Does Technology Drive History?
The Dilemma of Technological Determinism

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The Political and Feminist Dimensions of Technological Determinism

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Like most of the contributors to this volume, Rosalind Williams is critical of scholars who emphasize "economic agendas and rational motives" when discussing processes of technological change. The source of such thinking is to be found in the Enlightenment conception of progress, which, she maintains, fostered the belief in technological determinism. The argument that technology is inherently rational disturbs Williams because it obscures the fact that technological systems can be, and often are, designed for authoritarian purposes of control and domination. Drawing primarily on the writings of Lewis Mumford, she maintains that we need "to understand the motives behind the construction of powerfully determinative technologies." She also points to the fundamental "dissonance between technological determinism and a feminist understanding of history," noting that, while women have played "highly significant" roles in the development of "democratic biotechnics," they have been "routinely excluded from the creation and operation of authoritarian monotechnics." A feminist perspective, by contrast, recognizes the inextricable relationship that exists between the social and the organic, between human and nonhuman nature. According to Williams, the recognition of such interdependencies is essential. "We dwell in an environment where natural and technological processes have merged," she observes. Any theory of history that assumes the contrary "is plainly unrealistic and simplistic."

The many varieties of technological determinism can be reduced to a three-word logical proposition: "Technology determines history." In four of the best-known overviews of the subject, Donald MacKenzie, Langdon Winner, Robert Heilbroner, and Bruce Bimber all get around to analyzing each of these three words.[1] Let us begin with this approach and see how far it takes us.

What is "technology," for starters? There seems to be general agreement that any definition of technology must begin with material objects, but in many cases the definition extends well beyond that material core. Because the Marxist term "forces of production" includes labor power, MacKenzie notes, it "admits conscious human agency as a determinant of history; it is people, as much as or more than the machine, that make history."[2] Cultural critics such as Jacques Ellul and Lewis Mumford have argued that knowledge and ideology are inherently part of the meaning of "technology."[3] In recent years, the meaning of "technology" has been broadened as historians have come to favor the "technological system" rather than the "machine" or the "invention" as the basic unit of analysis.[4] The concept of the technological system has tended to expand imperialistically into social, cultural, economic, and political domains. Even the nonhuman natural environment may be incorporated into the technological system as a resource, as a sociologized actor (which "cooperates" or "resists"), or as a dump site.[5]

1. Donald MacKenzie, "Marx and the Machine," *Technology and Culture* 25 (July 1984): 473–502; Robert Heilbroner, "Do Machines Make History?" *Technology and Culture* 8 (July 1967): 333–345 (also in this volume); Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (MIT Press, 1977); Bruce Bimber, "Karl Marx and the Three Faces of Technological Determinism," *Social Studies of Science* 20 (May 1990): 333–351.

2. MacKenzie, p. 477.

3. See Kenneth Keniston, "Defining 'Technology'," *STS News*, Massachusetts Institute of Technology, (March 1990): 1–3.

4. See the discussion of the three levels of technology (objects, processes, and knowledge) on pp. 3 and 4 of *The Social Construction of Technological Systems*, ed. W. E. Bijker et al. (MIT Press, 1987).

5. On the socialization of nature see Rosalind Williams, "Cultural Origins and Environmental Implications of Large Technological Systems," *Science in Context* 6, no. 2 (1993): 75–101.

For example, the concept of a "Fordist system," or "Fordism," includes much of what used to be called "social context"—management strategies and modes of labor control, as well as techniques of mass consumption.[6] But the core of this multifaceted system is still commonly assumed to be the assembly line. The defining center of the conceptual constellation is technical; it is the hard fact to which the other social, cultural, and natural "factors" are "related." Rather than being said to "act upon" society, the technological system simply incorporates it. By encouraging us to think in terms of a material core dominating nonhuman or immaterial "other factors," the language of technological systems can become a covert form of technological determinism.

Another source of confusion about the term "technology" is the common assumption that certain technologies are more primary, more significant—more determinative, if you will—than others. For example, steam engines and automobiles are tacitly considered more powerful as determinants than household or entertainment technologies. The division of production into primary, secondary, and perhaps tertiary sectors can be especially befuddling when applied to a late capitalist economy, where the proportion of primary production in the traditional sense of sustaining life is so small. As Raymond Williams observes, "By the time you have got to the point when an EMI factory producing discs is industrial production, whereas somebody elsewhere writing music or making an instrument is at most on the outskirts of production, the whole question of the classification of activities has become very difficult."[7]

In the same discussion, Williams takes note of similar ambiguities surrounding the crucial verb "determines." In Williams's view, the common assumption that determination is equivalent to limitation reflects a bourgeois view of society as a system of constraints on a supposedly free preexisting individual. Williams insisted that determination is also pressure, in the sense of ongoing processes that may be internalized far below the level of consciousness.[8] Although Wil-

6. See, for example, the chapters on Fordism in David Harvey's book *The Condition of Postmodernity* (Blackwell, 1989). Harvey, however, does not succumb to the covert technological determinism described here.

