

Subversive Rationalization: Technology, Power, and Democracy¹

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This paper argues, against technological and economic determinism, that the dominant model of industrial society is politically contingent. The idea that technical decisions are significantly constrained by 'rationality' - either technical or economic - is shown to be groundless. Constructivist and hermeneutic approaches to technology show that modern societies are inherently available for a different type of development in a different cultural framework. It is possible that, in the future, those who today are subordinated to technology's rhythms and demands will be able to control it and to determine its evolution. I call the process of creating such a society 'subversive rationalization' because it requires technological advances that can only be made in opposition to the dominant hegemony.

I. The Limits of Democratic Theory

Technology is one of the major sources of public power in modern societies. So far as decisions affecting our daily lives are concerned, political democracy is largely overshadowed by the enormous power wielded by the masters of technical systems: corporate and military leaders, and professional associations of groups such as physicians and engineers. They have far more to do with control over patterns of urban growth, the design of dwellings and transportation systems, the selection of innovations, our experience as employees, patients, and consumers, than all the governmental institutions of our society put together.

Marx saw this situation coming in the middle of the nineteenth century. He argued that traditional democratic theory erred in treating the economy as an extra-political domain ruled by natural laws such as the law of supply and demand. He claimed that we will remain disenfranchised and alienated so long as we have no say in industrial decision-making. Democracy must be extended from the political domain into the world of work. This is the underlying demand behind the idea of socialism.

Modern societies have been challenged by this demand for over a century. Democratic political theory offers no persuasive reason of principle to

reject it. Indeed, many democratic theorists endorse it.² What is more, in a number of countries, socialist parliamentary victories or revolutions have brought parties to power dedicated to achieving it. Yet today we do not appear to be much closer to democratizing industrialism than in Marx's time.

This state of affairs is usually explained in one of the following two ways. On the one hand, the common-sense view argues that modern technology is incompatible with workplace democracy. Democratic theory cannot reasonably press for reforms that would destroy the economic foundations of society. For evidence, consider the Soviet case: although they were socialists, the communists did not democratize industry, and the current democratization of Soviet society extends only to the factory gate. At least in the ex-Soviet Union, everyone can agree on the need for authoritarian industrial management.

On the other hand, a minority of radical theorists claim that technology is not responsible for the concentration of industrial power. That is a political matter, due to the victory of capitalist and communist elites in struggles with the underlying population. No doubt modern technology lends itself to authoritarian administration, but in a different social context it could just as well be operated democratically.

In what follows, I will argue for a qualified version of this second position, somewhat different from both the usual Marxist and social-democratic formulations. The qualification concerns the role of technology, which I see as *neither* determining nor as neutral. I will argue that modern forms of hegemony are based on the technical mediation of a variety of social activities, whether it be production or medicine, education or the military, and that, consequently, the democratization of our society requires radical technical as well as political change.

This is a controversial position. The common-sense view of technology limits democracy to the state. By contrast, I believe that unless democracy can be extended beyond its traditional bounds into the technically mediated domains of social life, its use-value will continue to decline, participation will wither, and the institutions we identify with a free society will gradually disappear.

Let me turn now to the background to my argument. I will begin by presenting an overview of various theories that claim that in so far as modern societies depend on technology, they require authoritarian hierarchy. These theories presuppose a form of technological determinism which is refuted by historical and sociological arguments I will briefly summarize. I will then present a sketch of a non-deterministic theory of modern society I call 'critical theory of technology'. This alternative approach emphasizes contextual aspects of technology ignored by the dominant view. I will argue that technology is not just the rational control of nature; both its devel-

opment and impact are intrinsically social. I will then show that this view undermines the customary reliance on efficiency as a criterion of technological development. That conclusion, in turn, opens broad possibilities of change foreclosed by the usual understanding of technology.

II. Dystopian Modernity

Max Weber's famous theory of rationalization is the original argument against industrial democracy. The title of this paper implies a provocative reversal of Weber's conclusions. He defined rationalization as the increasing role of calculation and control in social life, a trend leading to what he called the 'iron cage' of bureaucracy. 'Subversive' rationalization is thus a contradiction in terms.

Once the traditionalist struggle against rationalization has been defeated, further resistance in a Weberian universe can only reaffirm irrational life-forces against routine and drab predictability. This is not a democratic program but a romantic anti-dystopian one, the sort of thing that is already foreshadowed in Dostoevsky's *Notes from Underground* and various back-to-nature ideologies.

My title is meant to reject the dichotomy between rational hierarchy and irrational protest implicit in Weber's position. If authoritarian social hierarchy is truly a contingent dimension of technical progress, as I believe, and not a technical necessity, then there must be an alternative way of rationalizing society that democratizes rather than centralizes control. We need not go underground or native to preserve threatened values such as freedom and individuality.

But the most powerful critiques of modern technological society follow directly in Weber's footsteps in rejecting this possibility. I am thinking of Heidegger's formulation of 'the question of technology' and Ellul's theory of 'the technical phenomenon'.⁴ According to these theories, we have become little more than objects of technique, incorporated into the mechanism we have created. As Marshall McLuhan once put it, technology has reduced us to the 'sex organs of machines'. The only hope is a vaguely evoked spiritual renewal that is too abstract to inform a new technical practice.

These are interesting theories, but I have time to do little more than pay tribute to their contribution to opening a space of reflection on modern technology. Instead, to advance my own argument, I will concentrate on their principal flaw, the identification of technology in general with the specific technologies that have developed in the last century in the West. These are technologies of conquest that pretend to an unprecedented autonomy; their social sources and impacts are hidden. I will argue that

this type of technology is a particular feature of our society and not a universal dimension of 'modernity' as such.

