From Essentialism to Constructivism: Philosophy of Technology at the Crossroads

Andrew Feenberg

What Heidegger called "the question of technology" has a peculiar status in the academy today. After World War II, the humanities and social sciences were swept by a wave of technological determinism. If technology was not praised for modernizing us, it was blamed for the crisis of our culture. Whether interpreted in optimistic or pessimistic terms, determinism appeared to offer a fundamental account of modernity as a unified phenomenon. This approach has now been largely abandoned for a view that admits the possibility of significant "difference," i.e., cultural variety in the reception and appropriation of modernity. Yet the breakdown of determinism has not led to quite the flowering of research in philosophy of technology one might hope for.

On the one hand, mainstream philosophy, which was never happy with the intrusion of technological themes, sticks happily to its traditional indifference to the material world. Where the old determinism overestimated the independent impact of artifactual on social reality, the new social-scientific approaches appear to have so disaggregated the question of technology as to deprive it of philosophical significance. It has become matter for specialized research.[1] And for this very reason, most professional philosophers now feel safe in ignoring technology altogether, except of course when they turn the key in the ignition.

On the other hand, those few philosophers, notably Albert Borgmann, who continue the earlier interrogation of technology have hesitated to assimilate the advances of the new technology studies. They remain faithful to the determinist premises of an earlier generation of founders of the field, such as Ellul, Heidegger, and the Frankfurt School. For these thinkers

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1. See, for examples, Pinch, Hughes, and Bijker 1989.

modernity continues to be characterized by a unique form of technical action and thought that threatens nontechnical values as it extends itself ever deeper into social life. They argue that technology is not neutral. The tools we use shape our way of life in modern societies where technique has become all-pervasive. The results of this process are disastrous: the triumph of technological thinking, the domination of nature, and the shattering of community. On this account, modernity is fundamentally flawed.

While the problems identified in this tradition are undoubtedly real, these theories fail to discriminate different realizations of technical principles relevant to the alternatives we confront. As a result, technology rigidifies into destiny and the prospects for reform are narrowed to adjustments on the boundaries of the technical sphere. It is precisely this essentialist reading of the nature of technology that recent social-scientific investigations refute without, however, relating their nonessentialist conception of technology to the original problematic of modernity that preoccupies the philosophers.[2] Here I attempt to preserve the philosophers' advance toward the integration of technical themes to a theory of modernity without losing the conceptual space opened by social science for imagining a radically different technological future.

I now begin to present my argument with a brief reminder of Heidegger's approach.

HEIDEGGER

Heidegger is no doubt the most influential philosopher of technology in this century. Of course he is many other things besides, but it is undeniable that his history of being culminates in the technological enframing. His ambition was to explain the modern world philosophically, to renew the power of reflection for our time. This project was worked out in the midst of the vast technological revolution that transformed the old European civilization, with its rural and religious roots, into a mass urban industrial order based on science and technology. Heidegger was acutely aware of this transformation, which was the theme of intense philosophical and political discussion in the Germany of the 1920s and 1930s (Sluga 1993). At first he sought the political significance of "the encounter between global technology and modern man." The results were disastrous and he went on to purely philosophical reflection on the question of technology (Heidegger 1959, 166).

Heidegger claims that technology is relentlessly overtaking us (Heidegger 1977a). It is transforming the earth into mere raw materials, which

2. For an exception, see Latour 1993.

he calls "standing reserves." We ourselves are now incorporated into the mechanism, mobilized as objects of technique. Modern technology is based on methodical planning that itself presupposes the "enframing" of being, its conceptual and experiential reduction to a manipulable vestige of itself. He illustrates his theory with the contrast between a silver chalice made by a Greek craftsman and a modern dam on the Rhine (Heidegger 1977a). The craftsman gathers the elements—form, matter, finality—and thereby brings out the "truth" of his materials. Modern technology "de-worlds" its materials and "summons" nature to submit to extrinsic demands. Technology thus violates both humanity and nature at a far deeper level than war and environmental destruction. Instead of a world of authentic things capable of gathering a rich variety of contexts and meanings, we are left with an "objectless" heap of functions.

