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Modernity Theory and Technology Studies: Reflections on Bridging the Gap

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Posing the Problem

Theories of modernity and technology studies have both made great strides in recent years, but remain quite disconnected despite the obvious overlap in their concerns. How can one expect to understand modernity without an adequate account of the technological developments that make it possible, and how can one study specific technologies without a theory of the larger society in which they develop? These questions have not even been posed, much less answered persuasively, by most leading contributors to the fields. The basic issue I would like to address is the why and wherefore of this peculiar mutual ignorance.[1]

In the first half of this chapter I review the positions of some of the major figures in each field. After posing the problem briefly in this section, I sketch the background to the current impasse in the original contributions of Marx and Kuhn, and then consider the obstacles each field places in the way of encountering the other. In the second half of the chapter I propose one possible resolution of the dilemma, bridging the gap between the two fields through a synthesis of their main contributions. Both modernity theory and technology studies employ hermeneutic approaches that I elaborate further in a loosely Heideggerian account of innovation. In the concluding sections I summarize my own instrumentalization theory and show how it can be applied to the computerization of society.

Modernity theory relies on the key notion of rationalization to explain the uniqueness of modern societies. Rationalization refers to the generalization of technical rationality as a cultural form, specifically the

introduction of calculation and control into social processes, with a consequent increase in efficiency. Rationalization also reduces the normative and qualitative richness of the traditional social world, exposing social reality to technical manipulation. Modernity theories often claim that this reduction impoverishes our relation to the world. But, the theorists argue, impoverished though it may be, technical rationality gives power over nature, supports large-scale organization, and eliminates many spatial constraints on social interaction. This view of modernity is characteristic of a normative style of cultural critique that is anathema to contemporary technology studies. Albert Borgmann's theory of the "device paradigm" is a well-known example of this approach (Borgmann 1984; Higgs et al. 2000).

Rationalization depends on a broad pattern of modern development described as the "differentiation" of society. This notion has obvious applications to the separation of property and political power, offices and persons, religion and the state, and so on. However, a rationality differentiated from society as such appears to lie beyond the reach of social study. If technology is a product of such a rationality, it too would escape sociocultural determination.

Technology studies reject this whole approach. They point out the social complexity of technology, the multiple actors involved with its creation, and the consequent richness of the values embedded in design. The principles of symmetry embraced by technology studies undergird rigorous case studies that persuasively refute the very idea of pure rationality. Thus modernity theory goes wrong when it claims that all of society operates under values somehow specific to a science and technology differentiated from other spheres. However, if technology and society are not substantial "things" belonging to separate spheres, it makes no sense to claim that technology dominates society and transforms its values. Rather, technology is a social phenomenon through and through, no more and no less significant than any other social phenomenon.

Technology studies lose part of the truth when they emphasize only the social complexity and embeddedness of technology and minimize the distinctive emphasis on top-down control that accompanies technical rationalization. This trend depends on the differentiation of institutions

such as corporations that wield technical rationality in the interest of control. Limited though that differentiation may be, it nevertheless makes it possible to grasp any concrete value or thing as a manipulable variable, and this includes human beings themselves. Where traditional craft work expressed the vocational investment of the whole personality, the modern organization of work separates occupations from personal character and growth, the better to expose the worker to external controls (deskilling). Similarly, whereas traditional architecture combined historical and aesthetic expression with stability and durability, today strictly "utilitarian" construction is the rule. True, other social values fill the vacuum left by the differentiation of the technical sphere—e.g., profit—but this differentiation process is a real characteristic of modernity, and it has immense social consequences.

Is it possible to find some truth in both these positions or are they mutually exclusive, as they certainly appear to be at first sight? I believe a synthesis is possible, but only if the concept of technical rationality is revised to free it from implicit positivistic assumptions. It is this implicit positivism that leads modernity theory into the error of assuming that differentiation imposes a purely rational form on social processes, when in fact, as technology studies demonstrate, technology is social through and through. Science and technology studies could thus help us to avoid hypostatizing rationality as a substantial reality responsive only to its own logic.

We must also find a way to preserve modernity theory's insight into the distinctiveness of modernity and its problems. We need to explain how rationality operates as such even as it is intertwined with society through internal relations that determine its concrete realizations. This technology, that market, will always be socially specific and inexplicable in the terms of a philosophically purified concept of reason.[2] In the next section I sketch the background to the two very different ways of understanding rationality in modernity theory and technology studies.

Science of Society and History of Science

The writings of Karl Marx are surely the single most influential source of theories of modernity. His thought is usually identified with a

universalistic faith in progress. At its core there is an intuition he shared with his century, the notion that a "great divide" forever separates premodern from modern societies. All later contrasts of *Gesellschaft* versus *Gemeinschaft,* organic versus mechanical solidarity, traditional versus post-traditional society, and so on, owe something to Marx's canonical formulation of this idea in texts such as the *Communist Manifesto* and *Capital*.[3] After World War II, modernization theory emerged as the chief competitor to Marxism, but it shared Marx's progressive universalism.

The sense of radical discontinuity in these texts involves more than a theory of society. Marx's notion of what Max Weber later called "rationalization" covers not only the changes in economic and technical systems Weber identified, but a new form of individuality freed from ideology and religion. This new form of individuality is plain to see in the nineteenth-century novels contemporary with Marx's work, and he assumes its generalization to the lower classes under the conditions of modern capitalism. Modern workers have no fixed abode and are not subject to the paternalistic authority of nobles and clerics. As the tectonic plates of culture are thrown into movement by the market, workers are freed from naive faith in their "betters" and acquire a rational appreciation of the gaps between ideals and realities. Under these conditions, they gain mental independence and become, in Engels' phrase, "free outlaw[s]" (Engels 1970: p. 23). Marx's social theory is thus founded not just on cognitive hypotheses but on the existential irony of this modern individual. Its method is therefore fundamentally hermeneutic and demystifying as well as analytical. This duality explains the contrast between the method in Marx's critique of ideology and that in his positive economic theory. It shows up in various guises in modernity theory and is especially clear in Habermas who, as we will see later in this chapter, employs both hermeneutic and analytical methods to study modern society.

If there is any one figure who has played a comparable role for contemporary technology studies, it is Thomas Kuhn. It is true that the case for Kuhn as a founding father is less clear. Many students of science and technology, particularly historians, avoided the positivistic errors Kuhn criticized in his famous book, *The Structure of Scientific Revolutions* (Kuhn 1970). However, Kuhn's overwhelming success lent philosophical

legitimacy to these trends and encouraged others to follow their lead. Nonpositivist historiographic methods triumphed in science studies and subsequently influenced the new wave of technology studies that grew out of science studies in the 1980s. Unlike Marx, Kuhn is perhaps less a source than a symbol of a radically new approach.[4]

Of course neither Marx nor Kuhn are followed slavishly by contemporary scholars, but we should not be surprised to find that many of their background assumptions are still at work in the most up-to-date contributions to modernity theory and technology studies. I would like to begin by considering several such assumptions that may help to explain the gap between these two fields.

