 1850*, vol. 1, *Population* (Washington, D.C., 1853), 256 and 258.

worked or apprenticed with Philadelphia gunmakers. Along with their skills they brought a strong pride of craft and a venerable tradition of craft-oriented work habits. Although by 1815 gunmaking was subdivided into fifty-five separate tasks, the work still required considerable skill and experience, and there was almost no machinery involved. Despite the division of labor, however, traditional preindustrial habits prevailed. The men worked at their own pace, took frequent breaks, conducted personal business in the shops, and notably stopped for alcoholic refreshment, especially in the hot, humid summers. They worked in spurts; the most skilled could complete their monthly quota with ample time left for farming or hunting. A tacit understanding developed between the artisans and the managers: the latter protected the workers from new machines and from pressure by the Ordnance Department to improve productivity. In return, the workers tolerated the dominance of the local *junto*. If workers paid high prices for their goods, they were also well-paid. And, through the end of the 1820s, civilian managers made little effort to interfere in traditional work practices. Even when machinery was introduced, the skilled artisans always controlled the supervisory jobs and senior positions. It was the nexus of the location, the dominance of the *junto*, and the preindustrial craft ethos that shaped much of what transpired there. For the first thirty years of operation (half of the armory's history) the armorers and the local elites were largely left on their own. In that formative period an attitude of entitlement, suspicion and hostility toward the army, and a fierce craft pride became deeply entrenched.

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What stands out so strikingly in this story is not simply the preindustrial work habits and hostility toward machinery, but their tenacity through the entire sixty years of the armory. For example, when Roswell Lee, the Springfield superintendent, took over at Harpers Ferry in 1827 he set down strict rules of conduct, which were quickly dropped when he departed. In 1829, a new superintendent, Thomas Dunn, sought to enforce those rules. Within the year a disgruntled former worker murdered Dunn in broad daylight. Although the assassin was hanged, he became a folk hero, and workers regularly invoked Dunn's fate to intimidate future superintendents. Throughout the 1830s civilian managers continued to tolerate the casual work habits and resisted change. Finally, in 1841 the Ordnance Department took direct control of all operations. The new superintendent, a military officer, installed a clock. The workers indignantly went on strike and sent a delegation to lay their case before the president of the United States, complaining that the clock was "an outrageous insult to their self-respect and freedom" (quoted in Smith, p. 271). President John Tyler received them politely—presidents weren't so busy then—although the clock remained, along with rules on worker conduct. During the 1840s the shops were rebuilt and modernized. There were no more strikes or murders, but grudging resistance continued, and when, in 1854, the armory yet again reverted

to civilian control, many of the old habits quickly reasserted themselves. It took several more years to restore discipline. There was considerable turnover between the 1820s and the 1850s; nonetheless, the craft ethos was persistent enough to carry across those decades.

Preindustrial habits as a major theme in labor history dates from the 1960s and 1970s, drawing inspiration from the work of E. P. Thompson and Eric J. Hobsbawm on England and Herbert Gutman's application to the American experience.⁵ At the time Smith was writing, a number of labor historians were exploring the same theme, but *Harpers Ferry Armory* made a significant contribution to this literature in two ways. First, few studies have enjoyed the fortune of being able to trace a workforce and the experience of a single firm or worksite across the entire first sixty years of the nineteenth century. Second, few labor historians, then or since, linked preindustrial traditions with actual work processes and technological change as thoroughly as did Smith. Take just one example: it took three men ten heats to weld a musket barrel, and, as labor historian David Montgomery put it in his review, Smith's description is "so vivid as to leave the reader perspiring." Labor historians have tended to ignore the technology or gloss over it quickly. Because Smith described in detail what was required to handcraft a musket, the reader has a real sense of what transpired on the shop floor, and how the craft ethos connected with the work, as well as the challenges facing John Hall and other machine makers.⁶

5. E. P. Thompson, *The Making of the English Working Class* (New York, 1963), and "Time, Work-Discipline, and Industrial Capitalism," *Past and Present* 38 (December 1967): 56–97; E. J. Hobsbawm, *Labouring Men: Studies in the History of Labour* (Garden City, N.Y., 1967); Herbert Gutman, "Work, Culture, and Society in Industrializing America, 1815–1919," *American Historical Review* 78 (June 1973): 531–88, reprinted in Herbert Gutman, *Work, Culture, and Society in Industrializing America* (New York, 1977), chap. 1.