III. Technological Determinism

Determinism rests on the assumption that technologies have an autonomous functional logic that can be explained without reference to society. Technology is presumably social only through the purpose it serves, and purposes are in the mind of the beholder. Technology would thus resemble science and mathematics by its intrinsic independence of the social world.

Yet unlike science and mathematics, technology has immediate and powerful social impacts. It would seem that society's fate is at least partially dependent on a non-social factor which influences it without suffering a reciprocal influence. This is what is meant by 'technological determinism'.

The dystopian visions of modernity I have been describing are deterministic. If we want to affirm the democratic potentialities of modern industrialism, we will therefore have to challenge their deterministic premises. These I will call the thesis of unilinear progress and the thesis of determination by the base. Here is a brief summary of these two positions.

(1) Technical progress appears to follow a unilinear course, a fixed track, from less to more advanced configurations. Although this conclusion seems obvious from a backward glance at the development of any familiar technical object, in fact it is based on two claims of unequal plausibility: first, that technical progress proceeds from lower to higher levels of development; and second, that that development follows a single sequence of necessary stages. As we will see, the first claim is independent of the second and not necessarily deterministic.

(2) Technological determinism also affirms that social institutions must adapt to the 'imperatives' of the technological base. This view, which no doubt has its source in a certain reading of Marx, is now part of the common sense of the social sciences.⁵ Below, I will discuss one of its implications in detail: the supposed 'trade-off' between prosperity and environmental ideology.

These two theses of technological determinism present decontextualized, self-generating technology as the unique foundation of modern society. Determinism thus implies that our technology and its corresponding institutional structures are universal, indeed planetary, in scope. There may be many forms of tribal society, many feudalisms, even many forms of early capitalism, but there is only one modernity and it is exemplified in our society, for good or ill. Developing societies should take note: as Marx once said, calling the attention of his backward German compatriots to British advances: '*De te fabula narratur*' — of you the tale is told.⁶

IV. Constructivism

The implications of determinism appear so obvious that it is surprising to discover that neither of its two theses can withstand close scrutiny. Yet contemporary sociology of technology undermines the first thesis of unilinear progress while historical precedents are unkind to the second thesis of determination by the base.

Recent constructivist sociology of technology grows out of new social studies of science. These studies challenge our tendency to exempt scientific theories from the sort of sociological examination to which we submit non-scientific beliefs. They affirm the 'principle of symmetry', according to which all contending beliefs are subject to the same type of social explanation regardless of their truth or falsity.⁷ A similar approach to technology rejects the usual assumption that technologies succeed on purely functional grounds.

Constructivism argues that theories and technologies are underdetermined by scientific and technical criteria. Concretely, this means two things: first, there is generally a surplus of workable solutions to any given problem, and social actors make the final choice among a batch of technically viable options; and second, the problem-definition often changes in the course of solution. The latter point is the more conclusive, but also more difficult, of the two.

Two sociologists of technology, Pinch and Bijker, illustrate it with the early history of the bicycle.⁸ The object we take to be a self-evident 'black box' actually started out as two very different devices, a sportsman's racer and a utilitarian transportation vehicle. The high front wheel of the sportsman's bike was necessary at the time to attain high speeds, but it also caused instability. Equal-sized wheels made for a safer but less exciting ride. These two designs met different needs and were in fact different technologies with many shared elements. Pinch and Bijker call this original ambiguity of the object designated as a 'bicycle', 'interpretive flexibility'.

Eventually the 'safety' design won out, and it benefited from all the later advances that occurred in the field. In retrospect, it seems as though the high-wheelers were a clumsy and less efficient stage in a progressive development leading through the old 'safety' bicycle to current designs. In fact the high-wheeler and the safety bicycle shared the field for years, and neither was a stage in the other's development. The high-wheeler represents a possible alternative path of bicycle development that addressed different problems at the origin.

Determinism is a species of Whig history which makes it seem as though the end of the story was inevitable from the very beginning by projecting the abstract technical logic of the finished object back into the past as a cause of development. That approach confuses our understanding of the

past and stifles the imagination of a different future. Constructivism can open up that future, although its practitioners have hesitated so far to engage the larger social issues implied in their method.⁹

V. Indeterminism

If the thesis of unilinear progress falls, the collapse of the notion of determination by the technological base cannot be far behind. Yet it is still frequently invoked in contemporary political debates.

I shall return to these debates later in this paper. For now, let us consider the remarkable anticipation of current attitudes in the struggle over the length of the workday and child labor in mid-nineteenth-century England. Factory-owners and economists denounced regulation as inflationary; industrial production supposedly required children and the long workday. One member of parliament declared that regulation is 'a false principle of humanity, which in the end is certain to defeat itself'. He went on to argue that the new rules were so radical as to constitute 'in principle an argument to get rid of the whole system of factory labor'.¹⁰ Similar protestations are heard today on behalf of industries threatened with what they call environmental 'Luddism'.

Yet what actually happened once the regulators succeeded in imposing limitations on the workday and expelling children from the factory? Did the violated imperatives of technology come back to haunt them? Not at all. Regulation led to an intensification of factory labor that was incompatible with the earlier conditions in any case. Children ceased to be workers and were redefined socially as learners and consumers. Consequently, they entered the labor market with higher levels of skill and discipline that were soon presupposed by technological design. As a result no one is nostalgic for a return to the good old days when inflation was held down by child labor. That is simply not an option.

This example shows the tremendous flexibility of the technical system. It is not rigidly constraining but, on the contrary, can adapt to a variety of social demands. This conclusion should not be surprising given the responsiveness of technology to social redefinition discussed previously. It means that technology is just another dependent social variable, albeit an increasingly important one, and not the key to the riddle of history.

