2. How Society Shapes Technology

ROBERT POOL

Why do we all use VHS cassette recorders instead of Betamax, when most experts (and many nonexperts) agree that Betamax is a better technology? The two formats came on the market around the same time. They are incompatible, however, so consumers had to choose one or the other. When VHS gained a small lead, perhaps because of better marketing, perhaps because it uses six-hour cassettes instead of Betamax's five, or perhaps for other reasons, video rental stores began to stock more VHS tapes. This led people to buy more VHS machines and started a self-reinforcing cycle that, in a few years, made Betamax as obsolete as eight-track audio players.

This kind of interplay between the developers of technology and the society that uses that technology is characteristic of the way in which technology and society interact. It's not technological determinism and it's not just social construction; it's a combination of the two. Robert Pool examines this fascinating interplay in depth in his book, Beyond Engineering: How Society Shapes Technology, from which the following selection is taken. "Modern technology," he writes, "is like a Great Dane in a small apartment. It may be friendly, but you still want to make sure there's nothing breakable within reach." Pool, a freelance writer who has written for Science and Discover and was news editor at Nature, is the author of Fat: Fighting the Obesity Epidemic (2001) and Eve's Rib: The Biological Roots of Sex Differences (1994).

Any modern technology is the product of a complex interplay between its designers and the larger society in which it develops.

Consider the automobile. In the early part of this century, gas-powered cars shared the roads with those powered by boilers and steam engines, such as the Stanley Steamer. Eventually, internal combustion captured the market and the old steamers disappeared. Why? The usual assumption is that the two contenders went head to head and the best technology won. Not at all.

Although the internal combustion engine did have some advantages in performance and convenience, steam-powered cars had their own pluses: They had no transmission or shifting of gears, they were simpler to build, and they were smoother and quieter to operate. Experts then and now have called it a draw — the "better" technology was mostly a matter of opinion. Instead, the steamers were killed off by several factors that had little or nothing to do with their engineering merits. For one, the Stanley brothers, builders of the best steam-powered cars of the time, had little interest in mass production. They were content to sell a few cars at high prices to aficionados who could appreciate their superiority. Meanwhile, Henry Ford and other Detroit automakers were flooding the country

with inexpensive gas-powered cars. Even so, the steamers might well have survived as high-end specialty cars were it not for a series of unlucky breaks. At one point, for example, an outbreak of hoof-and-mouth disease caused public horse troughs to be drained, removing a major source of water for refilling the cars' boilers. It took the Stanley brothers three years to develop a closed-cycle steam engine that didn't need constant refilling, but by then World War I had begun, bringing strict government limits on the number of cars that businesses could build for the consumer market. The Stanley company never recovered, and it folded a few years later. The remnants of the steam automobile industry died during the Depression, when the market for high-priced cars all but disappeared.

Nonengineering factors play a role in the development of all technologies, even the simplest. In The Pencil, Henry Petroski tells how pencil designers in the late 1800s, in order to get around a growing shortage of red cedar, devised a pencil with a paper wrapping in place of the normal wood. It "worked well technically and showed great promise," Petroski writes, "but the product was a disappointment to unanticipated psychological reasons." The public, accustomed to sharpening pencils with a knife, wanted something that could be whittled. The paper pencil never caught on.

Today, particularly for such sophisticated creations as computers, genetic engineering, or nuclear power, nontechnical factors have come to exert an influence that is unprecedented in the history of technology. Invention is no longer, as Ralph Waldo Emerson's aphorism had it, simply a matter of "Build a better mousetrap and the world will beat a path to your door." The world is already at your door, and it has a few things to say about that mousetrap.

