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Rendezvous with Information? Computers and Communications Networks in the United States

During the past few years, a spate of innovations in information technology—symbolized above all by the Internet—has sparked a blizzard of media coverage, as well as a number of ventures in social forecasting. Historical analogies with earlier epochs abound. By fulfilling one of humanity’s “most basic desires—to communicate,” one journalist opined in a well-regarded business magazine in 1995, the Internet would eventually rank ahead of the telephone and television (though behind the printing press and the automobile) as one of the most consequential innovations of the modern world.¹ In the following year, an influential sociologist declared that a “technological revolution” was “reshaping, at [an] accelerated pace, the material basis of society.”² For journalists and scholars alike, it has become customary to hail the present as the “information age.” At the Smithsonian’s Museum of American History, a major permanent exhibit has been organized around this theme. The United States, these prognosticators posit, has embarked on a rendezvous neither with liberalism or bureaucracy (as previous historians had claimed), but with information. Historical perspective on these pronouncements is sorely needed: hence this special issue of the *Business History Review*.

A leading feature of the current information technology boom, most commentators agree, is the rapid coupling of computers and communications networks into an interactive system. This system is so diverse and heterogeneous that it is increasingly termed an “information

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¹Christopher Anderson, “The Internet: The Accidental Superhighway,” *Economist* 336 (1 July 1995): 4.

²Manuel Castells, *The Rise of the Network Society* (Oxford, U.K., 1996), 1.

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infrastructure”—a phrase that gained currency during the public-policy debates of the 1990s over public access to new kinds of electronic media, such as the World Wide Web.

The coming of “digital convergence,” as the coupling of computers and communications networks is often called, has long been predicted by specialists in information technology.³ The phrase “information technology” itself dates back at least as far as 1958, when it was invoked by two business school professors to describe the changes in business management that would accompany the widespread adoption of the computer.⁴ Beginning in the 1970s, policymakers, engineers, and sociologists coined a series of neologisms—including “telematics,” “compunications,” and “informationalism”—to describe the emerging integration of information transmission with information processing.⁵ Only within the past few years, however, has the coupling of computers and communications networks begun to attract the sustained attention of historians. The four essays featured in this special issue of the *Business History Review* are part of this larger historical project.⁶ These techno-

³ The process of digital convergence, one scholar explains, “implies that a computer begins to incorporate the functionality of a communicating device, and the telephone takes on the functionality of a computer.” David B. Yoffie, “CHESS and Competing in the Age of Digital Convergence,” in *Competing in the Age of Digital Convergence*, ed. Yoffie (Boston, Mass., 1997), 2. Not everyone is convinced that digital convergence will lead to a consolidation of the information industry. For some dissenting views, see Patrice Flichy, *Dynamics of Modern Communication: The Shaping and Impact of New Communication Technologies* (London, 1995), 148–50; and Steven W. Usselman, “Computer and Communications Technology,” in Stanley I. Kutler, ed., *Encyclopedia of the United States in the Twentieth Century* (New York, 1996), vol. 2, 826–7. Flichy predicted that digital convergence will be slowed by the incompatible corporate cultures of the computer and telecommunications industries. Usselman highlighted the impediments to integration posed by government regulation and continuing technical innovations in transmission techniques. Even in the “age of interconnection,” Usselman concluded, the hallmarks of American communications will remain competition, innovation, and access (p. 827).

⁴ Harold J. Leavitt and Thomas L. Whisler, “Management in the 1980s,” *Harvard Business Review* 36 (Nov.–Dec. 1958): 41.

