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Ruth Schwartz Cowan. *A Social History of American Technology.* Oxford: Oxford University Press, 1997. 342 pp. $44.95 (paper), ISBN 978-0-19-504605-2; $49.95 (cloth), ISBN 978-0-19-504606-9.

Reviewed by Sandra Katzman (Interac Co., Ltd., Independent researcher.)
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Slippery Technic: beyond control

Ruth Schwartz Cowan tells the history of a nation as the technological sociology of the United States. Her organization is compelling. The book is conceived as a teaching tool. The plot builds carefully from "In the Beginning," to "Industrialization," to "Twentieth Century Technologies."

The first of three parts, "In the beginning," includes a perspective statement. "But necessity and opportunity, although powerful, are not the only forces that direct and shape technological systems. The European colonists brought with them another social instrument-governmental policy-which can also have profound effects on technological change" (p. 23). Cowan typically makes sure to reinforce the main points throughout the book, such as this one on "The Land, the Natives, and the Settlers"; "The Europeans brought with them social and technological systems that had evolved slowly, over many millennia, somewhere else; but in North America, they were totally novel and had totally novel effects. (p. 26)"

The chapter "Husbandry and Huswifery in the Colonies" debunks "the myth of self-sufficiency (p. 29)" within a historical framework: "Perhaps even more important [than the government structure], our agricultural origins are reflected in our myths, the commonly held ideas that underlie whatever is unique about American culture: that special set of attitudes that distinguishes Americans-no matter what their ethnic origins may be-from citizens of other countries. (p. 29)"

The chapter "Colonial Artisans" tells that "American artisans understood that they had many things to gain and very little to lose from independence. Once independence came, once colonial artisans were freed from the shackles of mercantilist policy, the rate of American technological change accelerated. (p. 65)"

The second part, "Industrialization" from 1790 to 1930 introduces the theme. "Industrialization was a complex process that took a very long time to complete, which is why we no longer refer to it as a revolution. (p. 67)" Part II examines "The Early Decades of Industrialization," "Transportation Revolutions, and "Inventors, Entrepreneurs, and Engineers."

In Cowan's term, the keystone of the section is "Industrial Society and Technological Systems." This chapter "explores the concept of a technological system in some detail by focusing on five of the systems that developed during the nineteenth century-the telegraph, railroad, telephone, petroleum, and the electric systems. The intention of the chapter is to explain what makes industrial societies different from earlier societies. (p. 68)" Cowan explores how "people have become more rather than less dependent on technology, and, at the same time, more rather than less dependent on each other. (p. 68)" [original italics]

In the chapter "Transportation Revolutions," Cowan draws on early western history; "Since the demise of Roman Empire in the fifth and sixth centuries, no government had succeeded in unifying a territory the size of the United States for more than a few years. The classically educated founders of the American republic knew this very wellIn the domain of transportation, as Gallatin's report to the Senate made clear, they hoped that a national transportation system would unite the diverse parts of the country, making secession of any of the states, but most particularly the western states, both economically and politically unthinkable. (p. 94)"

In the chapter "Inventors, Entrepreneurs, and Engineers," Cowan seeks to simplify the task of describing the contributions of the thousands of people involved in creating industrialized society by placing them in one of three social roles (p. 119). Cowan describes the first engineering professional organization, the Franklin Institute: "...its history precisely reflects the social transformations of nineteenth century engineeringThey wanted to learn from each otherScience, or better yet, the sci-

entific method, was becoming part of the growing social distinction between the engineer and the artisan. (p. 142)"

The second part of the book finishes with two chapters titled "Daily Life and Mundane Work" and "American Ideas about Technology."

The third part of the book is current and most interesting. "Twentieth-century technologies" proves and tests Cowan's organizing principles of this history. "This last section," Cowan writes, "examines four technological systems that have dominated twentieth-century history: automobiles, and their attendant roads and fuel sources; aircraft, spacecraft and also rockets; electronic communication devices, from wireless telegraphy to personal computers; and finally, biotechnologies, new foodstuffs, medications, and contraceptives. All of these systems had their origins in previous centuries and none of them are solely American (p. 221)."