7. Raymond Williams, *Politics and Letters: Interviews with the New Left Review* (Verso, 1979), p. 353.

8. Ibid., p. 356. One of the best brief summaries of the meaning of deter-

liams does not invoke Antonio Gramsci in this discussion, elsewhere he reminds us of the importance of Gramsci's analysis of hegemony for any thorough understanding of determinism. Not only is the range of choices extremely limited in any historical situation, Gramsci reminds us; that situation also powerfully shapes the minds of those who choose. "[Hegemony] is a set of meanings and values which as they are experienced as practices appear reciprocally confirming. It thus constitutes a sense of reality for most people in the society. . . ." The most fundamental understanding of what is possible and what is not—of what is determined and what is not—is bound up with the hegemonic order.[9]

A more traditional way of distinguishing various levels of determinism is to speak of "hard" and "soft" varieties. Such distinctions are inherently vague, and they persist when other verbs ("influence," "shape," or, more grotesquely, "impact") are substituted for "determine." The problem of establishing levels of determination is further complicated by the fact that in science—from which concepts of determinism are so largely borrowed, and which is also divided into "hard" and "soft" varieties—modern investigators prefer to speak of probable trends (perhaps highly probable, but still only probable) rather than inevitable results.

Finally, there is "history," the most problematic term of the three. To begin with, it is not at all self-evident how to characterize any

minism is provided (rather unexpectedly) by Joseph Schumpeter on pp. 129 and 130 of his *Capitalism, Socialism, and Democracy* (second edition; Harper, 1947 [1942]) in a passage worth quoting in full: "Even if mankind were as free to choose as a businessman is free to choose between two competing pieces of machinery, no determined value judgment necessarily follows from the facts and relations between facts that I have tried to convey. . . . Whether favorable or unfavorable, value judgments about capitalist performance are of little interest. For mankind is not free to choose. This is not only because the mass of people are not in a position to compare alternatives rationally and always accept what they are being told. There is a much deeper reason for it. Things economic and social move by their own momentum and the ensuing situations compel individuals and groups to behave in certain ways whatever they may wish to do—not indeed by destroying their freedom of choice but by shaping the choosing mentalities and by narrowing the list of possibilities from which to choose. If this is the quintessence of Marxism then we all of us have got to be Marxists."

9. Raymond Williams, "Base and Superstructure in Marxist Critical Theory," in *Problems in Materialism and Culture: Selected Essays* (Verso, 1980), p. 37.

historical outcome. Consider, for example, the many late-nineteenth-century predictions that the advent of electrical power would lead to a decentralized electronic utopia.[10] Has history proved these predictions (technological cause, historical result) right, or wrong? Wrong: Consider urban skyscrapers, traffic gridlock, and centralized data banks. Right: Consider suburbs, telecommuting, and the decentralization of consumption through domestic appliances. You can also say that technology produces historical contradictions; this may be a more accurate response, but it is evasive if "contradictions" is simply taken to mean a mixed outcome.

In defining "history" in relation to technological determinism, furthermore, we are in danger of going around in logical circles. We tend to do implicitly what Robert Heilbroner does explicitly at the outset of his classic article "Do Machines Make History?" and also in "Technological Determinism Revisited." As Heilbroner stresses, the modern age has defined history in terms of socioeconomic factors rather than in terms of, say, political or diplomatic or religious events. This way of defining history is itself a result of priorities that are technology-based, if not technology-determined. Technology decisively entered the study of history in the Enlightenment and the early nineteenth century. In response to the great technological event of that epoch—the overwhelming and unprecedented increase in productivity—the concept of technological progress was gradually extrapolated to history as a whole, and history became redefined as the record of socioeconomic progress. In other words: For those of us living in the modern age, history is almost by definition a technology-driven process. As Heilbroner so powerfully reminds us, when we talk about how machines make history we must always bear in mind the socioeconomic meaning we attach to the crucial last word.[11]

10. These predictions are ably summarized by James W. Carey and John J. Quirk in "The Mythos of the Electronic Revolution," *American Scholar* 39 (spring 1970): 219–240 and 39 (summer 1970): 395–424.