⁵ “Telematics” is French in origin and enjoyed a brief vogue in the United States following the translation of Simon Nora and Alain Minc’s *The Computerization of Society: A Report to the President of France* (Cambridge, Mass., 1980). See, for example, Dan Schiller, *Telematics and Government* (Norwood, N. J., 1982). “Compunications” was coined by Harvard engineering professor Anthony Oettinger, and is discussed briefly in Daniel Bell, “Teletext and Technology: New Networks of Knowledge and Information in Postindustrial Society,” in Bell, *The Winding Passage: Essays and Sociological Journeys, 1960–1980* (New York, 1980), 39. “Informationalism” (patterned on “industrialism”) is a favorite phrase of sociologist Manuel Castells. For an early usage, see Castells, *The City and the Grassroots: A Cross-Cultural Theory of Urban Social Movements* (Berkeley, Calif., 1983), 307–8. “Industrialism,” Castells explained, “is oriented towards economic growth, that is, towards the increasing of output. Informationalism is oriented towards technological development, that is, towards the accumulation of knowledge.”

⁶ The historical literature on computing is enormous. The most accessible general history is Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Ma-*

logical changes have occurred so recently that it will be useful for readers of the essays to remember that the origin, character, and significance of recent innovations in information technology remain a matter of debate.

It may be helpful, before turning to the essays themselves, to summarize a few of the issues that have preoccupied students of the subject. Perhaps the best way to begin is with a deceptively simple question: is the present an information age, and, if so, when did this age begin?

This question has elicited a wide range of responses. One media pundit, in a typically cavalier historical assessment, located the beginning of the information age on a particular day: November 16, 1992.⁷ Others traced its genealogy back over decades, centuries, and even millennia.⁸ There are even contrarians who deny that any epoch in the past or present can be usefully described in this way.

No one has worked more systematically to identify the information age with the recent past than Manuel Castells, a Spanish-born sociologist who teaches at the University of California at Berkeley. In his magisterial trilogy, *The Information Age: Economy, Society, and Culture* (1996–98), Castells explored the social, political, and cultural implica-

chine (New York, 1996). For a survey of topics of special relevance to business historians, see James W. Cortada, *Information Technology as Business History: Issues in the History and Management of Computers* (Westport, Conn., 1996), and Alfred D. Chandler Jr., "The Computer Industry: The First Half-Century," in David B. Yoffie, ed., *Computing in the Age of Digital Convergence* (Boston, Mass., 1997), 37–122. On the computer's technical development, see Paul E. Ceruzzi, *A History of Modern Computing* (Cambridge, Mass., 1998). Historical writing on communications networks is less abundant and more uneven. For a good journalistic account, see Wade Rowland, *The Spirit of the Web: The Age of Information from Telegraph to Internet* (Toronto, 1997). Also valuable is Usselman, "Computer and Communications Technology." For its political dimension, see Alan Stone, *How America Got On-Line: Politics, Markets, and the Revolution in Telecommunications* (Armonk, N. Y., 1997). The implications of digital convergence for historical writing is touched on in Paul N. Edwards, "Virtual Machines, Virtual Infrastructures: The New Historiography of Information Technology," *Isis* 89 (March 1998): 93–99. On the Internet, see Janet Abbate, *Inventing the Internet* (Cambridge, Mass., 1999) and Thomas P. Hughes, *Rescuing Prometheus: Four Monumental Projects that Changed the World* (New York, 1998), ch. 6.

⁷ Bob Metcalfe, "ISDN is the Information Age Infrastructure," *Infoworld* (Dec. 1992), cited in Daniel R. Headrick, *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700–1850* (New York, 2000), 3. Metcalfe picked this day because it marked the completion of the first transatlantic all-digital telephone call.

⁸ Twentieth-century events that are often hailed as harbingers of the information age include the invention of the transistor in 1947 and the patenting of the integrated circuit in 1959. For historian of technology Daniel R. Headrick, the beginnings of the information age went back to the age of "reason and revolution" that spanned the century and a half between 1700 and 1850. For cultural historians Michael E. Hobart and Zachary S. Schiffman, its origins were coterminous with the advent of writing in classical antiquity. Headrick, *When Information Came of Age*, esp. pp. 3–14; Michael E. Hobart and Zachary S. Schiffman, *Information Ages: Literacy, Numeracy, and the Computer Revolution* (Baltimore, 1998).

