The Military Influence

Military Enterprise and Technological Change. Perspectives on the American Experience. MERRITT ROE SMITH, Ed. MIT Press, Cambridge, MA, 1985. viii, 391 pp., illus. $30.

For better or for worse the partnership of the military with industry has had a significant (some would say predominant) influence on the contours of recent American science, technology, and business. Perhaps, as one contributor to this volume claims, the military has even become "a de facto architect of high technology policy." In any case, this collection of essays convincingly demonstrates that the so-called military-industrial complex is nothing new. Searching for the imprint of military enterprise on American technology across nearly two centuries, this volume raises a range of important, and for the most part neglected, questions about the place and meaning of the military in American life.

To bring some order and direction to a project that cuts across most of American history and much of its technology, the editor, in a superb introduction, has set out a general topography of the field and a half-dozen suggestive themes. What really holds the essays together, though, is how they consistently define technology—less as hardware than as a complex set of social relations.

David Noble, in the most provocative (and also the most strident) piece in the collection, suggests how the special agenda of the military gets built into civilian technologies through the procurement system. He identifies this military agenda with performance, command, and what he calls "modern methods," essentially ways of achieving the other two. Sketches of interchangeability (Army), containerization (Navy), and automated machine tools (Air Force) depict what Noble sees as the military's obsession with cost-be-damned performance and centralized control. Those industries, he asserts, which assimilated the military philosophy and approach (for example, American machine tool manufacturers) ultimately fell behind more flexible foreign competitors, while skilled workers within those industries (for example, machinists) were downgraded into machine tenders. "What kind of progress are we talking about here, and progress for whom?" Noble asks (p. 346).

Several other essays examine the extent to which military interests have shaped civilian hardware and manufacturing technologies. The editor's own paper (reprinted, as was Noble's, from an earlier collection) reveals how the Army Ordnance Department's drive for "uniformity" was extended into private manufacturing by managers and mechanics trained in armory practice and notes that in the nonmilitary context, too, the key to uniformity was as much about the engineering of men as about the engineering of materials. And Thomas Misa makes an excellent case that the Army Signal Corps set a "technological style" for postwar American electronics that reflected a commitment to performance (for example, at extremes of temperature and frequency) over low cost.

The military seems to have left its stamp as much upon management practices as upon hardware. Not only did a military style of management reorient shop floor practice toward a new kind of work discipline, as Smith argues in the armory essay, it reoriented thinking in the executive suite as well. According to Charles O'Connell, America's railroads, the nation's first big business and the organizational model for later corporations, relied heavily upon Army management manuals and Army-trained managers in their formative years. The Baltimore and Ohio and the Pennsylvania railroads adopted management ideas such as the separation of line and staff that had been common practice in the military for a generation.

Even well-established civilian technologies had to be tailored to the special requirements of military bureaucracy. Susan Douglas, in a perceptive study of the introduction of the radio into the Navy, notes that naval officers initially looked at radio more as a threat to than as an extension of their authority. Stanford Hooper earned his title as the "father of naval radio" not so much for his technical contributions as for his organizational skills in showing naval officers how to fit radio into the established structure of command.

The military, as Lewis Mumford claimed, may have been the source and salvation of mass production. But as David Hounshell points out, mass production was not always the salvation of the military. Certain that mass production was a universal technology, Secretary of the Navy Josephus Daniels and Henry Ford set out to build submarine chasers on the assembly line, like Model T's, and pushed their plans over the strenuous objections of seasoned naval officers and architects. Not surprisingly, Ford never got anywhere near his stated production goals. Moreover, the completed "U-Flivvers," as they were dubbed, proved unseaworthy, Hounshell claims, precisely because they were designed with mass production in mind. And Ford (along with some of his automotive competitors who turned their assembly lines to making aircraft) learned something of the limitations of mass production. The venture failed, Hounshell says, because it never had "a close coupling of and careful interplay between military project managers and civilian contractors" (p. 201), a lesson clear enough in retrospect perhaps, but of equal relevance today.

As military technology became more complex, so did the problems of managing it. David Allison, in a piece on Navy research and development since World War II, argues that management innovation has become as important as technological innovation in weapons development. Using the examples of the Sidewinder missile and the Navy Tactical Data System (a sort of electronic battlefield for naval warfare), he shows how weapons technology is continually reshaped and redefined by management theory and practice. Though Allison's story occasionally gets lost in an alphabet-soup of Navy acronyms and implies a managerial competence that the mixed performance of some weapons fails to support, it certainly suggests the degree to which bureaucratic politics and managerial techniques have influenced recent military technologies. Allison concludes, however, that formal management is not everything: "initiative, advocacy, and entrepreneurship have become more disciplined and more bureaucratic, but no less necessary for program success" (p. 328).