Translated out of Heidegger's ontological language, this seems to mean that technology is a cultural form through which everything in the modern world becomes available for control. This form leaves nothing untouched: even the homes of Heidegger's beloved Black Forest peasants are equipped with TV antennas. The functionalization of man and society is thus a destiny from which there is no escape. Heidegger calls for resignation and passivity rather than an active program of reform that, in his view would simply constitute a further extension of modern technology. As Heidegger explained in his last interview, "Only a god can save us" from the juggernaut of progress (Heidegger 1977b).

Although Heidegger means his critique to cut deeper than any social or historical fact about our times, it is by no means irrelevant to a modern world armed with nuclear weapons and controlled by vast technology-based organizations. These latter in particular illustrate the basic concepts of the critique with striking clarity. Alain Gras explores the inexorable growth of such macrosystems as the electric power and airline industries (Gras 1993). As they apply ever more powerful technologies, gain control over more and more of their environment, and plan ever further into the future, they effectively escape human control and indeed human purpose. Macrosystems take on what Thomas Hughes calls momentum, a quasi-deterministic power to perpetuate themselves and to force other institutions to conform to their requirements (Hughes 1989).

Heidegger's basic claim that we are caught in the grip of our own techniques is thus all too believable. Increasingly, we lose sight of what is sacrificed in the mobilization of human beings and resources for goals that remain ultimately obscure. So far so good. But there are significant ambiguities in Heidegger's approach. He warns us that the essence of technology is nothing technological; that is to say, technology cannot

be understood through its usefulness, but only through our specifically technological engagement with the world. But is that engagement merely an attitude or is it embedded in the actual design of modern technological devices? In the former case, we could achieve the "free relation" to technology that Heidegger demands without changing technology itself. But that is an idealistic solution in the bad sense, and one that a generation of environmental action would seem decisively to refute.

Heidegger's defenders point out that his critique of technology is not concerned merely with human attitudes but also with the way being reveals itself. Again roughly translated out of Heidegger's language, this means that the modern world has a technological form in something like the way in which, for example, the medieval world had a religious form. Form in this sense is no mere question of attitude but takes on a material life of its own: power plants are the gothic cathedrals of our time. But this interpretation of Heidegger's thought raises the expectation that criteria for a reform of technology qua device might be found in his critique. For example, his analysis of the tendency of modern technology to accumulate and store up nature's powers suggests the superiority of another technology that would not challenge nature in Promethean fashion.

Unfortunately, Heidegger's argument is developed at such a high level of abstraction he literally cannot discriminate between electricity and atom bombs, agricultural techniques and the Holocaust.[3] All are merely different expressions of the identical enframing, which we are called to transcend through the recovery of a deeper relation to being. And since he rejects technical regression while leaving no room for a better technological future, it is difficult to see in what that relation would consist beyond a mere change of attitude. Surely these ambiguities indicate problems in his approach.[4]

3. In a 1949 lecture, Heidegger explained: "Agriculture is now the mechanized food industry, in essence the same as the manufacturing of corpses in gas chambers and extermination camps, the same as the blockade and starvation of nations, the same as the production of hydrogen bombs" (quoted in Rockmore 1992, 241).

4. I would of course be willing to revise this view if shown how Heidegger actually envisages technological change. What I have heard from his defenders is principally waffling on the attitude/device ambiguity described here. Yes, Heidegger envisages change in "technological thinking," but how is this change supposed to affect the design of actual devices? The lack of an answer to this question leaves me in some doubt as to the supposed relevance of Heidegger's work to ecology. One enthusiastic defender informed me that art and technique would merge anew in a Heideggerian future, but was unable to cite a text. That would indeed historicize Heidegger's theory, but in a way resembling Marcuse's position in *An Essay on Liberation* (1969) with its eschatological concept of an aesthetic revolution in technology. It is not clear how the case for Heidegger is fundamentally improved by this shift, which would not make much difference to the substantive arguments presented here. For an interesting defense of Heidegger's theory of technology that eschews mystification, see Dreyfus 1995.

