Authors contributing to this volume urge us to comprehend “technological competitiveness” in ways that widen and enrich the public-policy debate about the head-to-head competition between the leading industrial nations for technical and economic preeminence. The authors provide fresh clues on the strengths of up-and-coming nations as well as on the weaknesses of nations failing to stay abreast of the leading edge. It is surely refreshing that, owing to the historical grounding of this volume, which resulted from a three-day conference at Rutgers University in 1991, the up-and-coming nations include not only postwar Japan but also postwar France and turn-of-the-century Germany and the United States. The volume’s substantial international contributions (conference participants came from nine countries) liberate it from any nation-specific myopia about success and failure. The center holding the volume together is a spotlight on the electrical, electronic, and computer industries. Yet the very diversity of topics, technologies, and analytical approaches have made it difficult for the editor to impose a thematic unity on the essays or to limn historical lessons from them. The strengths of this volume rest on the individual essays, both longer substantial essays as well as shorter provocative pieces. Readers of this journal will be especially interested in the substantial essay by Boelie Elzen and Donald MacKenzie on supercomputing. No surprise that the story of supercomputers, which the authors define pragmatically as the fastest computers at any given time, revolves around Seymour Cray. His career after leaving Sperry Rand in 1957 resulted in a succession of legendary start-up companies, whose business and technical histories the authors relate succinctly. First was Control Data in 1957; later came Cray Research in 1972 and then Cray Computer in 1989. From Seymour Cray’s design table—or in his wake—came the legendary machines, including Control Data’s 3600 series, an early instance of computers designed primarily for compatibility with earlier models, a strategy IBM adopted near simultaneously with its System 360, and the great Cray models, each one designed beginning with “a clear sheet of paper” for the overriding goal of speed. A clear instance of the novel technical problems of supercomputers can be seen in the CRAY-1, which appeared in 1976. Achieving a clock cycle of 12.5 nanoseconds, a duration during which light in a vacuum travels about three meters, even less in wires, was especially challenging; the solution embraced superfast memories, novel cooling schemes, and the classic circular design (to reduce distances between components) that became a Cray hallmark. The authors also detail how vector and parallel processing were developed as alternative routes to speed. Aspects of their history—especially the charismatic role of Cray and the key role of nuclear weapons laboratories—are developed at greater length in the authors’ 1991 essays in the pages of this journal and in the (Dutch) Yearbook for Corporate History and History of Technology. What is fresh with this essay is the authors’ attempt to understand the broader sociotechnical dynamics of supercomputing, especially the importance of a network of designers, producers, and users that not only gave the field of supercomputing its early shape but also presently provides it with the capability of resisting change. Put briefly, the established linkages between the makers and users of
supercomputers have made it difficult for outsiders (e.g. NEC, Hitachi, and Fujitsu) to succeed in the field, dominated by Cray Research and IBM. Aspirants need not just the technical brilliance of a Seymour Cray, but the ability to deliver “total solutions.” Superfast hardware, once sufficient for the nuclear weapons laboratories that did their own programming, is no longer enough; now supercomputer purchasers require software capable of solving problems for varied applications and for huge data sets—as well as blinding computing speed.

The other essay focused on computing, by Martin Campbell-Kelly, elaborates on his recent book on ICL, the British computing giant. Here he examines the British government’s policy toward ensuring competitiveness in the computer field and the firm’s survival in the face of fierce American competition.

Several substantial essays analyze the competition between electricity and rival sources of energy at the turn of the 20th century. In explaining the mechanization of urban transit systems, Eric Schatzberg argues that considerations of relative costs do not account for electricity’s triumph over steam and cable and horse-powered trolley cars. Not only were costs difficult to determine; they were not known to the historical actors, as often is the case with introducing new and unproven technologies. (In her essay on nuclear power in France, Gabrielle Hecht finds engineers adept at manipulating cost estimates to legitimate their prior technical decisions.) The triumph of electric streetcars resulted from Americans’ widespread enthusiasm with electricity, which led managers and financiers to optimistic yet self-fulfilling prophecies about the costs of electricity, as well as from the structure of the electrical machinery industry. Because they wanted additional daytime loads to augment their nighttime lighting loads, both the Edison and the Thomson-Houston companies were financial backers of electric street railways. “Neither the horses, steam dummies, nor cable cars found similar dynamic and powerful allies in the American industrial structure,” Schatzberg writes (p. 237). Bernard Carlson scrutinizes the merger of these same two electrical companies to form General Electric in 1892. He finds that the merger had little to do with the desire of the merging companies to diversify their product lines by sharing complementary patents. Rather, he suggests that General Electric resulted from a desire to eliminate competition, the difficulties of raising large amounts of capital, and the efforts of managers and financiers to preserve and extend their organizational capabilities.

Like Schatzberg, Ulrich Wengenroth is impressed by how little certainty innovators can have about technology. He suggests that outstanding innovators have a rare ability to disregard the present characteristics of a given technology as well as the reigning assumptions about how it should be used. He presents a close and detailed account of introducing electric motors into the machine tool, steel, and textile industries to illustrate his point that shaping a technological potential and making it converge with society’s (evolving and flexible) demand is the crucial feat. Such convergence, he writes, represents “the very point where the knowledge of the laws of nature and society meet to form technology.” (p. 270)
The unpredictability of technology is echoed in several other essays. Kenneth Lipartito traces the virtual re-invention of the telephone in the 1910s and 1920s by regional telephone systems that disdained Bell Telephone’s monopolistic motto of “one policy, one system, universal service.” While Bell and AT&T focused on providing service to and linkages between urban centers, regional phone companies in the South and Midwest successfully extended cheap service to rural areas and helped reconceptualize the telephone from a business instrument to a device for promoting sociability. Eventually, if only because the regional systems signed up so many customers, Bell was compelled to respond to their successes. How such “oppositional” uses of technology challenge dominant sociotechnical paradigms is the theme of Susan Douglas’s essay, which provocatively outlines how amateur radio operators, hi-fi enthusiasts, and underground FM radio programmers each picked up a novel use for a technology that had been unseen or ignored by the dominant corporate interests.

The public policy advice that might be expected from a volume of this sort is largely cautionary. Brief essays by Stuart Leslie and Robert W. Smith declare that efforts to enhance a nation’s or region’s competitiveness on the once-successful models of Silicon Valley and Big Science projects will likely fail, the former due to the military underwriting that has withered away along with the Cold War and the latter owing the simplistic equation of technology as applied science. Since the editor’s thirty “lessons from history” appear to consider each essay individually, I offer three insights considering the essays collectively. First is the importance of how users construct new technologies and hence alter patterns of competition at all levels (Hecht, Douglas, Lipartito). Second is the crucial role of links between users and producers of technologies and knowledge (Stenberg, Takahashi, Elzen/MacKenzie, Schatzberg). The real strength of the Japanese technology research infrastructure, Lennart Stenberg hints, is the presence of joint research efforts and the resulting extensive, even competitive, collaboration between leading firms. Finally, the very term “technological competitiveness” already seems oddly anachronistic. Indeed, the ability to set the terms of a policy debate is half the debate itself. Now, the terms are no longer “competitiveness,” let alone “technology policy,” but on devising an effective technology “strategy.” One must hope that the ongoing debate will benefit from the sensitive insights about the dynamics of technology evident in this volume.

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