Like all modern historians and social theorists, Kuhn writes somewhere in the long shadow cast by Marx, as can be deduced from the place of "revolution" in the title of his major book, but his view of historical discontinuities is quite different from Marx's. Kuhn did not reject the idea of radical discontinuities in history, which, on the contrary, continue to shape his vision of the past. But where Marx took for granted the existence of a rationality gradient underlying the concept of modernity, Kuhn deconstructed the idea of a universal standard of rationality that was more or less identical with scientific reason and capable of transcending particular cultures and ordering them in a developmental sequence. The demystifying impulse is still present, but it is directed at the belief in a "great divide" that characterizes modernity itself. Now the ironic glance turns back on itself, undermining the cognitive self-assurance implied in the stance of the naive ironist.

Kuhn's method had momentous consequences for the wider reception of science studies in the academic world. He showed that there is no one continuous scientific tradition, but a succession of different traditions, each with its own basic assumptions and standards of truth, its own "paradigms." The illusion of continuity arises from glossing over the complexities and ambiguities of scientific change and reconstructing it as an upwardly linear progression leading to the present. If we go back to the decisive moments in the scientific revolution and examine what actually occurred from the standpoint of the participants, their competing positions, their arguments and experimental results, we will discover that the case for continuity is by no means so clear.

This practice-oriented approach is neatly captured in Latour's suggestion that science resembles a Janus looking back on its past in an entirely different spirit from that in which it looks forward to the future (Latour 1987: p. 12). Science, Latour suggests, is a sum of results that "hold" under certain conditions, such as repeated experimental tests. While the backward glance shows nature confirming the results of science, the forward glance presents a very different picture in which the results that hold are called "nature." Looking backward, one can say that the conditions of truth were met because the hypotheses of science were true. Looking forward, one must say rather that meeting the conditions defines what scientists will use for truth. The backward glance tells of an evolutionary progress of knowledge about the way things are, independent of science; the forward glance tells of the sheer contingency of the process in which science decides on the way things are.

I doubt if Kuhn would have appreciated this Nietzschean twist to his original contribution, from which he unfortunately retreated in subsequent writings. Kuhn himself never challenges the notion of modernity or the material progress associated with it. But the point is really not so much to offer an interpretation of Kuhn as of his significance on the maps of theory. He certainly had no intention of commenting on issues beyond his field, the history of science, but a critique of Marx is implied in his notion of scientific revolution insofar as the latter did believe that his own work was scientific and, more deeply, that rationality characterizes the institutions and forms of modernity. Thus just because Kuhn undermines the pretensions of science to access transhistorical truths, his work also undercuts Marxism and the modernity theory which inherited many Marxist assumptions. From that standpoint, it is clear that Kuhn is in some sense the nemesis of Marx and the harbinger of what has come to be called "postmodernism." To the extent that many contributions to technology studies reflect Kuhn's methodological innovations, they too bear a certain elective affinity for postmodernism, or at least for a "nonmodern" critique of Marx's heritage.

The implicit conflict came to the surface in various formulations of postmodernism, but it still seemed a mere disagreement between abstract epistemological positions. Philosophers engaged in heated debates over the nature of truth, but these debates had only a few echoes in

social theory, such as Habermas's critique of Foucault. Things have changed now that the conflict has emerged inside the ill-matched couple we are considering here, modernity theory and technology studies. Since no fully coherent account of modernity is possible without an approach to technology, and vice versa, the philosophical disagreement now appears as a tension between fields. It is no longer just a matter of one's position on the great question of realism versus relativism, but concerns basic analytical categories and research methods.

Consider the implications of technology studies for the notion of progress. If Kuhnian relativism has the power to dissolve the self-certainty of science and technology, then what becomes of the notion of a rationalized society? In most modernity theories, rationalization appears as a spontaneous consequence of the pursuit of efficiency once customary and ideological obstructions are removed. Technology studies, on the contrary, show that efficiency is not a uniquely constraining objective of design and development, but that many social forces play a role. The thesis of "underdetermination" holds that there is no one rational solution to technical problems, and this opens the technical sphere to these various influences. Technical development is not an arrow seeking its target, but a tree branching out in many directions. But if the criteria of progress themselves are in flux, societies cannot be located along a single continuum from the "less" to the "more" advanced. Like Kuhn's theory of scientific revolutions, but on the scale of society as a whole, constructivist technology studies complicate the notion of progress at the risk of dissolving it altogether.

In Latour's account, a contingent scientific-technical rationality can only gain a grip on society at large through the social practices by which it is actively "exported" out of the laboratory and into the farms, streets, and factories (Latour 1987: pp. 249ff.). The constructivist theorists export their relativistic method as they trace the movements of their object of study. They dissolve all the stable patterns of progress into contingent outcomes of "scaling up" or controversies. Institutional or cultural phenomena no longer have stable identities, but must be grasped through the process of their construction in the arguments and debates of the day. This approach ends up eliminating the very categories of modernity theory, such as universal and particular, reason and tradition,

culture and class, which are transformed from explanations into explananda. One can neither rise above the level of case histories nor talk meaningfully about the essence and future of modernity under these conditions.

Modernity theory suffers disaster on its own ground once it encounters the new technology studies approach. If no fixed path of technical evolution guides social development toward higher stages, if social change can take different paths leading to different types of modern society, then the old certainties of modernity theory collapse. One can no longer be sure if such essential dimensions of modernity as rationalization and democratization are actually universal, progressive tendencies of modern societies or just local consequences of the peculiar path of recent western development. Unless it squarely faces these difficulties, modernity theory must become so abstract that this kind of objection no longer troubles it, with a consequent loss of usefulness, or cease to be a theory at all and transform itself into a descriptive and analytical study of specific cases. Here are two examples that show the depth of the problems.

System or Practice

Modernity as Differentiation

Modernity theory on the whole either continues to ignore technology or acknowledges it in an outmoded deterministic framework. Most revealing is the extreme but instructive case of Jürgen Habermas. Habermas is one of the major social theorists of our time. His influence is widespread and the rigor of his thought admirable. Yet he has elaborated the most architectonically sophisticated theory of modernity without any reference at all to technology. This blissful indifference to what should surely be a focal concern of any adequate theory of modernity requires explanation, especially since Habermas is strongly influenced by Marx, for whom technology is of central importance.

Habermas's approach is based to a considerable extent on Weberian rationalization theory. According to Weber, modernity consists essentially in the differentiation of the various "cultural spheres." The state, the market, religion, law, art, science, technology each become distinct

social domains with their own logic and institutional identity. Under these conditions, science and technology take on their familiar post-traditional form as independent disciplines. Scientific-technical rationality is purified of religious and customary elements. Similarly, markets and administrations are liberated from the mixture of religious prejudices and family ties that bound them in the past. They emerge as what Habermas calls "systems" governed by an internal logic of equivalent exchange. Such systems organize an ever-increasing share of daily life in modern societies (Habermas 1984-87). Where formerly individuals discussed how to act together for their mutual benefit or to maintain customary rituals and roles, we moderns coordinate our actions with minimal communication through the quasi-automatic functioning of markets and administrations.