A CONTEMPORARY CRITIQUE

Technology and Meaning

Heidegger holds that the restructuring of social reality by technical action is inimical to a life rich in meaning. The Heideggerian relation to being is incompatible with the overextension of technological thinking. It seems, therefore, that identification of the structural features of enframing can found a critique of modernity. I intend to test this approach through an evaluation of some key arguments in the work of Albert Borgmann, the leading American representative of philosophy of technology in the essentialist vein.[5]

Borgmann's social critique is based on the concept of the "device paradigm" as the formative principle of a technological society that aims above all at efficiency. In conformity with this paradigm, modern technology separates off the good or commodity it delivers from the contexts and means of delivery. Thus the heat of the modern furnace appears miraculously from discreet sources in contrast with the old wood stove that stands in the center of the room and is supplied by regular trips to the woodpile. The microwaved meal emerges effortlessly and instantly from its plastic wrapping at the individual's command in contrast with the laborious operations of a traditional kitchen serving the needs of a whole family.

The device paradigm offers gains in efficiency, but at the cost of distancing us from reality. Let us consider the substitution of fast food for the traditional family dinner. To common sense, well-prepared fast food appears to supply nourishment without needless social complications. Functionally considered, eating is a technical operation that may be carried out more or less efficiently. It is a matter of ingesting calories, a means to an end, while all the ritualistic aspects of food consumption are secondary to biological need. But what Borgmann calls "focal things" that gather people in meaningful activities that have value for their own sake cannot survive this functionalizing attitude.

The unity of the family, ritually reaffirmed each evening, no longer has a comparable locus of expression. One need not claim that the rise of fast food causes the decline of the traditional family to believe that there is a significant connection. Simplifying personal access to food scatters people

5. For another interesting contemporary approach that complements Borgmann's, see Simpson 1995. Simpson denies that he is essentializing technology, and yet he works throughout his book with a minimum set of invariant characteristics of technology as though they constituted a "thing" he could talk about independent of the sociohistorical context (Simpson 1995, 15-16, 182). That context is then consigned to a merely contingent level of influences, conditions, or consequences rather than being integrated to the conception of technology itself.

who need no longer construct the rituals of everyday interaction around the necessities of daily living. Focal things require a certain effort, it is true, but without that effort, the rewards of a meaningful life are lost in the vapid disengagement of the operator of a smoothly functioning machinery (Borgmann 1984, 204 ff.).

Borgmann would willingly concede the usefulness of many devices, but the generalization of the device paradigm, its substitution for simpler ways in every context of daily life, has a deadening effect. Where means and ends, contexts and commodities are strictly separated, life is drained of meaning. Individual involvement with nature and other human beings is reduced to a bare minimum, and possession and control become the highest values.

Borgmann's critique of technological society usefully concretizes themes in Heidegger. His dualism of device and meaning is also structurally similar to Habermas's distinction of work and interaction (Habermas 1970). This dualism always seems to appear where the essence of technology is in question.[6] It offers a way of theorizing the larger philosophical significance of the modernization process, and it reminds us of the existence of dimensions of human experience that are suppressed by facile scientism and the uncritical celebration of technology. Borgmann's contrast between the decontextualization of the device and the essentially contextual focal thing reprises Heidegger's distinction between modern technological enframing and the "gathering" power of traditional craft production that draws people and nature together around a materialized site of encounter. Borgmann's solution, bounding the technical sphere to restore the centrality of meaning, is reminiscent of Habermas's strategy (although apparently not due to his influence). It offers a more understandable response to invasive technology than anything in Heidegger.