The reasons for this are several, some grounded in the changing nature of technology itself and others arising from transformations in society. A hundred years ago, people in Western nations generally saw technological development as a good thing. It brought prosperity and health; it represented "progress." But the past century has seen a dramatic change in Western society, with a resulting shift in people's attitudes toward technology. As countries have become more prosperous and secure, their citizens have become less concerned about increasing their material well-being and more concerned with such aesthetic considerations as maintaining a clean environment. This makes them less likely to accept new technologies uncritically. At the same time, citizens of Western democracies have become more politically savvy and more active in challenging the system with lawsuits, special interest groups, campaigns to change public opinion, and other weapons. The result is that the public now exerts a much greater influence on the development of technologies — particularly those seen as risky or otherwise undesirable — than was true one hundred, or even fifty, years ago.

Meanwhile, the developers of technology have also been changing. A century ago, most innovation was done by individuals or small groups. Today, technological development tends to take place inside large, hierarchical organizations. This is particularly true for complex, large-scale technologies, since they demand large investments and extensive, coordinated development efforts. But large organizations inject into the development process a host of considerations that have little or nothing to do with engineering. Any institution has its own goals and concerns, its own set of capabilities and weaknesses, and its own biases about the best ways to do things and which institutions are influential.

A closely related consideration is that of the information explosion. With their professional backgrounds in mathematics, science, or engineering, scientists and engineers often think in terms of systems and components that are not always the most pragmatic. But the people who must live with these technologies, often under the direction of committees and organizations, do not always think in those terms. They want solutions to be simple and easy to maintain, and they may not be willing to accept technologies that are not completely reliable.

The existence of such pressures allows a technology to remain in development for a relatively short time if the reasons are not compelling enough, and shoves everybody else to the sidelines.

But the most important consideration is that technology has changed dramatically — along with society — in the last few decades. Inventions of the past that improved crop yields, made transportation easier, and helped fight disease are almost unimaginable now. We have shifted from thinking of science as a tool to think about the future, and this has led to a greater emphasis on the development of new and improved technologies. As a result, technology has become a driving force in the economy and society, and it is now clearly the dominant force in shaping our world.

Even normally benign technologies have been multiplied to meet the needs of our society. The gas is an economical source of energy, and its use has multiplied dramatically. It is now being burned worldwide by burning oil and natural gas, generating the greenhouse gases that contribute to changes in the global climate.

Modern technology has also affected society in other ways. We are no longer able to ignore the impacts of our actions, and we must take into account the implications of our decisions. We need to consider the social, economic, and environmental impacts of our actions, and we must take into account the consequences of our decisions.

Besides its power, modern technology is equally important — in fact, more important — because of its complexity. Today, computers, for example, are used in many different ways, and the possibility of failure is high. We must understand their function and their limitations, and we must understand how they interact with other systems. We must also be aware that the outcome of a decision may be different from our intention, and that we may have unintended consequences. We must also understand the social, economic, and environmental impacts of our decisions, and we must take into account the consequences of our actions.
the best ways to do things. Inevitably, the scientists and engineers inside an institution are influenced — often quite unconsciously — by its culture.

A closely related factor is the institutionalization of science and engineering. With their professional societies, conferences, journals, and other means of communication, scientists and engineers have formed themselves into relatively close-knit — though large — groups that have uniform standards of practice and hold similar ideas. Today, opinions and decisions about a technology tend to reflect a group’s thinking more than any given individual’s.

The existence of large organizations and the institutionalization of the professions allow a technology to build up a tremendous amount of momentum in a relatively short time. Once the choice has been made to go a certain way, even if the reasons are not particularly good ones, the institutional machinery gears up and shoves everybody in the same direction. It can be tough to resist.

But the most important changes have come in the nature of technology itself. In the twentieth century, the power of our machines and devices has grown dramatically — along with their unanticipated consequences. When DDT was introduced, it seemed an unalloyed good: a cheap, effective way to kill insect pests and improve crop yields. It took years to understand that the pesticide made its way up the food chain to weaken the shells of birds’ eggs and wreak other unintended havoc. Similarly, chlorofluorocarbons, or CFCs, were widely used for decades — as refrigerants, as blowing agents in making foams, and as cleaners for computer chips — before anyone realized they were damaging the ozone layer.