Determinism, I have argued, is characterized by the principles of unilinear progress and determination by the base; if determinism is wrong, then technology research must be guided by the following two contrary principles. In the first place, technological development is not unilinear but branches in many directions and could reach generally higher levels along more than one different track. And, second, technological development is

not determining for society but is overdetermined by both technical and social factors.

The political significance of this position should also be clear by now. In a society where determinism stands guard on the frontiers of democracy, indeterminism cannot but be political. If technology has many unexplored potentialities, no technological imperatives dictate the current social hierarchy. Rather, technology is a scene of social struggle, a 'parliament of things', on which civilizational alternatives contend.

VI. Interpreting Technology

In the remainder of this paper I would like to present several major themes of a non-determinist approach to technology. The picture sketched so far implies a significant change in our definition of technology. It can no longer be considered as a collection of devices, nor, more generally, as the sum of rational means. These are tendentious definitions that make technology seem more functional and less social than in fact it is.

As a social object, technology ought to be subject to interpretation like any other cultural artifact, but it is generally excluded from humanistic study. We are assured that its essence lies in a technically explainable function rather than a hermeneutically interpretable meaning. At most, humanistic methods might illuminate extrinsic aspects of technology, such as packaging and advertising, or popular reactions to controversial innovations such as nuclear power or surrogate motherhood. Technological determinism draws its force from this attitude. If one ignores most of the connections between technology and society, it is no wonder that technology then appears to be self-generating.

Technical objects have two hermeneutic dimensions that I call their *social meaning* and their *cultural horizon*.¹¹ The role of social meaning is clear in the case of the bicycle introduced above. We have seen that the construction of the bicycle was controlled in the first instance by a contest of interpretations: was it to be a sportsman's toy or a means of transportation? Design features such as wheel size also served to signify it as one or another type of object.¹²

It might be objected that this is merely an initial disagreement over goals with no hermeneutic significance. Once the object is stabilized, the engineer has the last word on its nature, and the humanist interpreter is out of luck. This is the view of most engineers and managers; they readily grasp the concept of 'goal' but they have no place for 'meaning'.

In fact the dichotomy of goal and meaning is a product of functionalist professional culture, which is itself rooted in the structure of the modern economy. The concept of 'goal' strips technology bare of social contexts,

focusing engineers and managers on just what they need to know to do their job.

A fuller picture is conveyed, however, by studying the social role of the technical object and the lifestyles it makes possible. That picture places the abstract notion of 'goal' in its concrete social context. It makes technology's contextual causes and consequences visible rather than obscuring them behind an impoverished functionalism.

The functionalist point of view yields a decontextualized temporal cross-section in the life of the object. As we have seen, determinism claims implausibly to be able to get from one such momentary configuration of the object to the next on purely technical terms. But in the real world all sorts of unpredictable attitudes crystallize around technical objects and influence later design changes. The engineer may think these are extrinsic to the device he or she is working on, but they are its very substance as a historically evolving phenomenon.

These facts are recognized to a certain extent in the technical fields themselves, especially in computers. Here we have a contemporary version of the dilemma of the bicycle discussed above. Progress of a generalized sort in speed, power, and memory goes on apace while corporate planners struggle with the question of what it is all for. Technical development does not point definitively toward any particular path. Instead, it opens branches, and the final determination of the 'right' branch is not within the competence of engineering, because it is simply not inscribed in the nature of the technology.

I have studied a particularly clear example of the complexity of the relation between the technical function and meaning of the computer in the case of French videotex.¹³ Called 'Teletel', this system was designed to bring France into the Information Age by giving telephone subscribers access to databases. Fearing that consumers would reject anything resembling office equipment, the telephone company attempted to redefine the computer's social image; it was no longer to appear as a calculating device for professionals but was to become an informational network for all.

The telephone company designed a new type of terminal, the Minitel, to look and feel like an adjunct to the domestic telephone. The telephonic disguise suggested to some users that they ought to be able to talk to each other on the network. Soon the Minitel underwent a further redefinition at the hands of these users, many of whom employed it primarily for anonymous on-line chatting with other users in the search for amusement, companionship, and sex.

Thus the design of the Minitel invited communications applications which the company's engineers had not intended when they set about improving the flow of information in French society. Those applications, in turn, connoted the Minitel as a means of personal encounter, the very opposite

of the rationalistic project for which it was originally created. The 'cold' computer became a 'hot' new medium.

At issue in the transformation is not only the computer's narrowly conceived technical function, but the very nature of the advanced society it makes possible. Does networking open the doors to the Information Age where, as rational consumers hungry for data, we pursue strategies of optimization? Or is it a postmodern technology that emerges from the breakdown of institutional and sentimental stability, reflecting, in Lyotard's words, the 'atomization of society into flexible networks of language games?'¹⁴ In this case technology is not merely the servant of some pre-defined social purpose; it is an environment within which a way of life is elaborated.

In sum, differences in the way social groups interpret and use technical objects are not merely extrinsic but make a difference in the nature of the objects themselves. *What* the object *is* for the groups that ultimately decide its fate determines what it *becomes* as it is redesigned and improved over time. If this is true, then we can only understand technological development by studying the sociopolitical situation of the various groups involved in it.

VII. Technological Hegemony

In addition to the sort of assumptions about individual technical objects we have been discussing so far, that situation also includes broader assumptions about social values. This is where the study of the cultural horizon of technology comes in. This second hermeneutic dimension of technology is the basis of modern forms of social hegemony; it is particularly relevant to our original question concerning the inevitability of hierarchy in technological society.

