Does Technology Drive History?
The Dilemma of Technological Determinism

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Introduction

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If "determinism" sounds "cold and mathematical," as William James once noted,[1] then "technological determinism" surely sounds even more forbidding. Yet our subject is not nearly as esoteric as that arcane name suggests. By now, most people in modernized societies have become habituated to the seeming power of advancing technology (and its products) to change the way they live. For them, indeed, the steady growth of that power is just another self-evident feature of modern life, an obvious fact that calls for no more comment than the human penchant for breathing. As an explicit idea "technological determinism" may mean nothing to them, but the phenomenon it ostensibly represents is an omnipresent aspect of their awareness.

A sense of technology's power as a crucial agent of change has a prominent place in the culture of modernity. It belongs to the body of widely shared tacit knowledge that is more likely to be acquired by direct experience than by the transmittal of explicit ideas. Anyone who has witnessed the advent of the computer, for example, knows a great deal about how new technology can alter the very texture of daily life, and has gained this understanding as more than a bystander. Even those who do not use computers have had to accommodate their ways to some of its requirements in supermarkets, post offices, banks, libraries, schools, airlines, hospitals, or the military services—few departments of contemporary life remain unaffected by the new information technology. But of course the computer is only one of the radically new science-based technologies—along with television, jet aircraft, nuclear weaponry, antibiotics, the contraceptive

1. "The Dilemma of Determinism," in *Essays in Pragmatism* (Hafner, 1951), p. 40.

pill, organ transplants, and biogenetic engineering—whose transformative power has been experienced by millions alive today. For some three centuries, direct firsthand experience of that power has been a well-nigh universal feature of life in developed and developing countries.

The collective memory of Western culture is well stocked with lore on this theme. The role of the mechanic arts as the initiating agent of change pervades the received popular version of modern history. It is embodied in a series of exemplary episodes, or mini-fables, with a simple yet highly plausible before-and-after narrative structure. Before the fifteenth century, for example, Europeans are said to have known little or nothing about the western hemisphere; after the compass and other navigational instruments became available, however, Columbus and his fellow explorers were able to cross the Atlantic, and the colonization of the New World quickly followed. Newly invented navigational equipment is thus made to seem a necessary precondition, or "cause," of—as if it had made possible—Europe's colonization of much of the world.

Similarly, the printing press is depicted as a virtual cause of the Reformation. Before it was invented, few people other than the clergy owned copies of the Bible; after Gutenberg, however, many individual communicants were able to gain direct, personal access to the word of God, on which the Reformation thrived. As a final example, take the story, favored by writers of American history textbooks, about the alleged link between the cotton gin and the Civil War. In the late eighteenth century, slavery was becoming unprofitable in the American states; but after Eli Whitney's clever invention, the use of African slaves to harvest cotton became lucrative, the reinvigorated slavery system expanded, and the eventual result was a bloody civil war.

The structure of such popular narratives conveys a vivid sense of the efficacy of technology as a driving force of history: a technical innovation suddenly appears and causes important things to happen. It is noteworthy that these mini-fables direct attention to the consequences rather than the genesis of inventions. Whether the new device seems to come out of nowhere, like some *deus ex machina,* or from the brain of a genius like Gutenberg or Whitney, the usual emphasis is on the material artifact and the changes it presumably effects. In these episodes, indeed, technology is conceived in almost exclusively artifactual terms, and its materiality serves to reinforce a

tangible sense of its decisive role in history. Unlike other, more abstract forces to which historians often assign determinative power (for example, socio-economic, political, cultural, and ideological formations), the thingness or tangibility of mechanical devices—their accessibility via sense perception—helps to create a sense of causal efficacy made visible. Taken together, these before-and-after narratives give credence to the idea of "technology" as an independent entity, a virtually autonomous agent of change.

Today a similar idea informs the popular discourse of technological determinism. It is typified by sentences in which "technology," or a surrogate like "the machine," is made the subject of an active predicate: "The automobile created suburbia." "The atomic bomb divested Congress of its power to declare war." "The mechanical cotton-picker set off the migration of southern black farm workers to northern cities." "The robots put the riveters out of work." "The Pill produced a sexual revolution." In each case, a complex event is made to seem the inescapable yet strikingly plausible result of a technological innovation. Many of these statements carry the further implication that the social consequences of our technical ingenuity are far-reaching, cumulative, mutually reinforcing, and irreversible.

An invention, once introduced into society, is thus depicted as taking on a life of its own. For example, the continuing improvement of the computer has followed a kind of internal logic (a logic embedded in its constituent material components and its design), so that each "generation" of enhanced computational sophistication has led, in a seemingly predetermined sequence, to the next. As the use of the computer spreads, more and more institutions have to reconfigure their operations to comport with the new capacities and constraints it creates. In the process, society as a whole becomes increasingly dependent on large, intricately interrelated technical systems. The whole network—a system of systems, or a megasystem—becomes the indispensable technological armature of the economy. Its continued functioning is a precondition for the reproduction of the entire social order.

Such a deterministic view of technology is a pervasive theme of the mass media nowadays. Take, for example, "The Machine That Changed the World," a 1993 documentary television series about the coming of the computer. The narrative structure is based on the stock before-and-after model, and the title neatly captures the idea—evidently appealing to large audiences—that advancing technology

has a steadily growing, well-nigh irresistible power to determine the course of events. This version of the idea is what James calls "hard determinism."[2]

As the essays in this volume suggest, the idea of technological determinism takes several forms, which can be described as occupying places along a spectrum between "hard" and "soft" extremes. At the "hard" end of the spectrum, agency (the power to effect change) is imputed to technology itself, or to some of its intrinsic attributes; thus the advance of technology leads to a situation of inescapable necessity. In the hard determinists' vision of the future, we will have technologized our ways to the point where, for better or worse, our technologies permit few alternatives to their inherent dictates. To optimists, such a future is the outcome of many free choices and the realization of the dream of progress; to pessimists, it is a product of necessity's iron hand, and it points to a totalitarian nightmare.