Even normally benign technologies can take on different complexities when multiplied to meet the needs of a world with five billion people. Burning natural gas is an economical, safe, and clean way to heat homes and generate electricity. Its only major waste material is carbon dioxide, the same gas that humans exhale with each breath. But carbon dioxide, in the quantities now being produced worldwide by burning fossil fuels (coal and oil as well as natural gas), is exaggerating the greenhouse effect in the earth’s atmosphere and threatening major changes in the global climate.

Modern technology is like a Great Dane in a small apartment. It may be friendly, but you still want to make sure there’s nothing breakable within reach. So to protect the china and crystal, government bodies, special interest groups, businesses, and even individuals are demanding an increasing say in how technologies are developed and applied.

Besides its power, modern technology has a second feature — more subtle, but equally important — that makes it qualitatively different from earlier technologies: its complexity. The plow, the cotton gin, even the lightbulb — these are simple devices. No matter how much they are changed and improved, it is still easy to understand their functions and capabilities. But for better or worse, technology has reached the point where no individual can understand completely how, say, a petrochemical plant works, and no team of experts can anticipate every possible outcome once a technology is put to work. Such complexity fundamentally changes our relationship with technology.

Consider the accident that destroyed the space shuttle Challenger. Although the cause was eventually established as the failure of O-rings at low temperatures,
which allowed the escape of hot gases and led to an explosion of a fuel tank, the real culprit was the complexity of the system. Space-shuttle engineers had been concerned about how the O-rings would behave in below-freezing weather, and some even recommended the launch be postponed to a warmer day, but no one could predict with any certainty what might happen. There were too many variables, too many ways in which the components of the system could interact. Management decided to proceed with the launch despite the engineers’ disquiet, and it was only months later that experts pieced together the chain of events that led to the explosion.

Complexity creates uncertainty, limiting what can be known or reasonably surmised about a technology ahead of time. Although the shuttle engineers had vague fears, they simply did not — could not — know enough about the system to foresee the looming disaster. And in such cases, when there is not a clear technical answer, people fall back on subjective, often unconscious reasoning — biases and gut feelings, organizational goals, political considerations, the profit motive. In the case of the Challenger, NASA was feeling pressure to keep its shuttles going into space on a regular basis, and no one in the organization wanted to postpone a launch unless it was absolutely necessary. In this case, it was, but no one knew.

For all these reasons, modern technology is not simply the rational product of scientists and engineers that it is often advertised to be. Look closely at any technology today, from aircraft to the Internet, and you’ll find that it truly makes sense only when seen as part of the society in which it grew up.

The insight is not a particularly new one. Thoughtful engineers have discussed it for some time. As early as the 1960s, Alvin Weinberg, the longtime director of Oak Ridge National Laboratory, was writing on the relationship between technology and society, particularly in regard to nuclear power. There have been others. But until recently no one had studied the influence of society on technology in any consistent, comprehensive way. Philosophically inclined engineers like Weinberg did not have the time, the temperament, or the training to make careful studies. They reported what they saw and mused about the larger implications, but nothing more. And social scientists, when they noticed technology at all, viewed it primarily in terms of how it shapes society. Sociologists, economists, and others have long seen technology as the driving force behind much of history — a theory usually referred to as “technological determinism” — and they have happily investigated such things as how the invention of the printing press triggered the Reformation, how the development of the compass ushered in the Age of Exploration and the discovery of the New World, and how the cotton gin created the conditions that led to the Civil War. But few of these scientists turned the question around and asked how society shapes technology.