According to Habermas, the spread of such differentiated systems is the foundation of a complex modern society. But differentiation also releases everyday communicative interaction from the overwhelming burden of coordinating all social action. The communicative sphere, which Habermas calls the "lifeworld," now emerges as a domain in its own right as well. This lifeworld includes the family, the public sphere, education, and all the various contexts in which individuals are shaped as relatively autonomous members of society. It too, according to Habermas, is subject to a specific rationalization consisting in the emergence of democratic institutions and personal freedoms. However contestable this account of modernity, something significant is captured in it. Modern societies really are different from traditional ones, and the difference seems closely related to the impersonal functioning of institutions such as markets and administrations and the increase in personal and political freedom that results from new possibilities of communication.

At first Habermas argued that system rationalization threatened to create technocratic intrusions into the lifeworld of communicative interaction, and this reference to *techno-*cracy seemed to link his theory to the theme of technology (Habermas 1970; Feenberg 1995: chap. 4). However, his mature formulation of the theory ignores technology and focuses exclusively on the spread of markets and administration. The arbitrariness of this exclusion appears clearly in the following summary of Habermas's theory: "Because we are as fundamentally language-using

as tool-using animals, the representation of reason as essentially instrumental and strategic is fatally one-sided. On the other hand, it is indeed the case that those types of rationality have achieved a certain dominance in our culture. The subsystems in which they are centrally institutionalized, the economy and government administration, have increasingly come to pervade other areas of life and make them over in their own image and likeness. The resultant 'monetarization' and 'bureaucratization' of life is what Habermas refers to as the 'colonization of the life world'" (McCarthy 1991: p. 52). What became of the "tool-using" animal of the first sentence of this passage? Are its only tools money and power? How is it possible to elide technological tools in a society such as ours? The failure of Habermasian critical theorists even to pose much less respond to these questions indicates a fatal weakness in their approach. There is worse to come.

Habermas's reformulation of Weber's differentiation theory neutralizes rational systems by identifying them with nonsocial rationality as such. This has conservative political implications. In many of Habermas's formulations, for example when he considers workers' control, it seems that radical demands would be irrational if they treated systems as socially constructed and hence transformable barriers to full freedom (Habermas 1986: pp. 45, 91, 187). He thus offers no concrete suggestions, at least in *The Theory of Communicative Action*, for reforming markets and administrations, and instead suggests limiting the range of their social influence.

In the case of science and technology, this puzzling retreat from a social account is carried to the point of caricature. Habermas claims that science and technology are based quite simply on a nonsocial "objectivating attitude" toward the natural world (Habermas 1984-87: Vol. I, p. 238). This would seem to leave no room at all for the social dimension of science and technology, which has been shown over and over to shape the formulation of concepts and designs. Clearly, if scientists and technologists stand in a purely objective relation to nature, there can be no *philosophical* interest in studying the social background of their insights. In Habermas's view, it is difficult to see how a properly differentiated rationality could incorporate social values and attitudes except as sources of error or extrinsic goals governing "use." This implies, too, a

problematic methodological dualism in which phenomenological accounts of the lifeworld coexist with objectivistic systems-theoretic explanations of "systems" such as markets and administrations. No doubt there are objects best analyzed by these different methods, but which method is suited to analyzing the interactions between them? Habermas has little to say on this score beyond his account of the boundary shifts that preoccupy him.

The effect of this approach is to liberate social theory from all the details of sociological and historical study of actual instances of rationality. No matter what story sociologists and historians have to tell about a particular market, administration, or, a fortiori, technology, this is incidental to the philosophically abstracted forms of differentiated rationality. The real issue is not whether this or that contingent happening might have led to different practical results, for all that matters to social theory is the range of rational systems, the extent of their intrusions into the proper terrain of communicative action (Feenberg 1999a: chap. 7).

Could it be that the most important differentiation for Habermas is the one that separates social theory from certain sociological and historical disciplines, the material of which he feels he must ignore to pursue his own path as a philosopher? When the results are compared with earlier theories of modernity, it becomes clear what a tremendous price he pays to win a space for philosophy. Marx had a concrete critique of the revolutionary institutions of his epoch, the market and the factory system, and later modernization theory foresaw a host of social and political consequences of economic development. But Habermas's complaints about the boundaries of welfare state administration seem quite remote from the main sources of social development today, the response to environmental crisis, the revolutions in global markets, planetary inequalities, the growth of the Internet, and other technologies that are transforming the world. In his work the theory of modernity is no longer concerned with these material issues, but operates at a higher level, a level where, unfortunately, very little is going on.

Of course some social theorists have made contributions to the theory of modernity that do touch on technology in an interesting way, sometimes under the influence of other aspects of Habermas's theory.[5] Ulrich Beck has proposed a theory of "reflexive modernity" in which the role

of technology is explicitly recognized and discussed in terms of transformations in the nature of rationality. Beck starts out from the same concept of differentiation as Habermas, but he considers it to be only a stage he calls "simple modernity." Simple modernity creates a technology that is both extremely powerful and totally fragmented. The uncontrolled interactions between the reified fragments have catastrophic consequences.[6] Beck argues that today a "risk society" is emerging and is especially noticeable in the environmental domain. "Risk society . . . arises in the continuity of autonomized modernization processes which are blind and deaf to their own effects and threats. Cumulatively and latently, the latter produce threats which call into question and eventually destroy the foundations of industrial society" (Beck 1994: pp. 5-6).

The risk society is inherently reflexive in the sense that its consequences contradict its premises. As it becomes conscious of the threat it poses for its own survival, reflexivity becomes self-reflection, leading to new kinds of political intervention aimed at transforming industrialism. Beck places his hope for an alternative modernity in a radical mixing of the differentiated spheres that overcomes their isolation and hence their tendency to blunder into unforeseen crises. "The rigid theory of simple modernity, which conceives of system codes as exclusive and assigns each code to one and only one subsystem, blocks out the horizon of future possibilities. . . . This reservoir is discovered and opened up only when code combinations, code alloys and code syntheses are imagined, understood, invented and tried out" (Beck 1994: p. 32).[7]

This revision of modernity theory is daring and suggestive, but it still rests on a notion of differentiation that would surely be contested by most contemporary students of science and technology. Their major goal has been to show that "differentiation" (Latour calls something similar "purification") is an illusion, that the various forms of modern rationality belong to the continuum of daily practice rather than to a separate sphere (Latour 1991: p. 81).

Yet the main phenomena identified by the theory of modernity do certainly exist and require explanation. We have reached a puzzling impasse in the interdisciplinary relationship around this problem. Practice-oriented accounts of particular cases cannot be generalized to explain the systemic character of modernity, while differentiation theory

appears to be invalidated by what we have learned about the social character of rationality from science and technology studies. A large part of the reason for this impasse, I believe, is the continuing power of disciplinary boundaries which, even where they do not become a theoretical foundation as in Habermas, still divide theorists and researchers. Far from weakening, these boundaries have become still more rigid in the wake of the sharp empiricist turn in science and technology studies, and the growing skepticism in these fields with regard to the theory of modernity in all its forms (see Misa, chapter 1, this volume). I turn now to two examples from technology studies to illustrate this point.