As I will use the term, hegemony is a form of domination so deeply rooted in social life that it seems natural to those it dominates. One might also define it as that aspect of the distribution of social power which has the force of culture behind it.

The term 'horizon' refers to culturally general assumptions that form the unquestioned background to every aspect of life.¹⁵ Some of these support the prevailing hegemony. For example, in feudal societies, the 'chain of being' established hierarchy in the fabric of God's universe and protected the caste relations of the society from challenge. Under this horizon, peasants revolted in the name of the King, the only imaginable source of power. Rationalization is our modern horizon, and technological design is the key to its effectiveness as the basis of modern hegemonies.

Technological development is constrained by cultural norms originating in economics, ideology, religion, and tradition. We discussed earlier how

assumptions about the age-composition of the labor force entered into the design of nineteenth-century production technology. Such assumptions seem so natural and obvious that they often lie below the threshold of conscious awareness.

This is the point of Herbert Marcuse's important critique of Weber.¹⁶ Marcuse shows that the concept of rationalization confounds the control of labor by management with control of nature by technology. The search for control of nature is generic, but management only arises against a specific social background, the capitalist wage system. Workers have no immediate interest in output in this system, unlike earlier forms of farm and craft labor, since their wage is not essentially linked to the income of the firm. Control of human beings becomes all-important in this context.

Through mechanization, some of the control functions are eventually transferred from human overseers and parcelized work practices to machines. Machine design is thus socially relative in a way that Weber never recognized, and the 'technological rationality' it embodies is not universal but particular to capitalism. In fact, it is the horizon of all the existing industrial societies, communist as well as capitalist, in so far as they are managed from above. (In a later section, I discuss a generalized application of this approach in terms of what I call the 'technical code'.)

If Marcuse is right, it ought to be possible to trace the impress of class relations in the very design of production technology, as has indeed been shown by such Marxist students of the labor process as Harry Braverman and David Noble.¹⁷ The assembly line offers a particularly clear instance because it achieves traditional management goals, such as deskilling and pacing work, through technical design. Its technologically enforced labor discipline increases productivity and profits by increasing control. However, the assembly line only appears as technical progress in a specific social context. It would not be perceived as an advance in an economy based on workers' cooperatives in which labor discipline was more self-imposed than imposed from above. In such a society, a different technological rationality would dictate different ways of increasing productivity.¹⁸

This example shows that technological rationality is not merely a belief, an ideology, but is effectively incorporated into the structure of machines. Machine design mirrors back the social factors operative in the prevailing rationality. The fact that the argument for the social relativity of modern technology originated in a Marxist context has obscured its most radical implications. We are not dealing here with a mere critique of the property system, but have extended the force of that critique down into the technical 'base'. This approach goes well beyond the old economic distinction between capitalism and socialism, market and plan. Instead, one arrives at a very different distinction between societies in which power rests on the

technical mediation of social activities and those that democratize technical control and, correspondingly, technological design.

VIII. Double Aspect Theory

The argument to this point might be summarized as a claim that social meaning and functional rationality are inextricably intertwined dimensions of technology. They are not ontologically distinct, for example, with meaning in the observer's mind and rationality in the technology proper. Rather they are 'double aspects' of the same underlying technical object, each aspect revealed by a specific contextualization.

Functional rationality, like scientific-technical rationality in general, isolates objects from their original context in order to incorporate them into theoretical or functional systems. The institutions that support this procedure—such as laboratories and research centers—themselves form a special context with their own practices and links to various social agencies and powers. The notion of 'pure' rationality arises when the work of decontextualization is not itself grasped as a social activity reflecting social interests.

Technologies are selected by these interests from among many possible configurations. Guiding the selection process are social codes established by the cultural and political struggles that define the horizon under which the technology will fall. Once introduced, technology offers a material validation of the cultural horizon to which it has been preformed. I call this the 'bias' of technology: apparently neutral, functional rationality is enlisted in support of a hegemony. The more technology society employs, the more significant is this support.

As Foucault argues in his theory of 'power knowledge', modern forms of oppression are not so much based on false ideologies as on effective techniques 'encoded' by the dominant hegemony to reproduce the system.¹⁹ So long as that act of choice remains hidden, the deterministic image of a technically justified social order is projected.

The legitimating effectiveness of technology depends on unconsciousness of the cultural-political horizon under which it was designed. A recontextualizing critique of technology can uncover that horizon, demystify the illusion of technical necessity, and expose the relativity of the prevailing technical choices.

IX. The Social Relativity of Efficiency

These issues appear with particular force in the environmental movement today. Many environmentalists argue for technical changes that would

protect nature and in the process improve human life as well. Such changes would enhance efficiency in broad terms by reducing harmful and costly side-effects of technology. However, this program is very difficult to impose in a capitalist society. There is a tendency to deflect criticism from technological processes to products and people, from a priori prevention to a posteriori clean-up. These preferred strategies are generally costly and reduce efficiency under the horizon of the given technology. This situation has political consequences.

Restoring the environment after it has been damaged is a form of collective consumption, financed by taxes or higher prices. These approaches dominate public awareness. This is why environmentalism is generally perceived as a cost involving trade-offs, and not as a rationalization increasing overall efficiency. But in a modern society, obsessed by economic well-being, that perception is damning. Economists and businessmen are fond of explaining the price we must pay in inflation and unemployment for worshipping at Nature's shrine instead of Mammon's. Poverty awaits those who will not adjust their social and political expectations to technology.