In just the past decade or two, however, that has begun to change. Indeed, it has now become almost fashionable for economists, political scientists, and sociologists to bring their analytical tools to bear on various technologies, from nuclear power and commercial aviation to medical instruments, computers, even bicycles. Part of the reason for this is, I suspect, the increasing importance of technology to our world, and another part is the realization by social scientists that science and technology are just as amenable to social analysis as politics or religion. Whatever the reason, the assumption is that we are in a new light. Scholars now assume that technology matters, rather than just the people who make it. "Big science" is not just a product of the social environment in which it grows up, but a new element in the matrix by which societies are shaped.

Unfortunately, we still have far too little to say about the social context in which various technologies are developed. "Technology" is a catchall category that covers far too many diverse activities, from the shipbuilding industry to satellite communications, to make it a practical object of study. Fortunately, there is a growing body of research on such topics as new media technologies, political science, and management, and many others. At various points, tendencies in the field of technology are making inroads into the field of social science. The new media, for example, includes everything from the first typewriters to today’s spreadsheets. Such a vast array of developments point to the idea that the relationships between new technologies and society make much more sense if we look at these interdependences in terms of the social environment in which they arise.

Lurking just beneath the surface of much of this work, and other scholarly efforts, is the question of the day: What is the nature of the relationship between technology and society? It is a broad and important — rather than a question of the day, a question of the century.

There are two schools of thought, and they have little in common. One is the idea that technology is a force, that it goes by the name of "social change," that it is a mechanism as powerful as knowledge only by its ability to create social change. The other is the idea of hypothesis formation, that technology is a tool by which society can be changed, that it is absolutely — no matter what — what society is. In the first, there is no guarantee that the technology will achieve its goals; in the latter, the technology is always going to be as provisionally true as the society in which it is made. The notion of the relationship between technology and society is modified or replaced by a very different notion, the idea that society changes, that instead of a society that is contingent, the society that is contingent to the world.

The strength of the argument is its simplicity: For governments and businesses alike, it is the same. This is a world of capital, exploitation, and society. It is a world of the imposition of a power structure in the same way that it is a world of the imposition of capitalist country"
explosion of a fuel tank, the shuttle engineers had been below-freezing weather, and a warmer day, but no one knew. There were too many variables the system could interact. Despite the engineers' disquiet, they were the chain of events that be known or reasonably surmised about the system to forestall a crisis not a clear technical reasoning — biases and assumptions, the profit motive. In the keep its shuttles going into action wanted to postpone a launch, but no one knew. Surely the rational product of science. Look closely at any technological creation and you'll find that it truly makes sense. 

Shuttle engineers have discussed the training to make care about the larger implications, seen the technology at all, being a social construction of, by sociologists, economists, and behind much of history — a mintage78 — and they have haphazardly printed cards in the Age of how the cotton gin created these poor farmers turned the poor to cotton. Indeed, if political scientists, and sociologists were, in frequent use, and growing importance of social analysis as politics or

religion. Whatever the reason, the result has been to put technology in a whole new light. Scholars now talk about the push and pull between technology and society, rather than just the push of technology on society. Engineers have been brought down from the mountain to take their place as one — still very important — cog in the system by which technology is delivered to the world.

Unfortunately, very little of this has filtered down. It remains mostly specialists talking to other specialists in books and journals that few outside their fields ever see. The book from which this chapter is taken aims to change that. From its original design as a study of how engineers are creating a new generation of nuclear power, it has metamorphosed into a more general — and more ambitious — look at how non-technical forces shape modern technologies. In it I collect and synthesize work from a wide variety of disciplines: history, economics, political science, sociology, risk analysis, management science, psychology. At various points, the book touches on personal computers, genetic engineering, jet aircraft, space flight, automobiles, chemical plants, even steam engines and typewriters. Such a book obviously cannot be comprehensive. Instead, my goal is to introduce a different way to think about technology and to show how many things make much more sense when technology is viewed in this way.

Lurking just beneath the surface... is one of the most intriguing and frustrating questions of our time, although it seldom gets much attention outside universities and other scholarly places: How do we know what we know? Or, to put it differently, What is the nature of human knowledge? This may sound like the sort of abstract question that only a philosopher could love, but its answer has practical — and important — ramifications for how we deal with science and technology.