The Logic of Symmetry

The constructivist "principle of symmetry" is supposed to ensure that the study of technological controversies is not biased by knowledge of the outcome (Bloor 1976: p. 7). Typically, the bias appears in popular understanding as an "asymmetrical" evaluation of the two sides of the controversy, ascribing "reason" to the winners and "prejudice," "emotion," "stubbornness," "venality," or some other irrational motive to the losers. A similar bias is also presupposed by such basic concepts of modernity theory as rationalization and ideology. These concepts appear to be cancelled by the principle of symmetry.

Social constructivists' main concern is to achieve a balanced view of controversies in which rationality is not awarded as a prize to one side only, but recognized wherever it appears, and in which nontechnical motives and methods are not dismissed as distortions, but are taken into account right alongside technical ones as normal aspects of technological debate. The losers often have excellent reasons for their beliefs, and the winners sometimes prevail at least in part through dramatic demonstrations or social advantage as well as rational arguments. The principle of symmetry orients the researcher toward an even-handed evaluation by contrast with the inevitable prejudice in favor of the winners that colors the backward glance of methodologically unsophisticated observers.

However, there is a risk in such even-handedness where technology is concerned: if the outcome cannot be invoked to judge the parties to the controversy, and if all their various motives and rhetorical assets are

evaluated without prejudice, how are we to criticize mistakes and assign responsibility? Consider, for example, the analysis of the *Challenger* accident by Harry Collins and Trevor Pinch (Collins and Pinch 1998: chap. 2). Recall that several engineers at Morton Thiokol, the company that designed the space shuttles, at first refused to endorse a cold-weather liftoff. They feared that the O-rings sealing the sections of the launcher would not perform well at low temperatures. In the event they were proven right, but management overruled them and the launch went ahead, with disastrous results. The standard account of this controversy is asymmetrical, opposing reason—the engineers—to politics—the managers.

Collins and Pinch think otherwise. They show that the O-rings were simply one among many known problems in the *Challenger's* design. Since no solid evidence was available to justify canceling the fateful flight, it was reasonable to go forward and not a heedless flaunting of a prescient warning. Scheduling needs as well as engineering considerations influenced the decision, not because of managerial irresponsibility, but as a way of resolving a deadlocked engineering controversy. It appears that no one is to blame for the tragic accident that followed, at least in the sense that this is a case where normally cautious people would in the normal course of events have made the same bad decision.

However, the evidence Collins and Pinch offer could have supported a rather different conclusion had they evaluated it in a broader context. Their symmetrical account obscures the asymmetrical treatment of different types of evidence within the technical community they study. It is clear from their presentation that the controversy at Morton Thiokol was irresolvable because of the systematic demand for quantitative data and the denigration of observation, even that of an experienced engineer. Can an analysis of the incident abstain from criticizing this bias?

Roger Boisjoly, the engineer who was most vociferous in arguing for the dangers of a cold-weather launch, based his warnings on the evidence of his eyes. This did not meet what Collins and Pinch prissily define as "prevailing technical standards" (Collins and Pinch 1998: p. 55). The fact that Boisjoly was probably right cannot be dismissed as a mere accident. Rather, it says something about the limitations of a certain

paradigm of knowledge, and suggests the existence of an ideological bias masked by the principle of symmetry. Could it be that Boisjoly's observations were dismissed—and quantitative data demanded—mainly to keep the National Aeronautics and Space Administration (NASA) on schedule? Or put another way, would the need for quantitative data have seemed compelling in the absence of that pressure? By identifying this case with every other known risk in the design, without regarding Boisjoly's observations as a legitimate reason for extra caution, Collins and Pinch appear to surrender critical reason to so-called "prevailing technical standards."[8]

Now, I cannot claim to have made an independent study of the case, and Collins and Pinch may well have stronger reasons for their views than those that appear in their exposition. However, we know from experience that quantitative measures are all too easily manipulated to get the answer demanded by the powers that be. For example, quantitative studies were long thought to "prove" the irrelevance of classroom size to learning outcomes, contrary to the testimony of professional teachers. This "proof" was very convenient for state legislators anxious to cut budgets, but it resulted in an educational disaster that, like the *Challenger* accident, could not be denied. Similar abuses of cost-benefit analysis are all too familiar. How can critical reason be brought to bear on cases such as these without applying sociological notions such as "ideology," which presuppose asymmetry?

A similar problem regarding the supposed opposition of local and global analyses bedevils science studies. Science studies scholars sometimes claim that a purely local analysis extended to ever-wider reaches suffices in the study of society without the need for empirically "ungrounded" global categories. This is to be sure a puzzling dichotomy. If the local analysis is sufficiently extended, does it not become nonlocal, indeed global? Why not just generalize from local examples to macro categories and theories, as modernity theory does?

For Bruno Latour, the analysis of contingent contests for power within specific networks suffices, and the introduction of terms such as "culture," "society," or "nature" would simply mask the activities that establish these categories in the first place. "If I do not speak of 'culture,' that is because this word is reserved for only one of the units

carved out by Westerners to define man. But forces can only be distributed between the 'human' and the 'nonhuman' locally and to reinforce certain networks" (Latour 1984: pp. 222-223, my translation).[9] Latour continues in this passage to similarly reduce the terms "society" and "nature" to local actions.

This "symmetry of humans and nonhumans" eliminates any fundamental difference between them. The "social" and the "natural" are to be understood now in the same terms. Attributions of social and natural status are contingent outcomes of processes operating at a more fundamental level. Then the distinctions we make between the social or natural status assigned to such things as a student protest in Paris and a dieoff of fish in the Mississippi, a politician's representation of American farmers and a scientist's representation of nuclear forces, are all products of the network to which we belong, not presuppositions of it.

This stance appears to have conservative political implications since in any conflictual situation the stronger party establishes the definition of the basic terms, "culture," "nature," and "society," and the defeated cannot appeal to an objective "essence" to validate their claims *quand même.* John Law's well-known network analysis of Portuguese navigation is thus widely criticized for ignoring the fate of the conquered peoples incorporated into the colonial network. And Hans Radder argues that actor-network theory contains an implicit bias toward the victors (Law 1987; Radder *1996:* pp. 111-112).

Underlying Latour's difficulty with resistance is the strict operationalism that works as an Ockham's razor, stripping away generations of accumulated sociological and political conceptualization. If nature and society are exhaustively defined by the procedures through which they emerge as objects, it is unclear how unsuccessful competitors for the defining role can gain any grip on reality at all, even the feeble grip of ethical exigency. For example, the aspiring citizens of an aristocratic society may appeal to "natural" equality against the caste distinctions imposed by the "collective" to which they belong. But if nature is defined by the collective, not simply ideologically or theoretically but really, how can an appeal to nature be invoked oppositionally to sanction demands for change? Or consider demands for justice for the weak

and dominated. The concept of justice stands here for an alternative organization of society, haunting the actual society as its better self. What can ground the appeal to such transcendent principles if the very meaning of society is defined by the forces that effectively organize and dominate it?

