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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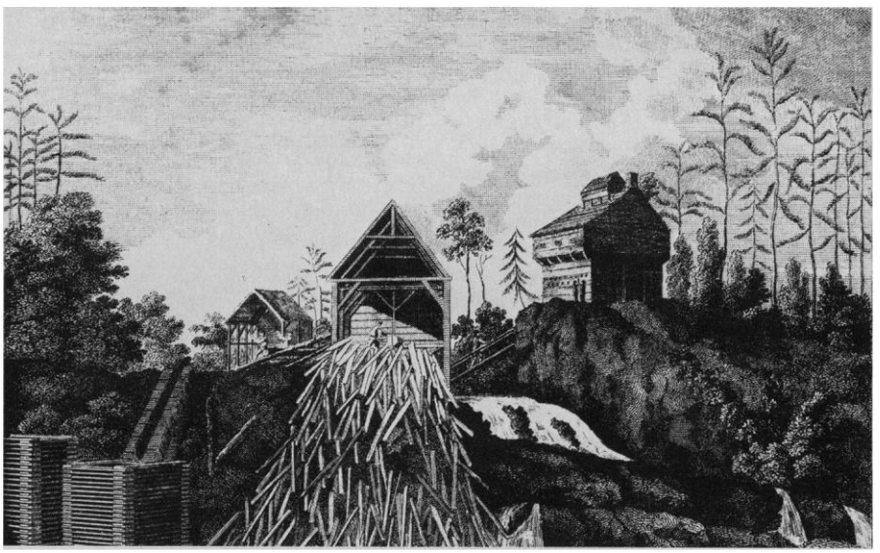
A Technological Awakening

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

for independence and helped to propel the colonies along their revolutionary course: "Americans had gone to war to determine their own technological as well as their own political destiny" (p. 214). This assertion is a gross exaggeration, and not merely because, as York acknowledges, very few Americans understood or cared about technology before, during, or after the Revolution. A more fundamental problem is the apparent conflation of programs to promote manufacturing and those intended to encourage invention. York provides a solid account of the latter and presents impressive evidence of the activities of a small number of energetic men. But he overstates his case. Insofar as a coherent program for the promotion of manufacturing existed, it was one advocated by, and in large measure confined to, Hamilton and his coterie. Although York correctly observes that their program embraced the application of best-practice technology and even the stimulation of invention, he fails to recognize that this was a comparatively minor feature of the program, which laid greater stress upon technological mimesis.

Notwithstanding these problems, *Mechanical Metamorphosis* has some important things to say to students of technological change and economic history. The book's sixth chapter, "Limits to innovation: the Pennsylvania rifle," presents a superb account of an instance when institutional resistance to an invention—rifled weapons to replace smooth-bore muskets—frustrated its adoption. Most of this case study has appeared in article form, but its inclusion here will make it accessible to a wider audience. Readers will also appreciate York's treatment of the patent systems of the American colonies and the United States under the Articles of Confederation and the Constitution. The importance to industrial development and technological change of the development of a coherent procedure for protecting the proprietary rights of inventors emerges fairly clearly in York's discussion of the efforts of sorely tried American inventors such as Oliver Evans and John Fitch to profit from their work. York is at his best when discussing the work and vision of specific inventors in the context of a largely indifferent and occasionally hostile society. His thesis that a "mechanical metamorphosis"—even if only a conceptual one—had occurred among anything more than a minuscule group of Americans by 1790 is not convincing and detracts from a study that has a number of worthwhile things to say.

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The Psychology of Music

The Musical Mind. The Cognitive Psychology of Music. JOHN A. SLOBODA. Clarendon (Oxford University Press), New York, 1985. x, 291 pp., illus., $36. Oxford Psychology Series, no. 5.

The Musical Mind is a welcome addition to the literature on the cognitive processes involved in musical skills. Sloboda is both a musician and a psychologist, and the principal value of the book lies in his careful and informative discussions of musical phenomena from the point of view of cognitive psychology. The book is distinguished by its emphasis on processes involved in the production of music—composition, improvisation, and performance. Sloboda uses composers' sketchbooks (especially those of Beethoven) as well as his own experiences as a composer in discussing the planning processes that go into composing a work. And he provides a good psychological analysis of the differences between composition and improvisation.

Parallels between language and music are emphasized throughout. Sloboda provides a broad overview of the features that are common to music and language, such as categorical perception and aspects of the structural organization of temporal units. He even raises the possibility of systematic reference to extramusical events. Sloboda suggests that music evolved together with language as a social communication system. He rejects the view that music evolved out of elaborations of mating calls, noting that most primate vocalizations involve wider categories of social communication more closely connected with group cohesion than with mating. There is every reason to believe that music was preserved in early human society because of its contributions to communication and cohesion, though Sloboda points out that music has since been elaborated in the peculiarly human ways that arise from "some specifically human tendency to create and notice organized patterns, hierarchies, and sequences" (p. 266).

Sloboda is appropriately cautious in presenting the principal results of recent research on the information processing of melodic patterns, and his discussion of the subject is lucid and informative. The perception of music is introduced by way of a discussion of the Gestalt principles of figural pattern organization in perception—the grouping of notes into melodies on the basis of similarity, proximity, and continuity. Here a puzzle confronts us: why are we so good at perceiving hidden figures we know are there? In the "find six lions in the jungle" type of hidden-figures problem familiar to schoolchildren the lions are not seen spontaneously but pop out when one searches for them. Musical analogs of the hidden-figures problem pose a similar puzzle: how can we focus attention on a pattern that has no distinguishing features of an obvious physical sort?

Tonal scales for the organization of pitch are virtually universal in the world's musical systems. Such scales define fixed sets of pitch intervals to be used in melodies, define hierarchies of importance for pitches, and establish dynamic tendencies of attraction and repulsion among them. Evidence that scale frameworks are important to perception and to memory for melodies and that they play an essential role in the comprehension of melody is reviewed here. Sloboda rightly emphasizes the contributions of several factors to the understanding of melody: tonal frameworks, melodic contours, rhythmic patterns, and the complex interactions among them. His treatment of the development of musical information-processing capacities during childhood is especially good and quite accessible to the nonspecialist.

No book of this size could cover all of the current work in the psychology of music. *The Musical Mind* focuses on cognitive processes and is not concernedwith sensory phenomena underlying the cognition of music. Within the cognitive domain, the book omits consideration of the results of multidimensional scaling studies of pitch, rhythm, timbre, and harmony. An acquaintance with the basic materials of music and with European music notation is assumed. The best passages in the book occur when Sloboda finds an illuminating musical example to illustrate a psychological point, and the examples are given in notation. The discussions of psychological phenomena do not require a specialized background and should be accessible to the general reader. *The Musical Mind* is a lucid and useful introduction to the aspects of the field that it covers.

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Some Other Books of Interest

Haldane. The Life and Work of J. B. S. Haldane with Special Reference to India. KRISHNA R. DRONAMRAJU. Aberdeen University Press, Aberdeen, 1985. xvi, 211 pp. £14.95.

The geneticist J. B. S. Haldane spent the last years of his life (1957–1964) in India. Here Krishna Dronamraju, an associate of Haldane's during those years, presents a memoir to supplement the collection of