The concept of technoscience introduces the blurred line between technology and science. Of the resulting power, Cowan gets right to the good or bad "ultimate questions that a history of technology must ask (p. 222)." And she gets to the immediate and re-examined paradoxical answers.

Concerning automobiles, "There doesn't seem to be any way out of this impasse; it is not unique to the twentieth century. (p. 222)" Concerning electronic communication, "the answer is ironic; something about the mechanisms of the market have all conspired against giving any individual or organization ultimate control of communication. (p. 222)."

The main point is not new or surprising. But it is made clearly and forcefully in general and specifically in the chapters that follow. "One crucial lesson of this chapter-and this book-is that because of technoscience we cannot trust the experts to make decisions about these issues because none of them is disinterested. As members of the species homo faber, we are all, for good or ill, enmeshed in tehnological systems from which we cannot escape-and about which we need to be informed (p. 223)."

In the chapter "Automobiles and Automobility" we learn of this beginning of federal legislation of the 1966 National Traffic and Motor Vehicle Safety Act. "This act created the National Highway Traffic Safety Administration, which was authorized to set safety standards for new cars-whether purchased by the government or not-beginning in the 1968 model year. Passage of the act meant that for the very first time federal regulators were going to play a determining role in the design of American automobiles (p. 240)."

Cowan's humor is infrequent, appropriate good writing. For example, "In the same years that Americans were starting to worry about whether they could safely drive their cars, they were also starting to worry about whether they could safely breath their air. (p. 240)"

Cowan tells the relevant historical facts that the National Air Pollution Control Act in 1955 was passed when "no one realized the extent to which automobiles were contributing to pollution. The smogs of New York and London were gray, not yellow, and they were composed largely of sulfur dioxide; Los Angeles smog was yellow, and its major component turned out to be nitrous oxide. The culprit was the city's cars, not its smokestacks. (p. 241)"

In the chapter "Taxpayers, Generals, and Aviation" Cowan explains "The relationship that had seemed natural and normal in the world of muskets and cannon had become suspect and fearful in the world of hydrogen bombs and intercontinental ballistic missiles. One good way to understand the importance and complexity of the military role in technological change, as well as to evaluated the extend to which that role changed after 1940, would be to examine the history of the aerospace industry (p. 250)."

Cowan delivers on her promise to examine the aerospace industry. "The birth of the aircraft industry had made total war possible; the advent of total war made the growth and development of that industry both a defensive and an offensive necessity. By the time peace came in 1918, a strong link had been forged between the American military and the American aircraft industry.

"By 1930, however, the Post Office Department's airmail business was used not only to support aircraft manufacturers but also to support the newly created commercial airlines (p. 252)."

Cowan continues explore the nature of the research projects of World War II. 'Many people believe that the techniques of these scientists and engineers developed during the war, the techniques for managing large research and development projects, were the most revolutionary wartime technological changes of all because they had such a profound impact on the postwar years, the years when the "hot" war turned into the "cold" war. Managed research is a social technology in which the end goal is a specific artifact, but many different social systems have to be successfully manipulated in order to both invent and product the artifact. (p. 258)"

In the conclusion of this vast chapter, Cowan brings together these military sponsored programs: "Thus, the space program, paid for with tax dollars, is akin to the numerous military aviation programs of the post-war years, and both are akin to the numerous programs by which-even before World War II-the federal government sponsored technological change through its military services (p. 269)."

About the value judgement of this management, Cowan is kind: "Other people-over time, probably the majority and certainly the majority of those in positions of power-applaud both the methods and the results that this historically unique combination of military, university, and industrial talent produced (p. 270)."

In the chapter "Communications Technologies and Social Control" the big question is "Who should be in charge of all the various technologies of communication (p. 273)?" Cowan shows the drama of history efficiently. After the sinking of the luxury ocean liner the Titanic "Within days, journalists began demanding government regulation of wireless communication; within a week, Congress began taking testimony (p. 279)."