I have argued elsewhere that without a global social theory, it is difficult to establish what I call the "symmetry of program and antiprogram," i.e., the equal analytical value of the principal actors' intentions, more or less successfully realized in the structure of the network, and those of the weaker parties they dominate (Feenberg 1999a: chap. 5). In particular, the symmetry of humans and nonhumans blocks access to the central insight of modernity theory, the extension of technical control from nature to humans themselves. I concluded that although the empiricist preference for the local sounds innocent enough, in excluding all explanations based on the traditional categories of social theory, such as class, culture, ideology, and nature, truly rigorous localism blocks even-handed study of social conflict.

Latour's recent book on political ecology attempts to address criticisms like these (Latour 1999a). He faces up to the challenge of explaining oppositional agency, that is, resistance to the dominant definition of the network in which the subject is enrolled. Political morality requires that he find a place for such resistance in his theory. However, consistency requires that he do this without reintroducing a transcendent nature or morality. The following is a necessarily abbreviated account of his provocative central argument.

The operational reduction of society and nature in earlier presentations of his theory seemed paradoxically to eliminate the contingency of the phenomena he described. The case resembles artistic production. A musical composition depends on the composer's decisions, which might have been different, yet once it has been completed, the composition is perfectly self-defined. There is no higher authority to which one might appeal against it. Beethoven's Fifth is a necessary product of the contingencies of its creation. Similarly, Latourian networks define themselves as necessary in the course of their self-creation, with no higher authority able to cast doubt on that definition. The contrary hypothesis, that nature is not simply what the collective takes it to be, and that society

overflows the bounds imposed on it by those with influence and power, would seem to violate Latour's operationalism. Yet without some such hypothesis, one inevitably ends up in the most uncritical conformism. Can Latour accept such a hypothesis without his theory cracking open at the seams?

Latour finds a way of having his operationalist cake and eating it too. He argues that the necessary conditions of opposition can be met without positing transcendent principles. The solution is again operational: look not to the transcendent *objects* but to the contestatory *procedures* by which they are given a chance to emerge within the collective. These procedures can prevent premature totalizations or closures that ignore the weak and violate human rights. In sum, Latour substitutes a democratic doctrine of legitimate debate for nature and morality as the ultimate ground of resistance (Latour 1999a: pp. 156, 172-173).

However, there is an ambiguity about this solution. Latour's claim might be interpreted as an antitechnocratic constitutional principle: "Thou shalt not interrupt the collective conversation with authoritative findings." He might be saying that this is all that philosophy can persuasively claim without prejudging the content of democratic discourse. In the terms of contemporary political philosophy, this would imply a distinction between the right and the good, the one universally valid, the other contentious and rationally undecidable. That interpretation still leaves open the possibility that ordinary actors could legitimately bring forward appeals to a transcendent nature and society. But this does not seem to satisfy Latour. He wants to expel the transcendent objects not only from theory but from practice as well. This is a consequence of ontologizing the network, treating it as the actual foundation of the objects it contains. Short of proposing a double discourse, a true one for the theorist and a false one for the masses, Latour is obliged to introduce his theoretical innovations into the collective conversation as an alternative to the outmoded discourse of transcendence.

These theoretical innovations consist of techniques of local analysis that trace the co-emergence of society and nature in the processes of social, scientific, and technological development. Since these processes are historical, what we call "nature" now develops and changes much as "society" does. Pasteur's discovery of lactic acid yeast was a great event,

not only in Pasteur's life, but also in the life of the yeast. Latour refers to Whitehead's process philosophy for a metaphysical sanction for the effacement of the difference between nature and society to make room for a third term out of which both emerge (Latour 1994: p. 212). This is interesting and provocative as philosophy, but can these philosophical innovations become generally available to ordinary people as a substitute for the now disqualified appeal to transcendent grounds for resistance? That promises to be difficult, requiring that common sense itself become Latourian! Presumably, the traditional appeal to a preexisting "nature" (e.g., natural equality) would give way in a Latourian society to an appeal for a favorable evolution of nature itself. If I have understood him, Latour is confident something like this will occur (Latour 1999a: pp. 32-33), but that seems quite unlikely. I conclude that his attempt to evade the conformist implications of his position shows more good will than practical plausibility.

Now, there is no intrinsic reason why science studies should seek to explode the entire framework of social theory, and not all current approaches lead to such radical consequences. Yet the tendency to do so is influential in science studies circles. I call attention to it because it takes to the limit a consequence of certain original methodological choices applied to technology and through technology to modern social life. The results, I have argued, are intriguing but ultimately unsatisfactory.

Splitting the Difference

Interpretation and Worldhood

I now want to suggest one of several possible lines of argument leading to a partial resolution of the conflict between modernity theory and technology studies. The key point on which I focus is the role of interpretation in these two disciplines. Where society is not studied as a realm of causal interactions governed by law, it is usually considered to be a realm of meaning, engaging interacting subjects of some kind, for example, subjects of consciousness or language. Interpretative understanding of society is thus an alternative to deterministic accounts, and hermeneutics appears as an explanatory model better suited to society than the nomological approach imitated from physical science.

The place of interpretation in technology studies should be obvious from the Kuhnian critique of the "myth of the given." Data do not speak unambiguously, but must be interpreted, and interpretation calls into play the very theories the data are supposed to verify. This hermeneutic circularity has social ontological implications when a similar approach is applied to technology. Technologies serve needs while also contributing to the emergence of the very needs they serve; human beings make technologies that in turn shape what it means to be human.

These circular relationships are familiar from hermeneutics. The famous "hermeneutic circle" describes the paradoxical nature of interpretative understanding: we can only understand what, to some degree, we already understand. A completely unfamiliar object would remain impenetrable. However, this circularity is not vicious since we can bootstrap our way to fuller understanding, starting from a minimal "preunderstanding," "like using the pieces of a puzzle for its own understanding" (Palmer 1969: p. 25).

Pinch and Bijker's analysis of the bicycle highlights the role of "interpretative flexibility" in the evolution of design (Pinch and Bijker 1987). At its origin, the bicycle had two different meanings for two different social groups. That difference in interpretation of a largely overlapping assemblage of parts yielded designs with distinctive social significance and consequences. Pinch and Bijker conclude that "different interpretations by social groups of the content of artifacts lead by means of different chains of problems and solutions to different further developments" (Pinch and Bijker 1987: p. 42). This means that there is no stable, pregiven telos of technological development because goals are variables, not constants, and technical devices themselves have no self-evident purpose. Clearly, we are a long way here from the old deterministic conception of technology in which changes in design follow from the technical logic of innovation. Meaning is now central.

Interpretation plays an equally important role for modernity theorists such as Habermas and Heidegger. Both thinkers rely on a contrast between scientific-technical rationality and the phenomenological approach to the articulation of human experience. They see the everyday "lifeworld" as an original realm within which human identity and the

meaning of the real are first and most profoundly encountered. Interpretation rather than law prevails in the study of this realm.