Critics of "hard" determinism question the plausibility of imputing agency to "technology." After all, they argue, the word is merely a modern abstract noun for a certain category of the arts—what used to be called "the mechanic arts." There are hundreds of technologies, and few assertions about "technology" apply with equal validity to all of them. In spite of the existence of an engineering profession, technology is not an organized institution; it has no members or stated policies, nor does it initiate actions. How can we reasonably think of this abstract, disembodied, quasi-metaphysical entity, or of one of its artifactual stand-ins (e.g., the computer), as the initiator of actions capable of controlling human destiny? To note the reified character of this presumed agent is to recall that—until now, at least—no technology, no matter how ingenious and powerful, ever has initiated an action not preprogrammed by human beings.[3]

2. Ibid.

3. The proviso "until now" is included in deference to the claims often made nowadays on behalf of the imminent capacity of scientists and engineers, with the help of artificial intelligence, robotics, biogenetic technology, and artificial-life theory (or some combination thereof), to create a suprahumanly intelligent, self-directing, self-replicating agent, or "mind child," whose existence will in effect render obsolete the traditional boundaries between the mechanical and the organic, between art and nature. This claim may be seen, in fact, as the current terminus of one popular tradition of technological determinism.

At the other end of the spectrum, the "soft" determinists begin by reminding us that the history of technology is a history of human actions. To understand the origin of a particular kind of technological power, we must first learn about the actors. Who were they? What were their circumstances? This approach leads willy-nilly to the more exacting and productive questions in the historian's tool kit. Why was the innovation made by these people and not others? Why was it possible at this time and this place rather than another time or place? Who benefited, and who suffered? In lieu of a "hard" monocausal explanation for the genesis of the presumed determinative power of a technical innovation, these questions suggest the greater plausibility of a "soft," less specific, multivalent explanation.[4] Instead of treating "technology" *per se* as the locus of historical agency, the soft determinists locate it in a far more various and complex social, economic, political, and cultural matrix.

The soft determinists' viewpoint may be illustrated by the way they might explain the growing credence given to the idea of technological determinism itself. An obvious historical starting point for this tendency is the marked acceleration in the rate of technical innovation that occurred, according to a broad current consensus of knowledgeable historians, in the West in the seventeenth and eighteenth centuries. But why did a propensity to innovate come to the fore at that time in the British Isles, in the North American colonies, and in Western Europe? Historians have proposed a great variety of well-documented, well-reasoned answers. Some focus on the particular efficacy of certain material, geographic, demographic, and socioeconomic preconditions: access to raw materials or markets; the existence of a mercantile capitalist economy; the operation of the profit motive; the accumulation of capital; the availability of a needy, teachable, exploitable labor force. Others attribute causal primacy to intellectual, cultural, or ideological factors: the extent of secular learning; the existence of a reservoir of entrepreneurial or financial skills; the presence of scientific rationalism, Christianity, the Protestant work ethic, or an artisanal ethos. Indeed, almost every identifiable attribute of early modern Western societies has been proposed as the putatively critical factor. Although it seems probable that the answer is to be found in some distinctive combination of these factors, the truth is that no one can say exactly what accounts for the special propensity to innovate that *initially* developed in the West in the early modern

era.[4] Thus agency, as conceived by "soft" technological determinists, is deeply embedded in the larger social structure and culture—so deeply, indeed, as to divest technology of its presumed power as an independent agent initiating change.

And yet we need only look at the world of the 1990s to revivify the intuitively compelling idea that technological innovation is a major driving force of contemporary history, if not the primary driving force. Even if the critique of hard determinism is valid, it may only lead us to alter the status of technology to that of a second-order agent of history. Its power to effect change may be derived from certain specific socio-economic and cultural situations, but to say that is only to relocate the *origin* of that power. Once it has been developed, its determinative efficacy may then become sufficient to direct the course of events. In that case "technological determinism" has been redefined; it now refers to the human tendency to create the kind of society that invests technologies with enough power to drive history. If any particular form of human power now has an outstanding claim to that distinction, it probably is technological power. Indeed, one of our chief reasons for collecting these essays is our sense of the increasingly strong hold of that claim on the public imagination. People seem all too willing to believe that innovations in technology embody humanity's choice of its future. Whether that choice is an expression of freedom or an expression of necessity is the dilemma these essays are intended to elucidate.

Many of these essays were first delivered at a two-day workshop held at MIT in December 1989. In addition to the contributors to this volume, the participants included James Bartholomew, Nicholas Bloembergen, Alfred D. Chandler, Jr., I. Bernard Cohen, Jill K. Conway, Colleen Dunlavy, Gerald Holton, Robert Howard, Carl Kaysen, Kenneth Keniston, Philip Khoury, Bruce Mazlish, and William H. McNeill. Their contributions and interventions proved essential in helping us establish the topical and thematic outlines of the book.

4. The word "initially" requires special emphasis here because the recent development of technological sophistication in Japan, South Korea, Taiwan, and Singapore undermines any notion of an inherently or permanently distinctive affinity between the West and technological innovation.

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