11. See also Leo Marx's discussion of the role of technology in redefining history, and of the problem of going around in hermeneutic circles, in "The Idea of 'Technology' and the Tenor of Postmodern Pessimism," a paper delivered at the International Workshop on Technological Pessimism, Modern Societies and Their Environments, Tel Aviv and Jerusalem, 1992. (See also Marx's essay in the present volume.)

Even this brief analysis of the words "technology," "determines," and "history" suggests both the benefits and the limitations of semantic analysis. Plainly, we need to unpack these words in order to use critically language that is all too often used uncritically. On the other hand, we may also end up juggling categories, going in linguistic circles, and tossing around abstractions that eventually float free from connections to the social world of material interests and intentions. It would be more in the spirit of Karl Marx (which must hover over any discussion of this subject) to ask why any individual or group would be motivated to assert technological determinism—hard, soft, or otherwise. To paraphrase Heilbroner: We need to think of historical determinism itself in historical and even in political terms.

Interests and motivations are often better revealed by what people deny than by what they assert. To affirm that technology drives history is to deny that God does. Marx in particular was denying that history is directed by God, or by some similar Hegelian or idealistic power. But technological determinists do more than slay God the Father; they also slay Mother Nature, or at least declare her death. Marx was by no means alone in declaring that nature had ceased to be an independent force in history, that its role had been displaced by the "second nature" of human-made artifice. A whole epoch of bourgeois thought is involved here—an epoch in which "technocratic consciousness" (Jürgen Habermas's term) affirms that history is made by humanity as nature is made by God. History is declared to be part of what Sir Francis Bacon called "the human empire." Technological determinism declares humanity's liberation from spiritual and natural necessity alike.

To declare independence is to make a revolutionary political statement—and technological determinism has repeatedly been appealed to as a revolutionary force. Once again, Marx is the obvious example, though one that must be handled with caution. If Marx was a technological determinist at all, he was an exceedingly subtle and ambivalent one.[12] Still, Marx did announce that his mission was to change the world. Paradoxically enough, he proposed that what appears to be determinism actually liberates the proletariat to assume its historical destiny. If capitalist politics or ideology had any significant role in shaping history, then maybe, through some manipulations or

12. See especially the articles by MacKenzie and Bimber cited in note 1.

concessions or new ideas, capitalism could save itself. But since its fatal contradictions arise from its mode of production (and however one wants to interpret that phrase, it is clearly grounded in technology), collapse cannot be averted. Revolution is inevitable precisely because technology is largely out of human control.

The connection between historical theories of technological determinism and the politics of revolution predates Marx, however. The connection was first established by Enlightenment *philosophes*—particularly Anne Robert Jacques Turgot (1727–1781), whose 1750 *Discours sur les progrès successifs de l'esprit humain* is commonly cited as marking the opening of the Enlightenment, and Marie Jean Antoine Nicolas Caritat, marquis de Condorcet (b. 1743), whose suicide in 1793 is commonly cited as marking its end. Turgot's *Discours* and Condorcet's *Esquisse d'un tableau historique des progrès de l'esprit humain* (composed while Condorcet was hiding from the Jacobins) are generally recognized as enormously influential statements of the Enlightenment theory of inevitable historical progress. What is not generally recognized is that they base this theory on a "hard" technological determinism.

In the *Discours,* Turgot outlines the essence of the argument: that historical progress in time is determined by the creation of systems of transportation and communication across space. For Turgot, history is by definition global; it is the story of "the human race," which to the "eye of a philosopher" appears as "one vast whole." Historical progress records the gradual enlightenment of the global human mind. More specifically, Turgot narrates how groups of human beings have become more enlightened in direct proportion to the frequency and intensity of their contacts with other groups. Through most of history, lasting progress was doomed because these contacts were so few and feeble. Genius might appear in one locality—in ancient Athens, to cite a notable example—but would inevitably disappear in the ocean of time. Humankind could innovate, but could never accumulate its innovations.