There are two schools of thought on the nature of human knowledge, and they have little common ground. One has its roots in the physical sciences and goes by such names as positivism or objectivism or rationalism. Positivism accepts as knowledge only those things that have been verified by the scientific method of hypothesis formation and testing. It is, of course, impossible to verify anything absolutely — no matter how many times the sun comes up right on schedule, there is no guarantee it won't be a couple of hours late tomorrow — but positivists are generally content with verifying something beyond a reasonable doubt. Karl Popper, the influential philosopher of science, put a slightly different spin on it: Scientific statements, he said, are those that can be put to the test and potentially proven wrong, or falsified. It's not possible to prove a hypothesis is true, but if the hypothesis is tested extensively and never proven false, then one accepts it as provisionally true. If it later turns out to be false in certain situations, it can be modified or replaced. By this method, one hopes to get better and better approximations to the world's underlying physical reality. Absolute knowledge is not attainable. This provisional knowledge is the best we can do.

The strength of positivism — its insistence on verification — is also its weakness, for there is much that people think of as "knowledge" that cannot be verified in the same way that theories in physics or biology can. "The United States is a capitalist country" is a statement most would accept as true, but how does one
prove it? Or how about, “Santa Claus wears a red suit and rides in a sleigh pulled by eight reindeer”? This is clearly knowledge of a sort — everyone in our culture older than two or three “knows” it — and though it may not be in the same intellectual league as, say, the general theory of relativity, it’s much more important to most people than anything Einstein came up with. Yet the positivist approach has no place for such folderol.

For many years, social scientists, impressed with the success of the physical sciences, modeled their methods along the same positivist lines. They made observations, formed hypotheses, and tested their theories, attempting to make their research as objective as possible. Many social scientists still do, but in the past few decades an influential new school of thought has appeared, one that offers a different take on human knowledge. This approach, often referred to as “social construction” or “interpretation,” is designed explicitly to deal with social reality — the web of relationships, institutions, and shared beliefs and meanings that exist in a group of people — instead of physical reality. It sees knowledge not as something gleaned from an underlying physical reality but as the collective product of a society. Social constructionists speak not of objective facts but only of interpretations of the world, and they set out to explain how those interpretations arise. They make no attempt to judge the truth or falsity of socially constructed knowledge. Indeed, they deny that it even makes sense to ask whether such knowledge is true or false.

Thus, positivism and social construction offer diametrically opposed views of knowledge. Positivists see knowledge as arising from nature, social constructionists see it as a product of the human mind. Positivists speak of proof, social constructionists of interpretation. Positivists assume knowledge to be objective, social constructionists believe it to be subjective. In general, positivists have been willing to defer to the social constructionists in the case of social knowledge.

After all, information about Santa Claus or the importance of capitalism is not really what a positivist has in mind when he speaks about “knowledge.” But the social constructionists have been unwilling to return the favor and so have triggered a sharp, if so far bloodless, battle.

All human knowledge is social knowledge, the social constructionists say, even science. After all, scientific knowledge is created by groups of people — the scientific community and its various subsets — and so it inevitably has a collective character. There is no such thing as a scientific truth believed by one person and disbelieved by the rest of the scientific community; an idea becomes a truth only when a vast majority of scientists accept it without question. But if this is so, the argument goes, then science is best understood as socially constructed rather than derived in some objective way from nature.

The earliest and best-known example of this approach to science is Thomas Kuhn’s *The Structure of Scientific Revolutions.* In it, Kuhn depicts most science as taking place inside a “paradigm” — a set of beliefs and expectations that guide the research, defining which questions are important and designating the proper ways to go about answering them. Scientific revolutions — such as the shift from the Ptolemaic to the Copernican view of the universe — occur when a paradigm breaks down and the scientific community collectively settles on a new paradigm in which to work. Kuhn goes on to explain the rules by which such shifts occur and the shift or for decision and the construction of a new paradigm. Ironically, the general idea of paradigm is reminiscent of Kuhn’s work. It’s not just a paradigm; it’s a paradigm even though the paradigmatic paradigms have not yet been

Today, many social scientists argue that the idea of scientific knowledge has been redefined. In a whole series of publications, systems pertaining to the collective representation of certain knowledge is treated as a sociological entity.