Fortunately, Smith has not restricted the scope of "technological innovation" to systems of hardware and means of organizing them. The social sciences, too, have been powerful technologies for imposing performance and command on the human side of military enterprise. In a fresh, and rather difficult, essay Peter Buck looks beyond the obvious questions about how the military employed social science in ventures like intelligence testing and asks instead how the military experiences of social scientists in World War II affected their postwar research programs. "World War II gave many academics their first taste of working within rather than merely consulting for large operating agencies," Buck writes. "The realities of bureaucratic life and politics taught them that power and influence went together with the right to define problems for others to study" (p. 205). As junior members of the military enterprise, social scientists had their problems defined for them, passing "knowledge" up and "propaganda" down. However, as senior members of the postwar academic enterprise at places such as Harvard they had an opportunity to define their own research agenda. According to Buck that agenda—small group sociology, social engineering, cultural values and social theory—

reflected the experiences and frustrations of the war years.

Smith makes no claims to completeness: "Our goal, simply stated, is to sample a limited number of important topics, to advance some hypotheses about the meaning of military enterprise, and to suggest paths for future research." Certainly this volume offers ample resources, both thematic and bibliographic, for those future efforts. Alex Roland's bibliographic essay, which curiously enough for a book subtitled "Perspectives on the American Experience" ranges from mangonels to missiles and from Persia to the Pentagon, provides encyclopedic coverage along with a number of provocative ideas for bringing together past and present. Smith also takes a look at the best of the literature in his introduction to the volume.

Unfortunately the collection says virtually nothing (Buck's comments on the social sciences excepted) about the ways in which the military mind-set has been extended into the university, the place where technologists and managers are trained and a place increasingly at the center of modern technology. The military influence on engineering education goes back to the beginnings of the discipline and in recent years has left its mark on nearly every aspect of science and technology.

And the collection only begins to suggest the ways in which the military itself is shaped by the social order. Smith is certainly correct in claiming that the military shares with most other important American institutions—educational, governmental, and corporate—a set of "values that underpin industrial civilization as we know it today" (p. 21). What invites further study is just how these fundamental shared values shape and reshape the various institutions they have created and continue to support.

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A Technological Awakening

Mechanical Metamorphosis. Technological Change in Revolutionary America. NEIL LONGLEY YORK. Greenwood, Westport, CT, 1985. xviii, 240 pp., illus. $35. Contributions in American Studies, no. 78.

Until fairly recently, accounts of the origins of industrialization in the United States have emphasized the abruptness of the transformation, called variously industrial revolution or, after Walt Rostow, "take-off." This perspective has given ground of late

"Sawmill in Colonial New York, Symbol of Early American Ingenuity and Productivity." [From *Mechanical Metamorphosis;* Courtesy of the Library of Congress]

before a "gradualist" or "evolutionist" view according to which the transformation was a mainly accretive process in which new and old techniques and modes of thought coexisted, and occasionally competed. York's *Mechanical Metamorphosis* finds its place, somewhat uncomfortably, in the largely uncharted land between the two interpretations.

York's investigation covers the tumultuous era of the American Revolution, roughly from 1760 to 1790. This, according to York, was the seminal period during which the intellectual, political, and cultural climate shifted from indifference to, and even denigration of, invention and its practitioners to avid, if naive, enthusiasm. York characterizes the long contest with Britain as "a quest for technological as well as political independence" (p. 7). Presumably, then, just as the American Revolution was, for John Adams, accomplished in the minds of the people before the first shots were fired, the industrial revolution of factories, machines, and steam was preceded and, moreover, consciously anticipated by the technological revolution of the mind that triumphed by 1790.

This is slippery ground that York traverses. That a shift in the way Americans conceived of inventive activity and, more broadly, industrialization necessarily antedated their energetic pursuit of new techniques and devices is intuitively plausible. And it is only reasonable that the new orientation had to have begun some time, somewhere, and with some people. But, one is left with a set of troubling questions. Did the very small number of individuals, influential in state and national government though they were, who advocated invention and mechanical arts really speak to or for many beyond their own circle? And of this small group, how many, when speaking of the importance of encouraging the new nation's manufactures, really meant much more than that? Apart from a few visionaries such as Alexander Hamilton, Tench Coxe, and Oliver Evans, who among them really understood the fostering of invention and the development of a manufacturing base as complementary parts of an economic program? York argues that the promoters of technology in the nascent republic not only understood its relationship to the larger aim of national development but considered it "an essential part of their ideal of the virtuous republic" (p. 213). At another point, he asserts that "as far as many Americans were concerned, there was a direct connection between national prosperity and the rate of technological change. They treated the political republic and the technological republic as obverse sides of the same coin" (p. 176).

Apart from the troubling use of the word "many," there is the more serious problem presented by the use of phrases such as "technological republic," "national commitment to technological progress" (p. 216), and "national technological aptitude" (p. 219). It is York's thesis that the American failures in producing munitions and arms to equip the Continental Army during the Revolution instilled in the nation's leadership a determination that such difficulties would never again arise. (They did, of course, recur, in 1812.) More to the point, America's leaders came to believe that the way to ensure this was to foster American invention and the adoption of new technologies. This conviction of the importance of technology and invention, according to York, had been growing even before the war