The inconclusive ebb and flow of history would have continued indefinitely had it not been for the crucial inventions that finally overcame historical entropy and pushed the human race onto the track of cumulative progress. The first and greatest invention was language. In Turgot's words, language "made of all the individual stores of knowledge a common treasure-house, which one generation transmits to another, an inheritance which is always being enlarged by the discoveries of each age." Next, the discovery of writing meant

that genius, until then at the mercy of local oblivion, could reach a global audience and therefore become immortal. The climactic invention was the printing press, which rescued the treasures of antiquity from the dust, brought "light to talents which were being wasted in ignorance," and disseminated the discoveries of modern science throughout the globe. Progress in time depends upon diffusion in space, which in turn depends upon crucial inventions.[13]

For Turgot, intellectual, technical, and political revolution are virtually synonymous. The triumph of the bourgeoisie is identified with the triumph of a scientific world view based on universally valid truths. The aristocracy and the clergy, on the other hand, are allied with the regressive forces of error based in localities. To use a Leninist anachronism, Turgot argues that the scientific revolution will never be safe in one country alone; to be secure, the revolution must be global. The construction of technological systems of communication and transportation to disseminate scientific learning is a political act, for these systems are the weapons that will make the triumph of the bourgeoisie inevitable. Technology is revolution.

These political implications, only implied in Turgot's *Discours,* are spelled out much more clearly in Condorcet's *Esquisse.* For Turgot the main danger to progress had been inertia, routine, and passivity. Condorcet defines a far more active and therefore dangerous opponent: the oppressive, mystifying class of priests. From the very first stages of human development, Condorcet asserts, priests had actively opposed human progress, using "crude cunning" to play upon the "credulity" of the dupes who believed them.[14] In Condorcet's vast historical conspiracy theory, intellectual error had been deliberately used by the powerful to maintain their political dominance. Therefore, truth alone could not conquer error; truth allied with technology, however, could. The technological conquest of space had to be achieved before the place-based power of the clergy and their aristocratic allies could be overcome. The ten chapters of Condorcet's *Esquisse* record the major steps in this conquest.

Like Turgot, Condorcet regarded the invention of a written alphabet as the first crucial step. Once spoken language could be reproduced as enduring and transportable signs, the "progress of the human race [was ensured] forever." Still, there were many obstacles

13. Turgot, *Discours,* pp. 41, 57.

14. Condorcet, *Esquisse,* pp. 17–18.

along the way. Like Turgot, Condorcet used the fate of Greek learning as a cautionary tale; that learning was lost for so long, he says, mainly because the Greeks lacked better means of communication. And Condorcet too praised above all the momentous effects of the invention of printing, which had finally and definitively freed the human mind from spatial limitations: "The public opinion that was formed in this way was powerful by virtue of its size, and effective because the forces that created it operated with equal strength on all men at the same time, no matter what distances separated them."[15]

The appeal to technology as a revolutionary force is therefore not particular to Marxism. It is part of a comprehensive view of inevitable historical progress that emerged in the Enlightenment and still endures, though greatly weakened. Technological determinism is an integral part of that theory of progress, according to which technologies of communication and transportation will conquer not just the clergy and the aristocracy but history itself. The long centuries of ebb and flow, of rise and decline, of truth emerging and sinking back into the trackless ocean of time—those centuries are now over. Technical innovation is the decisive factor that has moved history onto an entirely new pathway of unending progress.

We began by analyzing the terminology of technological determinism; then we moved on to consider the intentions and interests of those who have served as powerful advocates of that idea; now we have to consider the intentions and interests of those who acted upon the idea. In the end, we should pay the most attention to those who build determinative technologies—those least responsive to human will, or (in the helpful language of the historian Thomas P. Hughes) those with the most technological momentum. Technological systems can be designed to be highly responsive to human control—or not to be. Human powerlessness can be part of the design. Fate can be engineered. In that case, we should look at those who choose to invest in large, complex technologies, and consider that they may do so quite deliberately in order to *create* technological determinism.

As Hughes reminds us, engineers build values into their designs, and one value that has motivated some prominent engineers is precisely the desire to construct a comprehensive technological system.

15. Ibid., pp. 7, 100.

(Hughes cites Thomas Edison as a prime example.[16]) But there are less aesthetic, more plainly political reasons for constructing comprehensive systems. After all, in most cases engineers themselves do not control the resources needed to create technologies of great scale and complexity. We need to consider not only the inventors and designers but also the sponsors of such technologies.[17] More precise, we need to pay special attention to the ideological, economic, and political motivations of those who control investment in technological systems that, once in place, significantly reduce the range of subsequent human choices.

When revolutionaries are out of power, their appeal to technological determinism is primarily rhetorical, taking the form of the claim that historical inevitability is on their side. In power, however, they are in a position to act upon that claim. They might well be tempted to speed up the pace of historical evolution by sponsoring the construction of technologies they see as determinative.