Such comments and publications are, not perhaps, the final words on the new paradigm. The multiple meanings of the social construction of scientific knowledge is that it is not possible to completely separate the social and the scientific. The process of scientific discovery is not just a matter of finding the truth, but also of creating it. In this way, and continued to be a significant influence on the way science is conducted. Science may not be a naturalistic approach to the understanding of the world, but it is certainly not a social one.

This all may seem to no one besides sociologists but the public. Of course, the recombinant bovine growth factor and the community pronouncements of the researchers were in the public eye and by their own implicit standards of what constitutes knowledge.
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in which to work. Kuhn argued that because such a paradigm shift is a change of
the rules by which science is done, there can be no objective reasons for making
the shift or for deciding on one paradigm over another. The choice is a subject-
ive one. Ironically, much of the positivist scientific community has accepted the
general idea of paradigms without understanding the deeper implications of
Kuhn’s work. It’s not unusual to hear a scientist speak of “working within a para-
digm” even though that scientist would be appalled by Kuhn’s claim that sci-
tific paradigms have no objective basis.

Today, many social scientists agree with Kuhn that the positivist claims for sci-
ence were a myth. For example, in 1987 the sociologists Trevor Pinch and Wiebe
Bijker wrote:

[T]here is widespread agreement that scientific knowledge can be, and indeed
has been, shown to be thoroughly socially constructed. . . . The treatment of
scientific knowledge as a social construction implies that there is nothing epis-
temologically special about the nature of scientific knowledge: It is merely one
in a whole series of knowledge cultures (including for instance, the knowledge
systems pertaining to “primitive” tribes). Of course, the successes and failures of
certain knowledge cultures still need to be explained, but this is to be seen
as a sociological task, not an epistemological one.14

Such comments anger many scientists. Physicists especially dispute the conclu-
sions of the social constructionists.15 Yes, they admit, of course the creation of
scientific knowledge is a joint effort, but nonetheless it is epistemologically special.
Quantum mechanics, for instance, provides predictions that are consistently accu-
rate to a dozen or more decimal places. This is no accident, they insist, but instead
reflects the fact that science is uncovering and explaining some objective reality.

On the whole, the physicists get the better of this particular argument. Social
construction theory is useful in explaining social knowledge and belief, but it does
little to explain why physicists accept general relativity or quantum mechanics as
accurate portrayals of physical reality. Social constructionists like Pinch and Bijker
ignore a key difference between science and other knowledge cultures: science’s
insistence that its statements be falsifiable.16 As long as science restricts itself in
this way and continues testing its theories and discarding those that disagree with
experiments, it is indeed epistemologically special. This and nothing else explains
why science has been so much more successful than other knowledge cultures.
Science may not be as objective as the positivists would like to believe, but the posit-
ivist approach comes closer than any other to capturing the essence of science.

This all may seem to be a tempest in an academic teapot, a question of inter-
est to no one besides philosophers and the handful of scientists with an interest
in epistemology, but it underlies many of the debates on scientific issues that
affect the public. Consider the controversy in the mid-1980s over the use of
recombinant bovine growth hormone in dairy cattle. Although the scientific
community pronounced it safe, opponents of its use suggested that the
researchers were more biased by the sources of funding for their research
and by their own inherent biases than by evidence.17 This argument depended
implicitly upon the assumption that the scientific opinions were not objective
but rather were socially constructed. In general, if science is accepted as objective, people will give a great deal of weight to the conclusions of the scientific community and to the professional opinions of individual scientists. But if science is seen as a social construct, vulnerable to biases and fashion, people will question or even dismiss its conclusions.