This trade-off model has environmentalists grasping at straws for a strategy. Some hold out the pious hope that people will turn from economic to spiritual values in the face of the mounting problems of industrial society. Others expect enlightened dictators to bite the bullet of technological reform even if a greedy populace shirks its duty. It is difficult to decide which of these solutions is more improbable, but both are incompatible with basic democratic values.²⁰

The trade-off model confronts us with dilemmas—environmentally sound technology vs. prosperity, workers' satisfaction and control vs. productivity, etc.—where what we need are syntheses. Unless the problems of modern industrialism can be solved in ways that both enhance public welfare and win public support, there is little reason to hope that they will ever be solved. But how can technological reform be reconciled with prosperity when it places a variety of new limits on the economy?

The child-labor case shows how apparent dilemmas arise on the boundaries of cultural change, specifically where the social definition of major technologies is in transition. In such situations, social groups excluded from the original design network articulate their unrepresented interests politically. New values which the outsiders believe would enhance their welfare appear as mere ideology to insiders who are adequately represented by the existing designs.

This is a difference of perspective, not of nature. Yet the illusion of essential conflict is renewed whenever major social changes affect technology. At first, satisfying the demands of new groups after the fact has visible costs and, if it is done clumsily, will indeed reduce efficiency until

better designs are found. But, usually, better designs can be found and what appeared to be an insuperable barrier to growth dissolves in the face of technological change.

This situation indicates the essential difference between economic exchange and technique. Exchange is all about trade-offs: more of A means less of B. But the aim of technical advance is precisely to avoid such dilemmas by elegant designs that optimize several variables at once. A single cleverly conceived mechanism may correspond to many different social demands, one structure to many functions.²¹ Design is not a zero-sum economic game but an ambivalent cultural process that serves a multiplicity of values and social groups without necessarily sacrificing efficiency.

X. The Technical Code

That these conflicts over social control of technology are not new can be seen from the interesting case of the 'bursting boilers'.²² Steamboat boilers were the first technology the US government subjected to safety regulation. Over five thousand people were killed or injured in hundreds of steamboat explosions from 1816, when regulation was first proposed, to 1852, when it was actually implemented. Is this many casualties or few? Consumers evidently were not too alarmed to continue traveling by riverboat in ever-increasing numbers. Understandably, the shipowners interpreted this as a vote of confidence and protested the excessive cost of safer designs. Yet politicians also won votes demanding safety.

The accident rate fell dramatically once technical improvements were mandated. Legislation would hardly have been necessary to achieve this outcome had it been technically determined. But in fact boiler design was relative to a social judgment about safety. That judgment could have been made on strictly market grounds, as the shippers wished, or politically, with differing technical results. In either case, those results *constitute* a proper boiler. What a boiler 'is' was thus defined through a long process of political struggle culminating finally in uniform codes issued by the American Society of Mechanical Engineers.

This example shows just how technology adapts to social change. What I call the 'technical code' of the object mediates the process. That code responds to the cultural horizon of the society at the level of technical design. Quite down-to-earth technical parameters, such as the choice and processing of materials, are *socially* specified by the code. The illusion of technical necessity arises from the fact that the code is thus literally 'cast in iron' or 'set in concrete' as the case may be.²³

Conservative anti-regulatory social philosophies are based on this illusion. They forget that the design process always already incorporates standards of safety and environmental compatibility; similarly, all technologies support some basic level of user or worker initiative. A properly made technical object simply *must* meet these standards to be recognized as such. We do not treat conformity as an expensive add-on, but regard it as an intrinsic production cost. Raising the standards means altering the definition of the object, not paying a price for an alternative good or ideological value as the trade-off model holds.

But what of the much discussed cost/benefit ratio of design changes such as those mandated by environmental or other similar legislation? These calculations have some application to transitional situations, before technological advances responding to new values fundamentally alter the terms of the problem. But all too often the results depend on economists' very rough estimates of the monetary value of such things as a day of trout fishing or an asthma attack. If made without prejudice, these estimates may well help to prioritize policy alternatives. But one cannot legitimately generalize from such policy applications to a universal theory of the costs of regulation.

Such fetishism of efficiency ignores our ordinary understanding of the concept which alone is relevant to social decision-making. In that everyday sense, efficiency concerns the narrow range of values that economic actors routinely affect by their decisions. Unproblematic aspects of technology are not included. In theory one can decompose any technical object and account for each of its elements in terms of the goals it meets, whether it be safety, speed, reliability, etc., but in practice no one is interested in opening the 'black box' to see what is inside.

For example, once the boiler code is established, such things as the thickness of a wall or the design of a safety valve appear as essential to the object. The cost of these features is not broken out as the specific 'price' of safety and compared unfavorably with a more efficient but less secure version of the technology. Violating the code in order to lower costs is a crime, not a trade-off. And since all further progress takes place on the basis of the new safety standard, soon no one looks back to the good old days of cheaper, insecure designs.

Design standards are only controversial while they are in flux. Resolved conflicts over technology are quickly forgotten. Their outcomes, a welter of taken-for-granted technical and legal standards, are embodied in a stable code and form the background against which economic actors manipulate the unstable portions of the environment in the pursuit of efficiency. The code is not varied in real-world economic calculations but treated as a fixed input.

Anticipating the stabilization of a new code, one can often ignore contemporary arguments that will soon be silenced by the emergence of a new horizon of efficiency calculations. This is what happened with boiler design and child labor; presumably, the current debates on environmentalism will have a similar history, and we will someday mock those who object to cleaner air as a 'false principle of humanity' that violates technological imperatives.