Such an oscillation between rhetoric and action is evident in the turbulent careers of Turgot and Condorcet. When Turgot delivered his celebrated *Discours,* he was a 23-year-old law student. In subsequent years, however, Turgot attained positions of political power, first as an *intendant* in Limoges and then as minister of finance under Louis XVI. In these offices he commanded resources that allowed him to embark upon ambitious programs of road and canal building. His tenure as Louis's minister of finance was brief, however, precisely because the aristocracy understood so well the revolutionary implications of his policies. After his fall, Turgot returned to advocating, rather than building, technological systems. (In particular, he toyed with inventions that would make possible the cheap reproduction of texts.) Condorcet's career shows a similar pattern. When his mentor Turgot was in power, Condorcet helped design hydraulic experiments to improve canal construction. After Turgot's fall, Condorcet became deeply involved with projects to establish a universal language

16. See, for example, Thomas P. Hughes, "Technological Momentum in History: Hydrogenation in Germany," *Past and Present* 44 (1969): 106–132; "The Electrification of America: The Systems Builders," *Technology and Culture* 20 (January 1979): 124–161.

17. See Ron Westrum's discussion of technological sponsors in *Technologies and Society: The Shaping of People and Things* (Wadsworth, 1991), described by Eric Schatzberg in a review in *Technology and Culture* (33 (April 1992): 392).

for the moral and physical sciences based on the calculus of probabilities.

The urge to ensure historical inevitability by building its technological base is especially evident in the case of Marxism. Marx wrote about technological determinism; Lenin built it in the form of vast projects of electrification, industrialization, and agricultural collectivization. As the Leninist example shows, the motivation for constructing such systems is not only to speed up the forward march of history, but also to prevent any backward slide by making counterrevolution impossible. In order to break the power of the *kulaks,* Lenin created a system of collective farms based on large agricultural machines that could not be used on smaller plots by independent or semi-independent small proprietors. In the same spirit, Turgot and Condorcet had tried to diminish the power of large aristocratic landholders by creating an internal system of canals and roads so small proprietors could sell their grain on the open market.

But revolutionaries who attain political power are by no means the only authorities who have reason to construct determinative technologies. Any elite may use such technologies to achieve political ends. In "Do Machines Make History?" Heilbroner suggested that the concept of technological determinism works best in this historical epoch, when "forces of technical change have been unleashed, but . . . the agencies for the control or guidance of technology are still rudimentary." I am just adding a reminder that some classes profit mightily from the absence of social controls. Ultimately, not machines but people create technological determinism.

The most obvious example of a technology designed to be beyond social control is the nuclear weaponry of the Cold War era. In the words of the essayist Wendell Berry: "We may choose nuclear weaponry as a form of defense, but that is the last of our 'free choices' with regard to nuclear weaponry. By that choice we largely abandon ourselves to terms and results dictated by the nature of nuclear weapons."[18] What Berry fails to emphasize is the political rationale for the seeming irrationality of turning over the power of decision to a technological system. In order for the threat of massive retaliation to be credible, the element of human decision *had* to be removed,

18. Wendell Berry, "Property, Patriotism, and National Defense," in *The Contemporary Essay,* second edition, ed. D. Hall (St. Martin's, 1989), p. 56.

precisely because rational human beings might choose negotiation over war.

The same principle can be used with regard to conventional weapons. In the late summer and the autumn of 1989, President George Bush made a series of decisions that had the net effect of putting half a million American troops in an offensive posture against an opponent who had been issued an unacceptable ultimatum. Those circumstances were constructed to ensure that in January 1990 the United States Senate would choose to declare war with Iraq. During the debate, one senator asked "Are we supposed to go to war simply because one man—the President—makes a series of unilateral decisions that put us in a box—a box that makes that war, to a greater degree, inevitable?"[19] The onset of Operation Desert Storm four days later provided a clear answer to his question.

In a 1963 essay, the cultural critic Lewis Mumford proposed that throughout history there have coexisted two ideal types of technics: democratic and authoritarian. "What I would call democratic technics," he wrote, "is the small scale method of production, resting mainly on human skill and animal energy but always, even when employing machines, remaining under the active direction of the craftsman or the farmer." Whereas democratic technics dates back to the origins of humanity, Mumford argued, authoritarian technics is relatively recent, beginning around the fourth millennium B.C. It was based on a compelling myth of an absolute ruler "whose word was law" and under whom "cosmic powers came down to earth" in this "entirely new kind of theological-technological mass organization." Authoritarian technics depended upon ruthless physical coercion in which human beings were organized into work armies and military armies for purposes of mass construction and mass destruction. Mumford thus interpreted the nuclear policies of the Cold War as a modern example of "human compulsions that . . . date back to a period before even the wheel had been invented"—most notably the compulsion to create systems of total control over physical nature and ultimately over human beings. Authoritarian technics is designed to be determinative, to place power in the technological system itself. In modern times the center of authority lies not in a visible, all-powerful king, but "in the system itself, invisible but omnipresent."