6. David Montgomery, review of *Harpers Ferry Armory and the New Technology in Ohio History* 87 (winter 1978): 94–96, quote on 94. On the connections between technology and work in the labor-history and history-of-technology literature, see two articles by Philip Scranton: "None-Too-Porous Boundaries: Labor History and the History of Technology," *Technology and Culture* 29 (October 1988): 722–43, and "The Workplace, Technology, and Theory in American Labor History," *International Labor and Working-Class History* 35 (spring 1989): 3–22. For an excellent synthesis of the literature on resistance to technological change in the antebellum years, see Smith's presidential address to SHOT, "Industry, Technology, and the 'Labor Question' in 19th-Century America: Seeking Synthesis," *Technology and Culture* 32 (July 1991): 555–70. For examples of studies by labor historians that address these issues, see Alan Dawley, *Class and Community: The Industrial Revolution in Lynn* (Cambridge, Mass., 1976); Paul Faler, *Mechanics and Manufacturers in the Early Industrial Revolution: Lynn, Massachusetts, 1780–1860* (Albany, N.Y., 1981); and Susan E. Hirsch, *Roots of the American Working Class: The Industrialization of Crafts in Newark, 1800–1860* (Philadelphia, 1978). For an excellent study by a historian of technology that deals with a single industry and community, see Judith McGaw, *Most Wonderful Machine: Mechanization and Social Change in Berkshire Paper Making, 1801–1885* (Princeton, N.J., 1987).

Smith does make some generalizations about New England workers that subsequent historians have revised: even there the rank and file did not embrace technological change so enthusiastically or evidence a “compulsive fascination with change” (p. 335). Robert V. Bruce wondered if Smith did not make too much of the difference between the armories in terms of casual punctuality and socializing.⁷ Smith also shares an assumption with Thompson, Gutman, and others that the resistance to a clock and to workplace rules represented a persistence of preindustrial habits. Of course that is true, but modern workers have also bridled against the deadening routine of factory labor, the speed-up, and inflexibility in administering rules.

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In addition to the role of the craft ethos and of location itself, the other major story of *Harpers Ferry Armory* is the quest to manufacture small arms with interchangeable parts. Smith's contribution comes in three areas: documenting the technical achievements; tracing in detail the dissemination of the new, hard-won knowledge; and demonstrating the critical role of the Ordnance Department of the army. Over a period of fifty years the Ordnance Department nurtured and financed the quest for interchangeable parts and coordinated the efforts of the two federal armories and the private contractors. Colonel George Bomford, a West Point graduate who was the chief from 1822 to 1841, provided the continuity and commitment. Bomford sent two of the most creative inventors of the age, Thomas Blanchard and John Hall, to Harpers Ferry. The former stayed only a short while, but Hall stayed twenty years. Although the ostensible rationale for weapons having interchangeable parts was that this would make repair in the field feasible and swift, Bomford, Roswell Lee of the Springfield Armory, and the private Connecticut Valley armsmakers all realized by the 1810s that weapons made with machines were more reliable, accurate, and consistent than those crafted by hand. However, it was not at all obvious until at least the 1830s that making muskets with machine tools was more cost-effective than craft methods.