A similar drama enabled communication production of wireless equipment. "In 1915, the government order the end to the dozens of patent suits that were holding up the manufacturing of various electronic components. A patent pool was created for the duration of the conflict, allowing any company with adequate facilities to manufacture anything that the government needed (p. 281)."

Cowan takes us through the exciting days of the creation of the Radio Corporation of America. Her history includes foreshadowing: "As clever as they were, the men who created RCA did not anticipate the character of the mass market that radio broadcasting would very shortly create. On the night that the Titanic sank, one of the wireless telegraphic operators who worked around the clock to relay messages for American Marconi was a young Russian-Jewish immigrant, David Sarnoff. (p. 283)"

Cowan tells about the first radio newsflash and Westinghouse Corporation's broadcasting of baseball games.

Again and again, Cowan makes the point of control's ambiguity: "The entire history of electronic communication follows the patterns established in the early decades of the twentieth century in the history of radio: there are many surprises for individuals and organizations that think they can remain in control of the business of communication (p. 289)."

The subject turns to how UHF channels differ from VHF transmission, and finally to cable TV. "As a result, cable television exercised a powerful, decentralizing force, creating new means by which independent points of view could be heard. In 1990, the figure [of households with cable service] had reached 55 million-and the social control that the networks and their advertisers had once exercised over the content of broadcasts had ended (p. 292)."

In discussing the vacuum tube and the transistor, Cowan again concludes about the impossibility of control: "Thus the history of electronic components mimics the history of electronic communications: when new industrial and technical frontiers are opened, older companies suddenly discover that the cannot control areas they had once expected to dominate (p. 293)."

The reasons for lack of control are threefold, according to Cowan. Amateurs innovating; government weakening monopolies; and free market economy.

In the chapter "Biotechnology" chooses case studies of hybrid corn, penicillin, and the birth control pill. Technology and science now form a continuum. Fore example, "They [penicillin workers] were able to make these discoveries partly because they were skilled at experimental procedure and partly because, due to their training in the sciences, they managed to make connections between various phenomena. Yet at each step of the way, each of those scientists was also exploring applications (p. 317)."

Cowan discusses the novelty of the birth control pill. "The FDA took a long time examining the reports of all the clinical trials; this would be, after all, the first medication intended to be taken by healthy people, who would be taking it for very long periods of time, possibly for decades (p. 322)."

The resulting transformation of sexual discussion and premarital activity due to the birth control pill "was an outcome that only a very few birth control advocates had ever expected, as completely unintended as some of the consequences of penicillin and hybrid corn. (p. 324)"

The conclusion: "Every technological change has profound social and ethical consequences, and we cannot rely on experts to make wise decisions about those consequences for us (p. 326)."

Every chapter has either a formal conclusion, or occasionally, an ending statement. The explicit statements are ripe teaching points: Quickening the Pace for Technological Change," "The Myth of Self-Sufficiency," "Reasons for the Slow Pace of Technological Change," "The Unique

Character of American Industrialization," "Was Industrialization Good or Bad for Workers?" "The Paradox of Automobility," "Costs and Benefits of Military Sponsorship," and "The Ultimate Failure of Efforts to Control Electronic Communication."

Each chapter has suggestions for further reading.

The historian's conundrum of changing names is adeptly solved. For example, the easily read description of canals: "For centuries, the Iroquois had utilized a series of rivers, streams, and brooks to travel by canoe between what the European settlers called the Hudson River in the eastern part of the state and Lake Erie at its western border." (p. 102)

The book is extremely well organized and evenly written, although the quantity of source material necessarily varies. In Cohen's words, the first section "examines the technological character of part of Northern America during the very long historical period before the industrial revolution began and the United States was born " (p. 3). The second section explains "what makes industrial societies different from earlier societies" (p. 68). The last section "examines four technological systems that have dominated twentieth-century history: Automobiles, and their attendant roads and fuel sources; aircraft, spacecraft and also rockets; electronic communication devices, from wireless telegraphy to personal computers; and finally, biotechnologies, new foodstuffs, medications, and contraceptives (p. 221).

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