19. Senator John Kerry (Democrat, Massachusetts), *Congressional Record* 137: 7 (January 11, 1991).

"The ultimate end of this technics," wrote Mumford, "is to displace life, or rather, to transfer the attributes of life to the machine and the mechanical collective. . . ."[20]

Mumford's theory is essentially Manichean; the good, "man-centered, relatively weak, but resourceful and durable" technics of democracy is locked in eternal struggle with the "system-centered, immensely powerful, but inherently unstable" technics of authority.[21] Like any grand theory, this one is wide open to criticism. One could argue that small-scale technologies can restrict human freedom, in their own way, as much as large-scale ones. On the other hand, many contemporary engineers would argue that technological systems are not inherently authoritarian but can be designed to be flexible and democratic in their postmodern "robustness." Most arguable is Mumford's conclusion that technological determinism is essentially an illusion, and that we can regain control of our technics simply by casting off the "myth of the machine." While the myths that justify the construction of authoritarian systems may be regarded as empty illusions, the systems themselves are quite real. If the constructions are of sufficient size and scope, they may indeed do what their creators intend—deprive human beings of the liberty to survive outside those systems.

With all that said, however, Mumford's dualistic theory, crude as it is, challenges us to consider the political agendas behind technological development, and in particular to consider the irrational motives of those who build enormous technological systems—in Mumford's strong words, "their paranoid suspicions and animosities and their paranoid claims to unconditional obedience and absolute power."[22] Capitalist rhetoric, in contrast, has always emphasized economic agendas and rational motives. This is the language that Heilbroner uses in "Technological Determinism Revisited" when he links technological development to a stable and systematic acquisitive drive to maximize possibilities for gain. Economics is based on the essentially rational "principle of 'maximizing,'" which is the "mechanism" that translates "a huge variety of stimuli . . . into a few well-defined behavioral vectors." The drive to maximize fortune is the "'rule' of

20. Lewis Mumford, "Authoritarian and Democratic Technics," *Technology and Culture* 5 (January 1964): 2–6.

21. Ibid., p. 2.

22. Ibid., p. 4.

behavior" in market societies that permits us to understand the rules of technological development in a social order that is based on rational, if limited, exchange values.[23]

This analysis begs some important questions—most notably, who decides (individuals? other groups? which groups?) and what criteria they use in deciding. (Defining fortune and the maximization of possibilities may not be so self-evident as it seems.) More generally, however, one must question the validity of the modernist language of physics, rules, stable drives, reason, and predictable behavior. This is familiar capitalist language, of course, but what does it really mean? To what extent does it correspond to human reality, and to what extent is it a word game, a justification of other motives? Mumford raises the possibility that the language of rationality might serve as a cover for political purposes of control and domination—motives that may or may not be congruent with individual goals of acquiring fortune. He also raises the possibility that capitalist elites might not behave in a manner so radically different from elites of the pre-capitalist past.

At the least, we need to consider Mumford's analysis along with the familiar account of economic rationality to understand the motives behind the construction of powerfully determinative technologies. For example, we cannot account for modern military technologies by relying only on a rational model of the acquisition of fortune. Nor does this model go far to illuminate the industrial history of the former Soviet Union and Eastern Europe between 1917 and 1991. If there was ever a modern example of technological development driven by a myth-based, irrational drive to dominate human beings and nonhuman nature alike, this is it. In one of the strangest intellectual twists of our time, it has been Vaclev Havel—playwright, former president of Czechoslovakia, and ardent Heideggerean—who has provided one of the most radical critiques of Soviet-style industrialization. By doing so, he as much as anyone has inherited Lewis Mumford's mantle as the prophet of postmodern technology.

Havel's analysis of the motives behind the construction of coercive technological systems, as well as his advice on how to liberate ourselves from them, echoes Mumford's critique to a remarkable extent. According to Havel, the ecologically disastrous, economically inefficient industry of the Soviet bloc was based on an irrational drive to construct all-encompassing systems of control: "Communism . . . was an attempt . . . to organize all of life according to a single model, and to subject it to central planning and control regardless of whether or not that was what life wanted." Havel asserts that the dominant reflex of modern civilization, whether capitalist or socialist, has been to address all social problems by amassing more scientific knowledge and technological power in order to construct better systems of control. Like Mumford, Havel argues that this response is ultimately futile; instead, "man's attitude to the world must be radically changed." Human beings must come to value democracy over authority, multiplicity over centralization, personal life rather than impersonal systems. "Things must once more be given a chance to present themselves as they are, to be perceived in their individuality. We must see the pluralism of the world. . . ."[24]