While Bomford provided the consistency and financial support, John Hall was the creative genius. Hall was preoccupied, obsessed perhaps, with making rifles with interchangeable parts. He spent two decades at Harpers Ferry developing and perfecting machines and techniques to make his breech-loading rifle. Hall operated essentially as an inside contractor. He designed extensive sets of gauges (working and master sets) and built innumerable special-purpose machines, including drop forge and milling machines, which, he bragged, he could run with untrained boys. Half his workers made machines, not rifles. In 1834 he and Simeon North in Massachusetts produced weapons that were interchangeable with each other. Smith highlights what creative and significant innovations these were. Ben-

7. Robert V. Bruce, review of *Harpers Ferry Armory and the New Technology in Labor History* 20 (summer 1979): 451–54.

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jamin Moor, the master armorer in the 1830s and 1840s, built on Hall's work and fashioned an effective production system. By the mid-1840s the two national armories produced essentially interchangeable percussion muskets.

Harpers Ferry Armory made a major contribution to our understanding of exactly how American system production came to be. David Hounshell, whose own work traced mass-production technologies, relied heavily on Smith for the early chapters of his book, *From the American System to Mass Production*. In a separate essay, Hounshell located Smith's work in the history-of-technology literature and called *Harpers Ferry Armory* "a virtually definitive study of interchangeable parts manufacture. . . ."⁸ Subsequent scholarship has only slightly modified Smith's findings. Robert Gordon, based on a detailed analysis of surviving weapons, found that hand-filing remained important until after the Civil War and that the filing itself was skilled work, but Gordon's work does not undermine Smith's conclusion or in any way diminish Hall's accomplishments.⁹ From the perspective of its contributions to technological innovation and American system techniques, the Springfield Armory was more important than its southern counterpart. Surprisingly, nobody has written a history of that armory at all comparable to Smith's study.

For Smith, the larger issue that his book raises is just how eagerly American workers embraced industrialism. He offers two main reasons for the resistance at Harpers Ferry to technological change: the artisans' craft ethos and the town's southern and rural location. Of course, it was the mutual reinforcement of the two circumstances that accounts for the story of the Harpers Ferry Armory. However, several reviewers questioned whether Harpers Ferry was too remote and isolated to serve as a representative case study of resistance to industrialization. Economic historian S. G. Checkland saw the book's major contribution in demonstrating the role of the federal government in sustaining the quest for interchangeability. But, regarding resistance to industrialism, he argued that "it is difficult to see how analogous cases could be found of such complete and intense hostility to new technology to establish a generalized paradigm of resistance." He suggests that Smith's "arresting case study . . . may exhaust its own category."¹⁰ Several reviewers, and Smith himself, called for additional studies to assess

8. David A. Hounshell, *From the American System to Mass Production, 1800–1932: The Development of Manufacturing Technology in the United States* (Baltimore, 1984), xxi, introduction, and chap. 1; Hounshell, "On the Discipline of the History of American Technology," *Journal of American History* 67 (March 1981): 854–65, quote on 858.

9. Robert B. Gordon, "Who Turned the Mechanical Ideal into Mechanical Reality?" *Technology and Culture* 29 (October 1988): 744–78; Gordon, "Simeon North, John Hall, and Mechanized Manufacturing," *Technology and Culture* 30 (January 1989): 179–88.

10. S. G. Checkland, review of *Harpers Ferry Armory and the New Technology* in *Annals of the American Academy of Political and Social Science* 436 (March 1978): 177–78, quote on 178.

how uniquely southern the Harpers Ferry story was. Perhaps Checkland was right that there are no other examples of significant industrial installations in slave states that used free labor, but the studies of northern communities undergoing industrialization provide sufficient evidence to make it clear that Smith was on to something important and that *Harpers Ferry Armory* broke new ground in 1977. Moreover, an understanding of this unique and vitally important armory is a critical part of both the labor history and the technological history of the antebellum era.¹¹

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Finally, we have not heard the last of John Hall. Roe Smith discovered only a few months ago that John Hall kept a diary. Astonishingly, it lay undetected in the Missouri Historical Society until recently (Hall died in Missouri). It has been relocated to the Maine State Museum where Smith plans to examine it. A whole new chapter in this remarkable story may soon be revealed!

11. Montgomery, 96; David A. Hounshell, review of *Harpers Ferry Armory and the New Technology* in *Isis* 68 (December 1977): 664–65.