tions of the “new technological paradigm” that has emerged since 1970.⁹ This “information technology revolution,” Castells contended, originated in the United States and has since spread through much of the industrialized world.¹⁰ Its beginnings, both here and abroad, owed little to either the market or the multinational corporation—and even less to teenage hackers tooling away in their parents’ garage. Rather, it was a byproduct of political fiat, and, at least in the United States, a largely unintended outcome of military procurement decisions made by the federal government during the cold war. As Castells observed:

[M]ilitary contracts and Defense Department technological initiatives played decisive roles . . . Even the major source of electronics discovery, Bell Laboratories, in fact played the role of a national laboratory; its parent company (AT&T) enjoyed a government-enforced monopoly of telecommunications; a significant part of its research funds came from the U.S. government; and AT&T was in fact forced by the government from 1956, in return for its monopoly on public telecommunications, to diffuse technological discoveries in the public domain.¹¹

Castells took care to anticipate some of the more obvious objections to his thesis. For example, he flatly rejected the questionable proposition that information technology in itself determined the course of historical development. In addition, he readily conceded that information has been important in times and places—such as medieval

⁹ Castells, *Network Society*, 5. Volumes 2 and 3 are titled, respectively, *The Power of Identity* (Oxford, U.K., 1997), and *End of Millennium* (Oxford, U.K., 1998).

¹⁰ Castells, *Network Society*, ch. 1.

¹¹ Castells, *Network Society*, 59. Historians, of course, have long recognized the role of the military in the innovation process. For a sampling of recent work on this topic, see Agatha C. Hughes and Thomas P. Hughes, eds., *Systems, Experts, Computers: The Systems Approach in World War II and After* (Cambridge, Mass., 2000). For a general introduction, see Merritt Roe Smith, ed., *Military Enterprise and Technological Change: Perspectives on the American Experience* (Cambridge, Mass., 1985). Recent monographs that document the influence of military priorities on innovations in information technology include Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, Mass., 1996); Arthur L. Norberg and Judy E. O’Neill, *Transforming Computer Technology: Information Processing for the Pentagon, 1962–1986* (Baltimore, 1996); AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass., 1994); and Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York, 1992).

¹² On this point, Castells concurred with most of the essayists featured in Merritt Roe Smith and Leo Marx, eds., *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, Mass., 1994). Castells cited this volume approvingly, and took pains to defend himself against a similar critique. Castells, *Network Society*, 5. The informational society, he explained, was *not* the superstructure of a new technological paradigm.

Europe—far removed from the present-day United States.¹² Yet he remained convinced that a new and distinctively dynamic mode of social organization—originating in the United States, and structured around the generation, processing, and transmission of information—has since the 1970s supplanted industrialism as the “fundamental” source of productivity and power.¹³ To underscore the novelty of these recent innovations, he distinguished between *information* societies, which have existed for centuries, and *informational* societies, which have emerged only in the past thirty years. To highlight this distinction, Castells settled on the simple shorthand phrase “The Information Age”—to characterize the present era.¹⁴ Whether or not social theorists believed we were living in an information age, Castells concluded, was beside the point. A tour of the world’s leading urban centers in 1988—in Asia and South America as well as North America and Europe—persuaded him that recent changes have been profound and have created the world in which we now live.¹⁵

Among specialists in the American past, the notion that the United States has entered an information age has found a champion in Alfred D. Chandler Jr., the eminent scholar who taught for many years at the Harvard Business School. Like Castells, Chandler is well aware that information had played a vital role in economic life for centuries. Thus, in a recent essay on “The Information Age in Historical Perspective,” Chandler highlighted the central role of the postal system in the information infrastructure of the commercial republic, and of the telephone grid in the information infrastructure of the industrial nation.¹⁶ Yet the beginnings of the information infrastructure of the information age, Chandler contended, dated back no further than the 1920s, when the

Rather, it was the product of the “historical tension” between the material power of information processing and the individual’s quest for a meaningful cultural identity. Castells, *End of Millennium*, 67. At its most basic, Castells declared, his theme was the “bipolar opposition” in modern societies between global networks of instrumental exchange (“the Net”) and the individual’s highly particularistic and historically rooted search for meaning (“the Self”). Castells, *Network Society*, 3.