Non-economic values intersect the economy in the technical code. The examples we are dealing with illustrate this point clearly. The legal standards that regulate workers' economic activity have a significant impact on every aspect of their lives. In the child-labor case, regulation helped to widen educational opportunities with consequences that are not primarily economic in character. In the riverboat case, Americans gradually chose high levels of security, and boiler design came to reflect that choice. Ultimately, this was no trade-off of one good for another, but a non-economic decision about the value of human life and the responsibilities of government.

Technology is thus not merely a means to an end; technical design standards define major portions of the social environment, such as urban and built spaces, workplaces, medical activities and expectations, life patterns, and so on. The economic significance of technical change often pales beside its wider human implications in framing a way of life. In such cases, regulation defines the cultural framework *of* the economy; it is not an act *in* the economy.

XI. The Consequences of Technology

The theory sketched here suggests the possibility of a general reform of technology. But dystopian critics object that the mere fact of pursuing efficiency or technical effectiveness already does inadmissible violence to human beings and nature. Universal functionalization destroys the integrity of all that is. As Heidegger argues, an 'objectless' world of mere resources replaces a world of 'things' treated with respect for their own sake as the gathering places of our manifold engagements with 'being'.²⁴

This critique gains force from the actual perils with which modern technology threatens the world today. But my suspicions are aroused by Heidegger's famous contrast between a dam on the Rhine and a Greek chalice. It would be difficult to find a more tendentious comparison. No doubt modern technology is immensely more destructive than any other. And Heidegger is right to argue that means are not truly neutral, that their substantive content affects society independent of the goals they serve. But

this content is not *essentially* destructive; rather, it is a matter of design and social insertion.

In another text, Heidegger shows us a jug 'gathering' the contexts in which it was created and functions. There is no reason why modern technology cannot also 'gather' its multiple contexts, albeit with less romantic pathos. This is in fact one way of interpreting contemporary demands for such things as environmentally sound technology, applications of medical technology that respect human freedom and dignity, urban designs that create humane living spaces, production methods that protect workers' health and offer scope for their intelligence, and so on. What are these demands if not a call to reconstruct modern technology, so that it gathers a wider range of contexts to itself rather than reducing its natural, human, and social environment to mere resources?

Heidegger would not take these alternatives very seriously, because he reifies modern technology as something separate from society, as an inherently contextless force aiming at pure power. If this is the 'essence' of technology, reform would be merely extrinsic. But at this point Heidegger's position converges with the very Prometheanism he rejects. Both depend on the narrow definition of technology that, at least since Bacon and Descartes, has emphasized its destiny to control the world to the exclusion of its equally essential contextual embeddedness. I believe that this definition reflects the capitalist environment in which modern technology first developed.

The exemplary modern master of technology is the entrepreneur, single-mindedly focused on production and profit. The enterprise is a radically decontextualized platform for action, without the traditional responsibilities for persons and places that went with technical power in the past. It is the autonomy of the enterprise that makes it possible to distinguish so sharply between intended and unintended consequences, between goals and contextual effects, and to ignore the latter.

The narrow focus of modern technology meets the needs of a particular hegemony; it is not a metaphysical condition. Under that hegemony technological design is unusually decontextualized and destructive. It is that hegemony that is called to account, not technology *per se*, when we point out that today technical means form an increasingly threatening life-environment. It is that hegemony, as it has embodied itself in technology, that must be challenged in the struggle for technological reform.

XII. The 'Essence' of Technology

Heidegger rejects any merely social diagnosis of the ills of technological societies and claims that the source of their problems dates back at least

to Plato, that modern societies merely realize a *telos* immanent in Western metaphysics from the beginning. His originality consists in pointing out that the ambition to control being is itself a way of being and hence subordinate at some deeper level to an ontological dispensation beyond human control. Heidegger's demand for a new response to the challenge of this dispensation is so shrouded in obscurity that no one has ever been able to give it a concrete content. The overall effect of his critique is to condemn human agency, at least in modern times, and to confuse essential differences between types of technological development.

This confusion has a historical aspect. Heidegger is perfectly aware that technical activity was not 'metaphysical' in his sense until recently. He must therefore sharply distinguish modern technology from all earlier forms of technique, obscuring the many real connections and continuities. I would argue, on the contrary, that what is new about modern technology can only be understood against the background of the traditional technical world from which it developed. Furthermore, the saving potential of modern technology can only be realized by recapturing certain traditional features of technique. Perhaps this is why theories that treat modern technology as a unique phenomenon lead to such pessimistic conclusions.

Modern technology differs from earlier technical practices through significant shifts in emphasis rather than generically. There is nothing unprecedented in its chief features, such as the reduction of objects to raw materials, the use of precise measurement and plans, the technical control of some human beings by others, large scales of operation. It is the centrality of these features that is new, and of course the consequences of that are truly without precedent.

What does a broader historical picture of technology show? The privileged dimensions of modern technology appear in a larger context that includes many currently subordinated features that were defining for it in former times. For example, until the generalization of Taylorism, technical life was essentially about the choice of a vocation. Technology was associated with a way of life, with specific forms of personal development, virtues, etc. Only the success of capitalist deskilling finally reduced these human dimensions of technique to marginal phenomena.

Similarly, modern management has replaced the traditional collegiality of the guilds with new forms of technical control. Just as vocational investment in work continues in certain exceptional settings, so collegiality survives in a few professional or cooperative workplaces. Numerous historical studies show that these older forms are incompatible not so much with the 'essence' of technology as with capitalist economics. Given a different social context and a different path of technical development, it might be possible to recover these traditional technical values and

organizational forms in new ways in a future evolution of modern technological society.