23. Heilbroner, "Technological Determinism Revisited" (in this volume).

There is one other crucial dimension of technical determinism that is omitted from the capitalist account but that is highlighted by Mumford's explanation: gender. Two years after publishing his essay on democratic and authoritarian technics, Mumford returned to his dualistic thesis in another *Technology and Culture* article, "Technics and the Nature of Man." Although the language of the essay, beginning with the title, may be gender-biased by contemporary standards, its content is quite the opposite. To be sure, Mumford does not address issues of gender directly. Instead, his main argument is that culture, not technology, should be considered the prime determinant of human history. In this essay Mumford uses the terms "biotechnics" and "true polytechnics" to refer to technology that is "life-centered, not work-centered or power-centered" because it is directed by cultural values. He then goes on to stress the importance of women's contributions to biotechnics, especially in agriculture and in the vital horticultural discoveries that must have preceded agriculture by many centuries. Mumford also emphasizes the technical significance of the containers primarily associated with women's activities: hearths, pits, houses, pots, sacks, clothes, baskets, and the like. In contrast, the authoritarian "monotechnics" of the Megamachine has been created almost exclusively by and for males—priests, the armed

24. Vaclev Havel, "The End of the Modern Era," *New York Times*, March 1, 1992.

nobility, bureaucrats, and ultimately the king who takes upon himself the cosmic power of the sun-god, "who characteristically created the world out of his own semen without female cooperation." According to Mumford, then, women have been highly significant in shaping democratic biotechnics, but have been routinely excluded from the creation and operation of authoritarian monotechnics.[25]

Mumford thus alerts us to the dissonance between technological determinism and a feminist understanding of history. To put it crudely: Doesn't technological determinism, whether in theory or in practice, represent a predominantly masculine view of human experience? This is true whether we adopt Mumford's political-mythological explanation for the origins of technological determinism or Heilbroner's rational-economic explanation. Mumford proposed that male elites, in their prideful effort to deny the feminine role in bearing and sustaining life, have deliberately created life-denying technological systems. For his part, Heilbroner explains the origins of technological determinism in drives to maximize possibilities and to acquire fortune, which are fundamental rules of human behavior in market economies. But just what do those "rules" mean for women, who through most of history have been restricted by law and custom from acquiring capital and engaging in market relationships? Is this not a "rule" of masculine rather than of human behavior?

Whether the perspective is political or economic, the fascination with technological determinism surely reflects a bias in favor of producers rather than users—the same productivist bias that has promoted general inattention to the role of women in technological history. As we have seen, technological determinism is habitually discussed from the viewpoint of the engineer, the sponsor, the king, or the bureaucrat. Few women have had the opportunity to participate in the creation or the operation of authoritarian technologies (or, to use more neutral language, technologies with considerable momentum). If the issue of technological determinism were examined from the user's point of view, it might look quite different. On the one hand, systems that are planned to be coercive may be considerably less so in reality. Michel de Certeau has reminded us how users can poach, wander, subvert, and otherwise tinker even with technologies intended to be authoritative. On the other hand, technologies intended to be "liberating" can have unintended or even opposite effects when considered from the user's viewpoint. As Ruth Schwartz Cowan has demonstrated in *More Work for Mother*, the development of "labor-saving devices" had the net effect of increasing the burden of housework for most women.

25. Lewis Mumford, "Technics and the Nature of Man," *Technology and Culture* 7 (July 1966): 310–311.

The point here is not that women have a different mindset about technology, not that they are more democratic or less acquisitive than men, but that they have a different perspective because they have had a significantly different social experience. The far more controversial question is whether women might, on the basis of their different biological experience, have a different perspective on technological determinism. The assertion that technology determines history, it should be recalled, amounts to a denial that Mother Nature does. Would most women be so ready to proclaim the liberation of human history from natural necessity? Might not women, because they experience biological imperatives in a direct and forceful way, be more alert to nature's continuing limitations on human aspirations?