¹³ Castells, *Network Society*, 21.

¹⁴ Castells enjoined historians to compare and contrast the recent globalization of information technology, communications, and politics, with analogous transformations in the less distant past. Should historical scholarship challenge his conclusions, Castells promised to revise future versions of his work. Until it did, he remained convinced that such an inquiry would highlight the “radically new processes” in technology, finance, communications, and politics that have unfolded since the 1970s. Castells, *Power of Identity*, 244–5, fn. 4.

¹⁵ Castells, *Network Society*, 57; *End of Millennium*, 336 fn. 1.

¹⁶ Alfred D. Chandler Jr., “The Information Age in Historical Perspective,” in *A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present*, Alfred D. Chandler Jr. and James W. Cortada, eds. (New York, 2000), 8, 15.

emergence of a new power source—electronics—hastened the widespread commercialization of the vacuum tube.¹⁷

By the final decades of the twentieth century, Chandler declared, this infrastructure was complete.¹⁸ Perhaps its most distinctive feature was the unique role played by human ingenuity—for the first time in human history—as an energy source. Just as coal had once powered the railroad, and gasoline the automobile, so software—a product of mental agility—has become the “fuel” that propels the computer.¹⁹

While any characterization of the recent past as an information age has, at the moment, an undeniable allure, it has by no means gone uncontested. Among its most trenchant critics is Anthony Giddens, a sociologist who taught for many years at Cambridge University and is now director of the London School of Economics. At present, Giddens concluded, we live in a “surveillance society,” in which the transmission and processing of electronically encoded information has become central to business, politics, and social life. Yet this world was most emphatically *not* an “information age.” On the contrary, Giddens located the origins of the “information society” in the political decisions of nineteenth-century government administrators. “The initial leap forward in the administrative power generated by the nation-state,” Giddens observed, “was accomplished prior to the development of electronic communication. But modern societies have been ‘electronic societies’ longer than we ordinarily imagine and ‘information societies’ since their inception.”²⁰

Unlike Chandler, who organized his explanatory scheme around the advent of new forms of energy, Giddens focused on the emergence of novel methods for ordering time and space. To make his point, Gid-

¹⁷ Chandler, “Information Age,” 4.

¹⁸ *Ibid.*

¹⁹ Chandler and Cortada, “The Information Age: Continuities and Differences,” in Chandler and Cortada, *Nation Transformed by Information*, 290. For a similar conclusion, see Castells, *Network Enterprise*, 32. “For the first time in human history,” Castells postulated, in surveying the technological transformations of the recent past, “the human mind is a direct productive force, not just a decisive element of the production system.” For a critique of this view, see Dolores Greenberg, “Energy, Power, and Perceptions of Social Change in the Early Nineteenth Century,” *American Historical Review* 95 (June 1990): 693–714.

²⁰ Anthony Giddens, *The Nation-State and Violence*, vol. 2 of *A Contemporary Critique of Historical Materialism* (Berkeley, Calif., 1987), 177–8. See also Giddens’s *Power, Property, and the State*, vol. 1 of *A Contemporary Critique of Historical Materialism* (Berkeley, Calif., 1981), 169–176. Historians share Giddens’s fascination with the nineteenth-century origins of present-day information technologies. For example, in *Computer: A History of the Information Machine*, Martin Campbell-Kelly and William Aspray credit Victorian mathematician and economist Charles Babbage with having envisioned a machine that embodied “almost all the important functions of the modern digital computer.” The Mark I, the early computer that IBM built at Harvard under the supervision of Howard H. Aiken during the Second World War, was, they concluded, fairly described as “Babbage’s Dream Come True.” Campbell-Kelly and Aspray, *Computer*, 54, 76.

dens provocatively declared—in a direct assault on Chandlerian orthodoxy—that the train schedule (a time–space ordering device) was a more transforming innovation than the steam engine.²¹