Technology is an elaborate complex of related activities that crystallizes around tool-making and -using in every society. Matters such as the transmission of techniques or the management of its natural consequences are not extrinsic to technology *per se* but are dimensions of it. When, in modern societies, it becomes advantageous to minimize these aspects of technology, that too is a way of accommodating it to a certain social demand, not the revelation of its pre-existing 'essence'. In so far as it makes sense to talk about an essence of technology at all, it must embrace the whole field revealed by historical study, and not only a few traits ethnocentrically privileged by our society.

XIII. Conclusion: Subversive Rationalization

For generations faith in progress was supported by two widely held beliefs: that technical necessity dictates the path of development, and that the pursuit of efficiency provides a basis for identifying that path. I have argued here that both these beliefs are false, and that, furthermore, they are ideologies employed to justify restrictions on opportunities to participate in the institutions of industrial society. I conclude that we can achieve a new type of technological society which can support a broader range of values. Democracy is one of the chief values a redesigned industrialism could better serve.

What does it mean to democratize technology? The problem is not primarily one of legal rights but of initiative and participation. Legal forms may eventually routinize claims that are asserted at first informally, but the forms will remain hollow unless they emerge from the experience and needs of individuals resisting a specifically technological hegemony.

That resistance takes many forms, from union struggles over health and safety in nuclear power plants to community struggles over toxic waste disposal to political demands for regulation of reproductive technologies. These movements alert us to the need to take technological externalities into account and demand design changes responsive to the enlarged context revealed in that accounting.

Such technological controversies have become an inescapable feature of contemporary political life, laying out the parameters for official 'technology assessment'.²⁵ They prefigure the creation of a new public sphere embracing the technical background of social life, and a new style of rationalization that internalizes unaccounted costs borne by 'nature', i.e. something or -body exploitable in the pursuit of profit. Here respect for

nature is not antagonistic to technology but enhances efficiency in broad terms.

As these controversies become commonplace, surprising new forms of resistance and new types of demands emerge alongside them. Networking has given rise to one among many such innovative public reactions to technology. Individuals who are incorporated into new types of technical networks have learned to resist through the net itself in order to influence the powers that control it. This is not a contest for wealth or administrative power, but a struggle to subvert the technical practices, procedures, and designs structuring everyday life.

Again, the example of the Minitel can serve as a model of this new approach. In France, the computer was politicized as soon as the government attempted to introduce a highly rationalistic information system to the general public. Users 'hacked' the network in which they were inserted and altered its functioning, introducing human communication on a vast scale where only the centralized distribution of information had been planned.

It is instructive to compare this case to the movements of AIDS patients.²⁶ Just as a rationalistic conception of the computer tends to occlude its communicative potentialities, so in medicine, caring functions have become mere side-effects of treatment, which is itself understood in exclusively technical terms. Patients become objects of this technique, more or less 'compliant' to management by physicians. The incorporation of thousands of incurably ill AIDS patients into this system destabilized it and exposed it to new challenges.

The key issue was access to experimental treatment. In effect, clinical research is one way in which a highly technologized medical system can care for those it cannot yet cure. But, until quite recently, access to medical experiments has been severely restricted by paternalistic concern for patients' welfare. AIDS patients were able to open up access because the networks of contagion in which they were caught were paralleled by social networks that were already mobilized around gay rights at the time the disease was first diagnosed.

Instead of participating in medicine individually as objects of a technical practice, they challenged it collectively and politically. They 'hacked' the medical system and turned it to new purposes. Their struggle represents a counter-tendency to the technocratic organization of medicine, an attempt at a recovery of its symbolic dimension and caring functions.

As in the case of the Minitel, it is not obvious how to evaluate this challenge in terms of the customary concept of politics. Nor do these subtle struggles against the growth of silence in technological societies appear significant from the standpoint of the reactionary ideologies that contend noisily with capitalist modernism today. Yet the demand for communication

these movements represent is so fundamental that it can serve as a touchstone for the adequacy of our concept of politics to the technological age.

These resistances, like the environmental movement, challenge the horizon of rationality under which technology is currently designed. Rationalization in our society responds to a particular definition of technology as a means to the goal of profit and power. A broader understanding of technology suggests a very different notion of rationalization, based on responsibility for the human and natural contexts of technical action. I call this 'subversive rationalization' because it requires technological advances that can only be made in opposition to the dominant hegemony. It represents an alternative to both the on-going celebration of technocracy triumphant and the gloomy Heideggerian counterclaim that 'Only a God can save us' from techno-cultural disaster.²⁷

But is subversive rationalization in this sense socialist? There is certainly room for discussion of the connection between this new technological agenda and the old idea of socialism. I believe there is significant continuity. In socialist theory, workers' lives and dignity stood for the larger contexts which modern technology ignores. The destruction of their minds and bodies on the workplace was viewed as a contingent consequence of capitalist technical design. The implication that socialist societies might design a very different technology under a different cultural horizon was perhaps given only lip service, but at least it was formulated as a goal.

We can make a similar argument today over a wider range of contexts in a broader variety of institutional settings with considerably more urgency. I am inclined to call such a position socialist and to hope that in time it can replace the image of socialism projected by the failed communist experiment.

More important than this terminological question is the substantive point I have been trying to make. Why has democracy not been extended to technically mediated domains of social life despite a century of struggles? Is it because technology excludes democracy, or because it has been used to block it? The weight of the argument supports the second conclusion. Technology can support more than one type of technological civilization, and may someday be incorporated into a more democratic society than ours.

NOTES

1 This paper expands a presentation of my book, *Critical Theory of Technology* (New York: Oxford University Press, 1991), delivered at the American Philosophical Association, 28 Dec. 1991.