Which brings us back to our original subject. At its heart, [the book from which this chapter was taken is] about technological knowledge: What is it? and, How is it formed? Traditionally, engineers have seen their work in positivist terms. Like scientists, they take it for granted that their work is objective, and they believe that to understand a technology, all one needs are the technical details. They see a strict dichotomy between the pure logic of their machines and the subjectivity and the irrationality of the world in which they must operate. On the other hand, a growing school of social scientists sees technology as socially constructed. Its objectivity, they say, is a myth created and propagated by engineers who believe their own press. As with science, this is no mere academic debate. Our attitudes toward technology hinge, in large part, on what we believe about the nature of the knowledge underlying it.

To understand technological knowledge, this book argues, it is necessary to marry the positivist and the social constructionist perspectives. Technology combines the physical world with the social, the objective with the subjective, the machine with the man. If one imagines a spectrum with scientific knowledge on one end and social knowledge on the other, technological knowledge lies somewhere in the middle. It is falsifiable to a certain extent, but not nearly to the same degree as science. Conversely, much of technological knowledge is socially constructed, but there are limits — no matter what a group of people thinks or does, an airplane design that can’t fly won’t fly. In short, the physical world restricts technology. Some things work better than others, some don’t work at all, and this leads to a certain amount of objectivity in technological knowledge. But, unlike scientists, engineers are working with a world of their own creation, and the act of creation cannot be understood in positivist terms.

Ultimately, any understanding of technological knowledge must recognize the composite nature of that knowledge. Our technological creations carry with them the traces of both the engineer and the larger society.

NOTES

6. Maureen Hogan, Challenger and Risks, ed., Technology and Times of a Technological Century
7. Alvin M. Weinberger, Institute of Physics, and Times of a Technology
8. For a critical review, in, eds., Does Technology Drive History? p. x
9. Leo Marx and Me, Technology
10. There have been many
11. Social science perspectives,
12. Pinch, eds., The Social and History of Technology
15. The seminal work of Reisley, A Treatise
16. A good summary can be found in Trevor J. Artifacts: Or How
20. David Mermin, a version of the social as "Sustaining Myth," Physics Relativity," Physics
21. Sokal's "nonsensical article about the social and its analyses. Sokal
22. "He had cobbled together postmodernist theory, and
23. This argument is
24. Professor of Philosophy
25. W. P. Norton, "Just in Time to Kolata, "When the


8. For a critical review of technological determinism, see Merritt Roe Smith and Leo Marx, eds., *Does Technology Drive History?* (Cambridge, MA: MIT Press, 1994).

9. Leo Marx and Merritt Rowe Smith, introduction to Marx and Smith, *Does Technology Drive History?* p. x.


In spring 1996, the dispute between physicists and social constructionists took an amusing turn—amusing, at least, for the physicists—when Alan Sokal published an article entitled "Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity" in *Social Text*, a "postmodernist" journal devoted to social constructionist analyses. Sokal, a physicist at New York University, later revealed that it was all a hoax. He had cobbled together bad science, even worse logic, and a bunch of catchphrases from postmodernist theorizing and had somehow convinced the editors of *Social Text* that the nonsensical article was a contribution worthy of publication. The editors were understandably not amused but neither were they contrite. They did not seem to see it as a weakness on their part—or even less, on the part of the entire postmodernist movement—that they could not tell the difference between an obvious hoax and what passes for serious work in their field. The original article appeared in *Social Text* 46/47 (Spring/Summer 1996), pp. 217-252. Sokal revealed the hoax in "A Physicist Experiments with Cultural Studies," *Lingua Franca* (May/June 1996), pp. 62-64.

16. This argument is modified from one offered by Thelma Lavine, Clarence J. Robinson Professor of Philosophy at George Mason University in Fairfax, Virginia.