Other critics highlighted continuities between recent developments in information technology and the earlier history of the industrial era. Every age has its “godword,” cultural historian Theodore Roszak sardonically observed: ours was “information.”²² Roszak conceded the emergence, since the 1970s, of a large and powerful information industry. Yet he dismissed the idea that we had entered an information age as more “journalistic glitter than social substance.” For Roszak, it was simply “nonsensical” to claim that we have left the industrial era behind: “Information technology is an outgrowth of the existing industrial system, which has always been dependent on the ‘knowledge’ that undergirds invention, management, and marketing. Like the electrical, automative, or chemical technologies that came before, high tech arises as another stage in the ongoing industrial process.”²³

The four essays in this special issue cannot resolve the many questions raised by these various commentators. The events are simply too recent, and the future too uncertain. Yet they can provide a historical perspective on how we arrived at our current situation and can illus-

²¹ Giddens, *Nation-State and Violence*, 174–75. For an extreme statement of this view, see Frank Webster, *Theories of the Information Society* (London, 1995). The “informatisation” of society, Webster contended, has been going on for several centuries, and has not changed in the past few decades in any fundamental way. From Webster’s standpoint, today’s information networks are little more than minor variants on the postal system, the telegraph, and the telephone. “From at least the early days of the postal service,” he added, “through to telegram and telephone facilities, much economic, social, and political life is unthinkable without the establishment of such information networks. Given this long-term dependency and incremental, if accelerated, development, why should it be that in the 1980s commentators began to talk in terms of ‘information societies?’” (p. 20).

²² Theodore Roszak, *The Cult of Information: A Neo-Luddite Treatise on High Tech, Artificial Intelligence, and the True Art of Thinking*, 2nd. ed. (Berkeley, Calif., 1994), 19. For an elaboration of this position—which, in large measure, represented a *response* to central themes of Daniel Bell’s *Coming of Post Industrial Society* (1973)—see Jorge Reina Schement, “The Origins of the Information Society in the United States: Competing Visions,” in Jerry L. Salvaggio, *The Information Society: Economic, Social, and Structural Issues* (Hillsdale, N. J., 1989), 29–50.

²³ Roszak, *Cult of Information*, 29. For a somewhat different critique of the “information age” concept, see Paul E. Ceruzzi’s *History of Modern Computing*. In this work, Ceruzzi denied that the present is an “information age,” since, in his view, the past few decades have been transformed *not* by information, but by computing (pp. 2–3). Ceruzzi also challenged the related notion—which had been prominently featured in the “Information Age” exhibit at the Smithsonian—that the Internet represented the “marriage” between communications and computing. On the contrary, Ceruzzi characterized the Internet as “yet another takeover, by digital computing, of an activity (telecommunications) that had a long history based on analog techniques” (p. 309).

trate some of the themes that historians are exploring. The essays focus on the period between 1950, when the computer was first emerging as a business tool, and 1995, when the final segment of the Internet was transferred to the private sector. In so doing, they provide a baseline for considering changes that have occurred not only more recently, but also in the most distant past.

The conceptual foundation for the recent coupling of computers and communications networks is the theme of Thomas Haigh's essay on the "information systems" movement in American business. Haigh documents how, beginning around 1950, a small yet enterprising group of technical staff specialists—the "systems men"—popularized the then-novel notion of information as an abstract entity that, if properly collected, stored, retrieved, and analyzed, could become a master key of corporate strategy. Once the computer had been adopted by many leading American corporations, the system men's campaign blossomed into a full-scale crusade. Yet, prior to 1968, the endpoint of Haigh's study, they had conspicuously failed to translate into reality their grand vision of a "total management information system." In hindsight, this is perhaps unsurprising: the IBM personal computer, after all, would not make its initial appearance as an office appliance until 1981. Yet, by popularizing the idea that computers could be a communications medium, the systems men had helped to lay the intellectual groundwork for the current boom in information technology.