For Heidegger, worlds are realms of meaning and corresponding practices rather than collections of objects as in conventional usage. A world is "disclosed" according to Heidegger in the sense that the orientation of the subject opens up a coherent perspective on reality. Heideggerian worlds thus more nearly resemble our metaphoric concept of a "world of the theatre," or a "Chinese world" than the literal meaning. Here interpretation is no specialized intellectual activity, but the very basis of our existence as human beings (Spinosa et al. 1997: p. 17).

In his later work Heidegger developed a radical critique of technology for its power to "deworld," that is, to strip objects of their inherent potentialities and reduce them to mere raw materials. This turn in Heidegger's analysis seems to cancel its hermeneutic import since the message of technology is always the same, what Heidegger calls "enframing" (Heidegger 1977). Although his theory of technology is unremittingly negative, some of his followers have attempted to modify it in interesting ways.

The early Heidegger's concept of the lifeworld has been applied by Charles Spinosa, Fernando Flores, and Hubert Dreyfus in a recent book *(Disclosing New Worlds).* As we will see, their major focus is on leadership rather than technology, but this turns out to be a correctable error of emphasis. The authors' starting point in any case is the notion of disclosure that lies at the center of Heidegger's thought. They take up Heidegger's basic concepts in the context of a theory of history. The problem to which the book is addressed is how disclosive activities actually change the world we live in, opening us to new or different perspectives and reorganizing our practices around a different sense of what is real and important. The book reviews three main types of history-making disclosive practices that correspond to three main types of historical actors.

"Articulations" refocus a community on its core values and practices. This is primarily the task of political leaders. As an example, the authors cite John Kennedy's ability to generate enthusiasm for the space race around such themes as the new frontier. "Cross-appropriations" weave together values and practices from diverse domains of social life in new

patterns that alter the structure of our world. This is the work of successful social movements, such as MADD (Mothers Against Drunk Driving), which transported ideas about responsible behavior from the domain of work to the domain of leisure. Finally, and most significantly, "reconfiguration" is the process by which a marginal practice is transformed into a dominant one. Entrepreneurs are the agents of reconfiguration, which they accomplish by introducing new products that suggest a new style of life. The focus of *Disclosing New Worlds* is not on the products but on the entrepreneurs. Yet the authors write explicitly, "it is the product or service, not the virtuous life-style of the entrepreneur, that makes the world change . . ." (Spinosa et al. 1997: p. 45).

Although technology studies are not mentioned, the examples illustrate nicely the theme of interpretative flexibility. The Gillette company's successful introduction of the disposable razor is a textbook case. The traditional straight razor belonged to a world in which men cared for and cherished finely made objects. Gillette sensed the possibility of a redefinition of the masculine relation to objects in terms of control and disposability and furthered that change with a new type of razor. In other words, Gillette did not just serve a preexisting need for sharper razors. "The entrepreneurial question was, what did his annoyance at the dullness mean? Did it mean that he just wanted a better-crafted straight-edge razor that kept its edge longer? Or did he want a new way of dealing with things? We shall argue that genuine entrepreneurs are sensitive to the historical questions, not the pragmatic ones, and that what is interesting about their innovations is that they change the style of our practices as a whole in some domain" (Spinosa et al. 1997: pp. 42-43). Style is a very general feature of worlds that is relevant to the design of artifacts. In this case the change in style involved the transition from a respectful to a controlling attitude toward objects.

We find more precise tools for discussing the reconfigurative work of artifacts in the notions of "actors" and "scripts" in technology studies (Akrich 1992; Latour 1992). In particular, the multiplicity of actors identified in many case histories offers a useful corrective to the book's implicit individualism. The bias toward the heroic disclosive power of poets, philosophers, and statesmen, who are presumed to be in touch with "Being," has been noted in Heidegger and his followers before.

Perhaps the overemphasis on entrepreneurs is a modest expression of that bias. In any case, the failure to deal adequately with technology confirms the tendency of modernity theories to abstract from the world of things. This time there is a difference: for once a theory lends itself to a shift in emphasis to take technology into account because in fact technology is already there at its core. "A *world,* for Heidegger," the authors write, "is a totality of interrelated pieces of *equipment*, each used to carry out a specific task such as hammering in a nail. These tasks are undertaken so as to achieve certain *purposes,* such as building a house. Finally, this activity enables those performing it to have *identities*, such as being a carpenter" (Spinosa et al. 1997: p. 17).

Instrumentalization Theory

We now have two complementary premises drawn from the two theoretical traditions we are attempting to reconcile. On the one hand, the evolution of technologies depends on the interpretative practices of their users. On the other hand, human beings are essentially interpreters shaped by world-disclosing technologies. Human beings and their technologies are involved in a co-construction without origin. Modernity theory asks how this process operates when it is mediated by differentiated technical disciplines and aims at the human control of human beings. Technology studies keeps us focused on the essentially social nature of the technical rationality deployed in those disciplines. The hermeneutic perspective builds a bridge between these different perspectives.

A synthesis must enable us to understand the central role of technology in modern life as both technically national in form and rich in socially specific content. This then is the program: to explain the social and cultural impact of technical rationality without losing track of the concrete social embodiment of actual devices and systems. Here is where the concept of world disclosure can be helpful, on the condition that the analysis be pursued not just in terms of the question of style, but more specifically in terms of the practical constitution of technical objects and subjects.

I have proposed what I call "instrumentalization theory" to effect such a synthesis (Feenberg 1999a, chap. 9). Instrumentalization theory

holds that disclosing new worlds involves a complementary process of deworlding inherent in technical action. The materials engaged in technical processes always already belong to a world that must be shattered if they are to be released for technical employment. The specific deworlding effect of technical action touches not only the object but also the subject. The technical actor stands in an insulated, external position with respect to his or her objects. We thus distinguish technical manipulation from the reciprocal relations of everyday communication. Philosophical models of instrumental rationality are generally based on this aspect of the technical. It is, for example, highlighted in Habermas's system/lifeworld distinction and Heidegger's critique of enframing.

Most modernity theory identifies deworlding with the essence of technology, without regard for the complexity of its disclosive dimension. I suspect that this identification is due to two features of the modern technical sphere. On the one hand, technical disciplines themselves incorporate social factors only in a stripped-down, abstract form. The most humane of values, for example compassion for the sick, is expressed technically in objective specifications such as a medical treatment protocol. The fact that the protocol can be followed without compassion suggests that the objective specifications are really self-sufficient, forming a closed universe from which values are excluded. On the other hand, modern technology has been structured around the extension of impersonal domination to human beings and nature, in profound indifference to their needs and interests. This line of technical development depends on severely restricting the range of social considerations that can be brought to bear on design. Thus deworlding looms especially large in the worlds disclosed in modern societies. These worlds differ from those of premodern societies in that they do not cover over the traces of their founding violence.