2 See, e.g., Joshua Cohen and Joel Rogers, *On Democracy: Toward a Transformation of American Society* (Harmondsworth: Penguin, 1983); Frank Cunningham, *Democratic Theory and Socialism* (Cambridge: Cambridge University Press, 1987).

- 3 Max Weber, *The Protestant Ethic and the Spirit of Capitalism*, trans. T. Parsons (New York: Scribners, 1958), pp. 181-2.
- 4 Martin Heidegger, *The Question Concerning Technology*, trans. W. Lovitt (New York: Harper & Row, 1977); Jacques Ellul, *The Technological Society*, trans. J. Wilkinson (New York: Vintage, 1964).
- 5 Richard W. Miller, *Analyzing Marx: Morality, Power and History* (Princeton: Princeton University Press, 1984), pp. 188-95.
- 6 Karl Marx, *Capital* (New York: Modern Library, 1906), p. 13.
- 7 See, e.g., David Bloor, *Knowledge and Social Imagery* (Chicago: University of Chicago Press, 1991), pp. 175-9. For a general presentation of constructivism, see Bruno Latour, *Science in Action* (Cambridge, MA: Harvard University Press, 1987).
- 8 Trevor Pinch and Wiebe Bijker, 'The Social Construction of Facts and Artefacts: or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other', *Social Studies of Science*, no. 14, 1984.
- 9 See Langdon's Winner's blistering critique of the characteristic limitations of the position, entitled, 'Upon Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology', *The Technology of Discovery and the Discovery of Technology: Proceedings of the Sixth International Conference of the Society for Philosophy and Technology* (Blacksburg, VA: The Society for Philosophy and Technology, 1991).
- 10 *Hansard's Debates, Third Series: Parliamentary Debates 1830-1891*, vol. LXXIII, 1844 (22 Feb.-22 April), pp. 1123 and 1120.
- 11 A useful starting-point for the development of a hermeneutics of technology is offered by Paul Ricoeur in 'The Model of the Text: Meaningful Action Considered as a Text', P. Rabinow and W. Sullivan (eds). *Interpretive Social Science: A Reader* (Berkeley: University of California Press, 1979).
- 12 Michel de Certeau used the phrase 'rhetorics of technology' to refer to the representations and practices that contextualize technologies and assign them a social meaning. De Certeau chose the term 'rhetoric' because that meaning is not simply present at hand but communicates a content that can be articulated by studying the connotations technology evokes. See the special issue of *Traverse*, no. 26, Oct. 1982, entitled *Les Rhetoriques de la Technologie*, and, in that issue, especially Marc Guillaume's article, *Telespectres* (pp. 22-23).
- 13 Andrew Feenberg, 'From Information to Communication: The French Experience with Videotex', in Martin Lea (ed.), *The Social Contexts of Computer Mediated Communication* (London: Harvester Wheatsheaf, 1992).
- 14 Jean-Francois Lyotard, *La Condition Postmoderne* (Paris: Editions de Minuit, 1979), p. 34.
- 15 For an approach to social theory based on this notion (called, however, *doxa*, by the author), see Pierre Bourdieu, *Outline of a Theory of Practice*, trans. R. Nice (Cambridge: Cambridge University Press, 1977), pp. 164-70.
- 16 Herbert Marcuse, 'Industrialization and Capitalism in the Work of Marx Weber', in *Negations*, trans. J. Shapiro (Boston: Beacon Press, 1968).
- 17 Harry Braverman, *Labor and Monopoly Capital* (New York: Monthly Review, 1974); David Noble, *Forces of Production* (New York: Oxford University Press, 1984).
- 18 Bernard Gendron and Nancy Holstrom, 'Marx, Machinery and Alienation', *Research in Philosophy and Technology* 2 (1979).
- 19 Foucault's most persuasive presentation of this view is *Discipline and Punish*, trans. A. Sheridan (New York: Vintage Books, 1979).
- 20 See, e.g., Robert Heilbroner, *An Inquiry into the Human Prospect* (New York: Norton, 1975). For a review of these issues in some of their earliest formulations, see Andrew Feenberg, 'Beyond the Politics of Survival', *Theory and Society* 7 (1979), no. 3.
- 21 This aspect of technology, called 'concretization', is explained in Gilbert Simondon, *La Mode d'Existence des Objets Techniques* (Paris: Aubier, 1958), ch. 1.
- 22 John G. Burke, 'Bursting Boilers and the Federal Power', in M. Kranzberg and W. Davenport (eds), *Technology and Culture* (New York: New American Library, 1972).

design and engineering. It is thus relative to a social position without for that matter being

a mere ideology or psychological disposition. As I will argue in the last section of this paper, struggle for socio-technical change can emerge from the subordinated standpoints of those dominated within technological systems. For more on the concept of standpoint epistemology, see Sandra Harding, *Whose Science? Whose Knowledge?* (Ithaca: Cornell University Press, 1991).

- 24 The texts by Heidegger discussed here are, in order, 'The Question Concerning Technology', *op. cit.*; and 'The Thing', *Poetry, Language, Thought*, trans. A. Hofstadter (New York: Harper & Row, 1971).
- 25 Alberto Cambrosio and Camille Limoges, 'Controversies as Governing Processes in Technology Assessment', in *Technology Analysis and Strategic Management* 3 (1991), no. 4.
- 26 For more on the problem of AIDS in this context, see Andrew Feenberg, 'On Being a Human Subject: Interest and Obligation in the Experimental Treatment of Incurable Disease', *The Philosophical Forum* 23 (1992), no. 3.
- 27 'Only a God Can Save Us Now', Martin Heidegger interviewed in *Der Spiegel*, trans. D. Schendler, *Graduate Philosophy Journal* 6 (1977), no. 1.

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