"Nearly all ecofeminists," writes Janet Biehl, ". . . draw on the idea that women have long been 'associated with nature' in Western culture, by males."[26] What is hotly debated is whether this association has some objective validity or is only a social convention. For example, psycho-biological ecofeminists, such as Andree Collard, have argued that women are uniquely ecological beings; this is because their reproductive systems, which make it possible for them to bring forth and nourish life, link them on a profound level with the rest of the living world. Other ecofeminists, such as Ynestra King, are more likely to argue that the identification of woman and nature is a metaphor, not a biological fact. According to King, this identification is "socially constructed . . . an ideology . . . made up by men as a way to sentimentalize and devalue both."[27] In King's striking phrase, "Women have been culture's sacrifice to nature."[28]

26. Janet Biehl, *Rethinking Ecofeminist Politics* (South End Press, 1991).

27. Ynestra King, quoted in Biehl, *Rethinking* (p. 68).

28. Ynestra King, "Healing the Wounds: Feminism, Ecology, and Nature/Culture Dualism," in *Gender/Body/Knowledge*, ed. A. M. Jaggar and S. Bordo (Rutgers University Press, 1989), p. 129. For a fine overview of the woman-nature metaphor and related issues, see Biehl, *Rethinking Ecofeminist Politics*, the introduction and the first chapter of which are excerpted in *Z Magazine* (4, no. 6 (1991): 66–71).

When so much feminist energy has been spent in opposing natural determinism, in protesting that biology is not destiny, I do not want to drag women back to the sacrificial altar of nature. It is hard to see any benefit in overturning a patriarchal technological determinism for a female-oriented but equally crude natural determinism. On the other hand, a position of absolute social construction is, King says, "disembodied." "The logical conclusion," she continues, "is a rationalized, denatured, totally deconstructed person." As King further argues, ecofeminism faces the challenge of overcoming the crude opposition of natural vs. social determinism in order to shape a "new, dialectical way of thinking about our relationship to nature. . . . It is for ecofeminism to interpret the historical significance of the fact that women have been positioned at the biological dividing line where the organic emerges into the social."[29]

Debates among ecofeminists should not be allowed to obscure their essential, common contribution: their insistence that the social remains inextricably linked to the organic. From such an ecofeminist perspective, theories of technological determinism involve a masculine bias because they are positioned so far to the social side of that dividing line. Instead, technology never has taken and never will take command of history as a causal factor independent of nonhuman nature. To be sure, the desire to reach this state of independence is persistent and strong. In Mumford's words, twentieth-century man seeks an entirely new stage of technics, "a radically different condition, in which he will not only have conquered nature but detached himself completely from the organic habitat."[30] Mumford criticizes this goal as seductive but unattainable. In his view, large authoritarian systems are inherently unstable, whereas modest but durable biotechnics accepts the interdependence of human and nonhuman nature.

Concern with this essential interdependence, with the point "where the organic emerges into the social," is not limited to recent ecofeminism. It has also been the concern of a subordinate but significant strand in the Marxist tradition. I still remember sitting in a freshman class in medieval history at Wellesley College, listening raptly as the professor expounded the theory of hydraulic societies of Karl Wittfogel—an erstwhile Marxist who explained the authoritarian character of Oriental societies by their need for complicated water-

29. King, "Healing the Wounds," p. 131.

30. Mumford, "Technics and the Nature of Man," p. 303.

management systems. What made the theory so appealing to a freshman is also its weakness: its simplistic and universalizing determinism. However, it is an environmental determinism rather than a strictly technological one. For Wittfogel, human agricultural practices and conditions of rainfall that are beyond human control combine to determine a social outcome.[31]

In recent years, some Marxist scholars have been picking up where Wittfogel left off. For the most part, they are geographers who seek to reconcile Marxism with their keen awareness of how the nonhuman environment limits and pressures even the most ambitious human-built technologies. "Historical materialism is finally beginning to take its geography seriously," says one of them, David Harvey, who refers to his own approach as "historical-geographical materialism."[32]

In a world of rapidly depleting aquifers, ozone holes, and global warming, any theory of technological determinism that assumes humanity's triumph over natural necessity is plainly unrealistic and simplistic. On the other hand, assertions of humanity's triumph over nature are not entirely mistaken either. Human imperialism is a fact. Our population and our technologies have reached such a scale that they have intertwined with natural systems. Nature may still be a force, but it is no longer an independent one. We human beings have not escaped from nature, but neither has it escaped from us. Is global warming a technical event or a natural one? We can no longer discern the difference. How about *El Niño*? Ozone depletion? Now that we can kill entire lakes and forests with fumes and fires, alter the food chain with oil spills, and scatter radioactivity across Europe, we dwell in an environment where natural and technological processes have merged. This new hybrid environment may not determine history, but it will profoundly and decisively affect the human fate.

31. See the discussion of Wittfogel in Daniel Worster's *Rivers of Empire* (Pantheon, 1985), pp. 22–30.

32. Harvey, *Condition of Postmodernity*, p. 355.