Of the many innovations that have hastened the coupling of computers and communications networks, none are more essential than the integrated circuit and software. Each is treated here in separate essays by Leslie Berlin and Martin Campbell-Kelly. The integrated circuit is not only a key component in the modern computer; it is also widely regarded as one of the most important technological innovations of the twentieth century.²⁴ By reconstructing the early business career of the engineer Robert Noyce, Berlin documents the chain of circumstances that led to its invention. Noyce, a talented entrepreneur, oversaw a team of gifted engineers at Fairchild Semiconductor during the 1950s and 1960s. In 1959, Noyce secured a patent for an integrated circuit that he had helped to develop at Fairchild. While Noyce proved to be extraordinarily successful at sustaining a highly creative research environment, he lacked the patience and persistence to monitor production schedules, track inventory, and meet customer demand. As a consequence, he proved unable to translate his ideas into a steady stream

²⁴ Chandler, "Computer Industry," 37.

of commercially viable products. Only after 1969, when Noyce left Fairchild to help found Intel, would he successfully combine cutting-edge engineering with high-volume production of integrated circuits.

Martin Campbell-Kelly's essay on the recent history of the software industry provides an analogous case study in the complex nature of the innovative process. Prior to the introduction in 1981 of IBM's first microcomputer, IBM had dominated the software business, which had become a five-billion-dollar business by 1975. Yet IBM chose not to develop the operating system for its own microcomputer. Instead, it subcontracted this task to Microsoft, a fledgling firm headed up by a then largely unknown entrepreneur named Bill Gates. Campbell-Kelly traces the subsequent history of the software industry, focusing not only on the meteoric rise of Microsoft, but also on the triumphs—and travails—of some of its most important rivals. In so doing, he considers the reasons for Microsoft's success and for the successes and failures of its competitors.

The advent of the Internet has marked the emergence of a new stage in the coupling of computers and communications technology into a single interactive system. Janet Abbate's essay documents the unusual government-business collaboration that fostered the development of this remarkable innovation. It is well known that the Internet grew out of the ARPANET, a military-backed project funded by the Department of Defense. Abbate demonstrates how government sponsorship shaped several of the Internet's most distinctive features. In particular, she shows how government administrators hastened the establishment of a flexible, decentralized, and somewhat anarchic information infrastructure. To meet the idiosyncratic needs of the military, ARPANET administrators during the 1960s and 1970s linked a heterogeneous array of computers and encouraged the engineers, who were at this time the principal users of the system to participate actively in its design. Only later, after the government had solved many of the most fundamental technical issues, would Internet-related ventures emerge as attractive opportunities for private-sector entrepreneurs. These entrepreneurs, in turn, would soon develop various user-oriented refinements—such as e-mail—that testify to the creative potential the government had helped to unleash.

Each essay in this special issue displays the distinguishing marks of the best historical scholarship. Grounded in the relevant primary sources, they all wrestle with the evidence, venture defensible conclusions, and describe and explain significant events that began and ended at a specific point in the past. Each locates the subject in its political

and cultural environment as well as its economic and technological setting. In the process, the authors illustrate the potential of an emerging, contextualist tradition in American business history.

Perhaps the most salutary feature of these essays is the extent to which they highlight the strikingly different assumptions about the relation of computers and communications networks that had been held until fairly recently by government officials and business leaders alike. As late as 1968, as Thomas Haigh's opening essay recounts, one could credibly assert—as one McKinsey consultant did—that the computer terminal would *never* become a fixture on the business executive's desk. Janet Abbate relates how, in 1973, not even the government administrators overseeing the computer network out of which the Internet would eventually evolve envisioned the possibility of this information infrastructure one day becoming a communications medium.

Equally noteworthy is the authors' coverage not only of business success—a traditional focus for scholarship in business history—but also of business failure. The failure described by Haigh is perhaps the most spectacular: as late as 1968, the systems men's dream of a total management information system remained "ubiquitous in theory and unknown in practice." Berlin, Campbell-Kelly, and Abbate, also devote considerable space to ventures that failed. Thus, we learn about Microsoft's competitors, Noyce's failure to mass produce integrated circuits at Fairchild, and the inability of giant enterprises such as AT&T and the British Post Office to capitalize on the early promise of the Internet.