In demonstrating the contingency of technical development, technology studies encourage us to believe in the possibility of other ways of designing and using technology that show more respect for human and natural needs. However, an alternative technology is apparently unimaginable from the external perspective of modernity theorists, who are generally innocent of any involvement with the messy and complex process of actual technical development. The theorists simply fail to

recognize that the deworlding associated with technology is necessarily and simultaneously entry into another world. The problems of our society are not due to deworlding as such, but to the flaws and limitations of the disclosure it supports under the social limitations of the existing form of modernity.

The duality of technical processes is reflected in the split between modernity theory and technology studies, each of which emphasizes one half of the process. Deworlding is a salient feature of modern societies, which are constantly engaged in disassembling natural objects and traditional ways of doing things and substituting new technically rational ways. An exclusive focus on the negative aspect of this process yields the dystopian critique we associate with thinkers like the later Heidegger. However, deworlding is only the other side of a process of disclosure that must be understood in social terms. Technology studies emphasize this aspect of the process. The antinomy results from the inherently dialectical character of technical action, which is unilaterally misunderstood in each case.

Instrumentalization theory characterizes this dialectic at two levels. Deworlding consists of a process of functionalization in which objects are torn out of their original contexts and exposed to analysis and manipulation while subjects are positioned for distanced control. Modern societies are unique in deworlding human beings in order to subject them to technical action—we call it "management"—and in theoretically prolonging the basic gesture of deworlding in technical disciplines that become the basis for complex technical networks. Disclosure involves a complementary process of realization, which qualifies functionalization by orienting it toward a new world containing those same objects and subjects. The two processes are analytically distinguishable but are essentially joined in practice.[10]

Terminal Subjects

I want to conclude these reflections with an example with which I am personally familiar and which I hope will illustrate the fruitfulness of a synthesis of modernity theory and technology studies. I have been involved with the evolution of communication by computer since the early 1980s, both as an active participant in innovation and as a researcher.

I came to this technology with a background in modernity theory, specifically Heidegger and Marcuse, whose student I was, but it quickly became apparent that they offered little guidance in understanding computerization. Their theories emphasized the role of technologies in dominating nature and human beings. Heidegger dismissed the computer as the pure type of modernity's machinery of control. Its deworlding power reaches language itself, which is reduced to the mere position of a switch (Heidegger 1998: p. 140).

However, what we were witnessing in the early 1980s was something quite different: the contested emergence of the new communication practices of online community. Subsequently, we have seen cultural critics inspired by modernity theory recycle the old approach for this new application, denouncing, for example, the supposed degradation of human communication on the Internet. Albert Borgmann argues that computer networks deworld the person, reducing human beings to a flow of data the "user" can easily control (Borgmann 1992: p. 108). The "terminal" subject is basically an asocial monster despite the appearance of interaction online. That reaction presupposes that computers actually are a communication medium, if an inferior one, which was precisely the issue 20 years ago. The prior question that must therefore be posed concerns the emergence of the medium itself. Most recently the debate over computerization has involved higher education, where proposals for automated online learning have met determined faculty resistance in the name of human values. Meanwhile, actual online education is emerging as a new kind of communicative practice (Feenberg 2001: chap. 5).

The pattern of these debates is suggestive. Approaches based on modernity theory are uniformly negative and fail to explain the experience of participants in computer communication. This experience can be analyzed in terms of instrumentalization theory. The computer reduces a full-blown person to a "user" in order to incorporate him or her into the network. Users are decontextualized in the sense that they are stripped of body and community in front of the terminal and positioned as detached technical subjects. At the same time, a highly simplified world is disclosed to the user. This world is open to the initiatives of rational consumers, who are asked to exercise choice there. Positioning

and initiative as described here are correlated as primary and second instrumentalizations, interventions that deworld and disclose.[11]

The poverty of this world appears to be a function of the very radical deworlding involved in computing. However, we will see that this is not the correct explanation of what actually occurs. Nevertheless, the critique is not entirely artificial; there are types of online activity that confirm it and certain powerful actors do seek enhanced control through computerization. However, modernity theorists overlook the struggles and innovations of those attempting to appropriate the medium to create online communities or legitimate educational experiments. In ignoring or dismissing these aspects of computerization, they fall back into a more or less disguised determinism.

The posthumanist approach to the computer inspired by commentators in cultural studies suffers from related problems. This approach often leads to a singular focus on the most "dehumanizing" aspects of computerization, such as anonymous communication, online role playing, and cybersex (Turkle 1995). Paradoxically, these aspects of the online experience are interpreted in a positive light as the transcendence of the "centered" self of modernity (Stone 1995). Such posthumanism is ultimately complicit with the humanistic critique of computerization it pretends to transcend in that it accepts a similar definition of the limits of online interaction. Again, what is missing is any sense of the transformations the technology undergoes at the hands of users animated by more traditional visions than one would suspect from this choice of themes (Bakardjieva and Feenberg, forthcoming).

The effective synthesis of these various approaches would offer a more complete picture of computerization than any one of them alone. In my writings in this field I have tried to accomplish this. I did not set out from a hypothesis about the essence of the computer, for example, that it privileges control or communication, humanist or posthumanist values, but rather from an analysis of the way in which such hypotheses influence the actors themselves, shaping design and use.

The lifeworld of technology is the medium within which the actors engage with the computer. In this lifeworld, processes of interpretation are central. Technical resources are not simply pregiven but acquire their meaning through these processes.[12] In Latour's language, the

"collective" is reformed around the contested constitution of the computer as this or that type of mediation responsive to this or that actor's program. However, under the influence of theorists like Latour, technology studies have become suspicious of the very terms of the actual debates surrounding computerization. Indeed, Latour's symmetry principle makes it difficult to recognize the uniquely significant role of the contests between control and communication, humanism and posthumanism, that I argue must be the focus of the study of innovations such as the Minitel and the Internet. As computers developed, communication functions were often introduced by users rather than being provided as normal affordances of the medium by their designers. To make sense of this history, the competing visions of designers and users must be introduced as a significant shaping force, not dismissed as irrelevant ideologies. How can one adopt the actors' perspective if it contradicts the premises of one's own method?

Consider the case of the current struggle over the future of online education (Feenberg 1999b,c). Over the past few years, corporate strategists, state legislators, top university administrators, and "futurologists" have lined up behind a vision of online education based on automation and deskilling. Their goal is to replace (at least for the masses) face-to-face teaching by professional faculty with an industrial product, infinitely reproducible at decreasing unit cost, such as compact disks, videos, or software. The overhead costs of education would decline sharply and the education "business" would finally become profitable. This is "modernization" with a vengeance.

In opposition to this vision, faculty have mobilized in defense of the human touch. This humanistic opposition to computerization takes two very different forms. There are those who are opposed in principle to any electronic mediation of education. This position has no effect on the quality of computerization, only on its pace. There are also numerous faculty who favor a model of online education that depends on human interaction on computer networks. On this side of the debate, a very different conception of modernity prevails. In this alternative conception, to be modern is to multiply opportunities for and modes of communication. The meaning of the computer shifts; instead of being viewed as a coldly rational information source, it becomes a communication medium, a support for human

development and online community. This alternative can be traced down to the level of technical design; for example, the conception of educational software and the role of "asynchronous discussion forums."