A final theme that these essayists share is a curiosity about the federal government's role as a promoter of innovation. In the case of the Internet, the government contribution is unmistakable. Much to the consternation of libertarian media pundits, who have done their best to downplay these links, the Internet is unmistakably a child of the military-industrial-academic complex.²⁵ It is but the most recent in a long series of information-technology innovations to have been shaped by public policy. The government has supported the American information infrastructure for more than two hundred years, from the postal system and the telephone industry to the computer and the semiconductor.²⁶ It may not be altogether coincidental that the most popular Internet application is known not as the *e-telegram*, but as *e-mail*.

²⁵ See, for example, Bob Metcalfe, "A Look Back at a Revolution of Communications and Where It Has Brought Us Today," *Infoworld*, 27 Dec. 1999–23 Jan. 2000, 76.

²⁶ For a related discussion, see Richard R. John, "Recasting the Information Infrastructure for the Industrial Age," in Chandler and Cortada, *Nation Transformed by Information*, 55–105, and John, "The Politics of Innovation," *Daedalus* 127 (Fall 1998): 187–214.

The critical role of government military contracting in the rise of the semiconductor industry is fully documented by Berlin. Though Robert Noyce eschewed military contracts at Fairchild, his business milieu was profoundly shaped by government funding and procurement standards. Noyce's management style was honed in such a setting; he operated *as if* he had been fulfilling military orders, even when he courted other markets.

Direct government involvement is less conspicuous in Haigh's survey of the information systems movement and Campbell-Kelly's overview of the software industry. Yet Haigh does document the intellectual influence on the systems men of real-time computing, a prominent feature of SAGE, an antimissile defense project funded by the Department of Defense.²⁷

The role of the government in the rise of the software industry was more oblique. Campbell-Kelly discounts the arguments of Microsoft critics who contend that the firm's bundling of its operating system with various applications—including a Web browser—constituted a violation of existing antitrust statutes. Indeed, his article can be read as a brief for the defense in the Justice Department lawsuit against Microsoft. Campbell-Kelly's conclusion departs sharply from the assessment of economists, such as David C. Mowery, who attribute much of the competitive vigor of the American software industry to a tough anti-trust policy that dated back to the 1960s, when IBM was dissuaded by legal worries from monopolizing the market. Campbell-Kelly is more impressed by Microsoft's economic vitality—and, more broadly, by the rapid pace of technological innovation within the industry.²⁸

The essays in this special issue help to frame the question that Manuel Castells has posed: To what extent do recent developments in information technology mark a decisive break with the past? Of the four essays, only Abbate's examines innovations in the 1970s, the decade in which, according to Castells, the information age began. Only Campbell-Kelly's treats innovations that originated in the more recent past.

Historians of big business in the United States sometimes treat the 1880s as a watershed that marked the birth of the modern industrial

²⁷ On SAGE, see Thomas P. Hughes, *Rescuing Prometheus: Four Monumental Projects that Changed the Modern World* (New York, 1998), ch. 2.

²⁸ David C. Mowery, "The Computer Software Industry," in David C. Mowery and Richard R. Nelson, eds., *Sources of Industrial Leadership: Studies of Seven Industries* (Cambridge, U.K., 1999), 147. On the influence of antitrust prosecution on the early history of the software industry, see also Chandler, "Computer Industry," 61. For a perspective closer to Campbell-Kelly's, see Stan J. Liebowitz and Stephen E. Margolis, *Winners, Losers, and Microsoft: Competition and Antitrust in High Technology* (Oakland, Calif., 1999).

corporation. Prior to the 1880s, they contend, bureaucracy—in either the public or the private sector—had yet to emerge. After the 1880s, in contrast, bureaucracy rapidly became the single most important catalyst for change.²⁹

None of the essays in this issue consider events that occurred before 1950. Yet by broadening the unit of analysis from the firm and industry to the infrastructure, they highlight aspects of American business that challenge the bifurcation of its history into a pre-1880 pre-bureaucratic past and a post-1880 bureaucratic present. Historians have an obligation, a wise practitioner once wrote, to avoid treating the past anachronistically as the “present writ small.” If business historians follow the lead of the contributors to this special issue, then it will no longer make sense to consign to oblivion events that took place *before* the rise of the modern industrial corporation. Our rendezvous with information, after all, began long before the sale of the first personal computer, or the laying of the first fiber-optic cable.

To gain a further perspective on Castells’s question, it is useful to turn to a recent quantitative study prepared by the economist Robert J. Gordon for the National Bureau of Economic Research. According to Gordon, recent innovations in information technology—including the Internet—have been less important in spurring economic development than the cluster of innovations that transformed the American economy in the late nineteenth century, and that included electricity, the internal combustion engine, and the telephone. The Internet, in contrast, has shaped a relatively narrow segment of the total economy, and, in large measure, merely substituted one mode of communication and entertainment for another. It has neither lowered the cost of computing nor created new forms of communication and entertainment, nor has it even supplanted existing modes of consumer-product distri-

²⁹ See, for example, Louis Galambos, *America at Middle Age: A New History of the United States in the Twentieth Century* (New York, 1983), 16. “The contrast between our history before 1900 and after that date could hardly more complete,” Galambos declared. In the colonial era and nineteenth century, Americans aggressively expanded their territorial domain; in the twentieth century, in contrast, they settled down to enjoy the fruits of a “far-reaching capitalist order.” In this schema, the period prior to the 1880s is notable primarily for the *absence* of bureaucracy—and, by implication, of the infrastructures that bureaucracy helped to sustain. Only after the 1880s, the period with which Galambos is primarily concerned, would bureaucracies become, in his view, the single most significant phenomena in American history. On this point, see Louis Galambos, *The Public Image of Big Business in America, 1880–1940: A Quantitative Study in Social Change* (Baltimore, 1975), 3. The rhetorical question in the title of my essay is a tribute, and a rejoinder, to Galambos’s celebrated quip that the United States in the twentieth century has been on a “rendezvous” with bureaucracy. Louis Galambos, “Technology, Political Economy, and Professionalization: Central Themes of the Organizational Synthesis,” *Business History Review* 57 (Winter 1983): 471.

bution, such as mail order.³⁰ In short, it is—at least for the moment—less the harbinger of a new age than a high-tech hybrid of the postal system and the home entertainment center.

Gordon's analysis, of course, is predicated on the assumption that the future information infrastructure will remain restricted to its current uses. This view is almost certainly too limiting. Should, for example, the managers of America's leading corporations find a way to deploy the Internet throughout the entire range of their operations, this application alone might well eclipse its current uses.

Whether or not the Internet becomes an indispensable business tool might well furnish a theme for a future special issue of the *Business History Review*. Even if it does, however, it is by no means self-evident that it will retain the luster that it has acquired in the past few years. The history of earlier information-technology innovations—such as mail delivery, telegraphy, and radio—strongly implies, paradoxical as it might seem, that the Internet will lose its glamour even as it becomes a more pervasive feature of American life. Business-to-business commerce is, of course, a key feature of the American economy. Yet, if the past is any guide, revolutions in wholesaling rarely rank high as harbingers of a new social order. If the Internet follows the trajectory of the postal system and the telephone grid, it will eventually become “second nature.”³¹ It may, that is, become such an indispensable feature of society that—for this very reason—it is ordinarily invisible and taken for granted. Should this occur, this special issue will serve as a reminder of the extravagant hopes with which—at the dawning of the new millennium—the coupling of computers and communications networks had been invested, and of the earlier infrastructure out of which it had emerged.

³⁰ Robert J. Gordon, “Does the ‘New Economy’ Measure Up to the Great Inventions of the Past?” Working paper 7833 (Cambridge, Mass.: National Bureau of Economic Research, 2000).

³¹ For an exploration of this concept in the context of the infrastructural development of a nineteenth-century American city, see William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York, 1991).