These approaches to online education can be analyzed in terms of the model of deworlding and disclosure introduced earlier. Educational automation decontextualizes both the learner and the educational "product" by removing them from the existing world of the university. In this decontextualized world, the learner becomes a technical subject confronted by menus, exercises, and questionnaires rather than with other human beings engaged in a shared learning process.

The faculty's model of online education involves a much more complex secondary instrumentalization of the computer in the disclosure of a much richer world. The original positioning of the user is similar: the person facing a machine. However, the machine is not a window onto an information mall but rather opens up onto a social world. The user is involved as a person in a new kind of social activity and is not limited to the role of individual consumer by a set of canned menu options. The corresponding software opens the range of the subject's initiative far more widely than an automated design. This is a more democratic conception of networking that extends it across a wider range of human needs.

The analysis of the dispute over educational networking reveals patterns that appear throughout modern society. In the domain of communication media, these patterns involve playing off primary and secondary instrumentalizations in different combinations that produce either a technocratic model of control or a democratic model of communication. Characteristically, a technocratic notion of modernity requires a positioning of the user that sharply restricts, potential initiative, while a democratic conception enlarges initiative in more complex virtual worlds. Parallel analyses of production technology or environmental problems would reveal similar patterns that could be clarified by reference to the actors' perspectives in similar ways.

Conclusion: Toward Synthesis

Let me conclude now by returning briefly to my starting point. I began by contrasting the theoretical revolutions of Marx and Kuhn and

promising to bring them together with a method of analysis that would reconcile modernity theory and technology studies. Can a phenomenology of technical worlds do the job? Recall that Marx emphasized the discontinuity introduced into history by what has come to be called "rationalization," the emergence of modern societies based on markets, bureaucracies, and technologies. This view seemed to imply a universalism that erased all cultural difference. By contrast, Kuhn, or at least his followers, subverted the notion of progress implied in Marx's vision of an increasingly rational social process and offered us a history subordinate to culture.

I argue that rationalization describes the generalization of a particular type of deworlding involved in technical action. That such deworlding uproots nature and traditional ways is clear. In this account, rationalization no longer stands opposed to culture as such, but appears as a more or less creative expression of it, disclosing new worlds. In practice this means that there may be many paths of rationalization, each relative to a different cultural framework. Rationality is not an alternative to culture that can stand alone as the principle of a social order, for better or worse. Rather, rationality in its modern technical form mediates cultural expression in ways that can in principle realize a wide range of values in the design of artifacts. The poverty of the actual technoculture must be traced not to the essence of technology, but to other dimensions of our society, such as the economic forces that dominate technical development, design, and the media. This insight challenges us to engage in what Terry Winograd and Fernando Flores have called "ontological designing," the conscious construction of technological worlds that support a desirable conception of what it is to be human (Winograd and Flores 1987: p. 179).

We can fruitfully combine modernity theory and technology studies in an empirically informed, critical approach to important social problems. The triviality that threatens a strictly descriptive, empirical approach to such humanly significant technical phenomena as genetic manipulation, global warming, or online education, can be avoided without falling into the opposite error of a priori theorizing. There are ways of recovering some of the normative richness of the critique of modernity within a more concrete sociological framework that does allow entry to a few

facts. Concepts such as "rationality," which technology studies have set out to demystify, can be employed in a new way, and the implicit emancipatory intent of that demystification can be brought to the surface as an explicit goal. Perhaps someday soon the disciples of Marx and Kuhn will be able to lie down together in the fields of the Lord.

Notes

1. Before I enter into my theme, I should add that I do not intend to survey all the activity in these two very active fields. An overview of the huge literature they have generated is a subject in itself, and not my subject here. In particular, I am leaving out of my account the many scholars who work on concrete problems with a range of tools drawn from both. My justification for this oversight is twofold: first, I have not yet found among these crossovers a satisfactory theoretical mediation between the two fields; and second, the most influential figures writing theory in these fields are not seeking such a mediation, but on the contrary ignore or exclude each others' contributions. Clearly, this situation deserves treatment on its own terms.

2. The notion of rationality as a cultural form is suggested by Weber's concept of rationalization. Lukács's theory of reification refined that concept by identifying the tensions between the type of rationality characteristic of capitalist society and the lifeworld it enframes (see Feenberg 1986: chap. 3).

3. For explorations of the relation between Marxism and modernity theory, see Berman (1982) and Frisby (1986).

4. There is an enormous literature on Kuhn. For an interesting recent critique, see Fuller (2000).

5. I have tried to reformulate Habermas's position to take technology into account (Feenberg 1999a: chap. 7).

6. The early Marxist Lukács already identified this plausible outcome of differentiation as a consequence of "reification." According to Lukács, capitalist society is characterized by the rationality of the "parts"—individual enterprises for example—and the irrationality of the whole, leading to recurrent crises (Feenberg 1986: pp. 69-70).

7. I have independently proposed something similar in Feenberg (1992) and Feenberg (1991: pp. 191-198). What I call "subversive" or "democratic rationalization" resembles Beck's "subpolitics," and his "code syntheses" is similar to the social interpretation of the theory of concretization I have developed. There seems nevertheless to be a difference in our relation to the field of technology studies, which should become clear to readers of Beck in what follows.

8. Richard Feynman defends the standard view of the accident, which he helped to shape. His observations are based not on constructivist methods but on common sense. Feynman's account is devastating for NASA management.

Consider, for example, the reaction of programmers to his praise for their very thorough testing programs: "One guy muttered something about higher-ups in NASA wanting to cut back on testing to save money: 'They keep saying we always pass the tests, so what's the use of having so many?'" (Feynman 1988: p. 194).

9. "[S]i je ne parle pas de 'culture', c'est parce que ce nom est réservé pour l'une seulement des unités découpés par les Occidentaux pour définir l'homme. Or, les forces ne peuvent être partagées en 'humaines' et 'non-humaines', sauf localement et pour renforcer certains réseaux."

10. In a review of *Questioning Technology,* Douglas Kellner (2001) objects that the term "instrumentalization theory" biases the analysis of technology toward modern instrumentalist interpretations of technical practice. This was not my intent. I do believe that peoples in all societies are capable of talking intelligently about their own technical practice in ways *we* would consider "instrumental" even if *they* do not routinely distinguish technique from other activities as we do. Analyzing this aspect of their culture in an "instrumentalization theory" does not necessarily imply that they share our conception of technique. I discuss this problem in Feenberg (1995: pp. 225ff.) I hope that the introduction here of the terminology of world-making helps to cancel the unfortunate connotation of my earlier choice of terms.

11. In Feenberg (1999a) I break instrumentalization down into eight correlated operations, including the primary instrumentalization of the subject, which I call "positioning," and the corresponding secondary instrumentalization, "initiative." Positioning is the general term for occupying the specific locus from which technical action is possible: the "driver's seat." So located, the subject finds itself before a "world" of affordances that invite initiatives of one sort or another.

12. I have developed this argument in relation to computerization in a detailed analysis of the Minitel (Feenberg 1995: chap. 7).