However, Borgmann's approach suffers from both the ambiguity of Heidegger's original theory and the limitations of Habermas's. We cannot tell for sure if he is merely denouncing the modern attitude toward technology or technological design, and in the latter case, his critique is so broad it offers no criteria for the constructive reform of technology itself. He would probably agree with Habermas's critique of the colonization of the lifeworld, although he improves on that account by discussing the all-important role of technology in modern social pathologies. But like Habermas, he lacks a concrete sense of the intricate connections of technology and culture beyond the few essential attributes on which his critique focuses. Since those attributes have largely negative consequences,

6. In the next part of this paper I will attempt to resituate this dualism within technology itself, to avoid the ontologized distinctions characteristic of essentialism.

we get no sense from the critique of the many ways in which the pursuit of meaning is intertwined with technology. And as a result, Borgmann imagines no significant restructuring of modern society around culturally distinctive technical alternatives that might preserve and enhance meaning.

But how persuasive is this objection to Borgmann's approach? After all, neither Russian nor Chinese communism, neither Islamic fundamentalism nor so-called Asian values have inspired a fundamentally distinctive stock of devices. Why *not* just reify the concept of technology and treat it as a singular essence? The problem with that is the existence of smaller but still significant differences that may become more important in the future rather than less so as essentialists assume. What is more, those differences often concern precisely the issues identified by Borgmann as central to a humane life. They determine the nature of community, education, medical care, work, our relation to the natural environment, the functions of devices such as computers and automobiles, in ways either favorable or unfavorable to the preservation of meaning and focal things. Any theory of the essence of technology that forecloses the future therefore begs the question of difference in the technical sphere.

Interpreting the Computer

I would like to pursue this contention further with a specific example that illustrates concretely my reasons for objecting to Borgmann's approach. The example I have chosen, human communication by computer, is one on which Borgmann has commented fairly extensively. While not everyone who shares the essentialist view will agree with his very negative conclusions, his position adequately represents that style of technology critique and is therefore worth evaluating here at some length.[7]

Borgmann introduces the term "hyperintelligence" to refer to such developments as electronic mail and the Internet (Borgmann 1992, 102 ff.). Hyperintelligent communication offers unprecedented opportunities for people to interact across space and time, but paradoxically it also distances those it links. No longer are the individuals "commanding presences" for each other; they have become disposable experiences that can be turned on and off like water from a faucet. The person as a focal thing has become a commodity delivered by a device. This new way of relating has weakened connection and involvement while extending its range. What happens to the users of the new technology as they turn away from face-to-face contact?

> Plugged into the network of communications and computers, they seem to enjoy omniscience and omnipotence; severed from their

7. For another critique of the computer similar to Borgmann's, see Slouka 1995.

> network, they turn out to be insubstantial and disoriented. They no longer command the world as persons in their own right. Their conversation is without depth and wit; their attention is roving and vacuous; their sense of place is uncertain and fickle. (Borgmann 1992, 108)

This negative evaluation of the computer can be extended to earlier forms of mediated communication. In fact Borgmann does not hesitate to denounce the telephone as a hyperintelligent substitute for more deeply reflective written correspondence (Borgmann 1992, 105).

There is an element of truth in this critique. On the networks, the pragmatics of personal encounter are radically simplified, reduced to the protocols of technical connection. It is easy to pass from one social contact to another, again following the logic of the technical network that supports ever more rapid commutation. However, Borgmann's conclusions are too hastily drawn and simply ignore the role of social contextualizations in the appropriation of technology. A look, first at the history of computer communication and second at its innovative applications today refutes his overly negative evaluation. We will see that the real struggle is not between the computer and low-tech alternatives, but within the realm of possibilities opened by the computer itself.

In the first place, the computer was not destined by some inner technologic to serve as a communications medium. The major networks, such as the French Teletel or the Internet were originally conceived by technocrats and engineers as instruments for the distribution of data. What actually happened in the course of the implementation of these networks? Users appropriated them for unintended purposes and converted them into communications media. Soon they were flooded with messages that were considered trivial or offensive by their creators. Teletel quickly became the world's first and largest electronic singles bar (Feenberg 1995, chap. 7). The Internet is overloaded with political debates dismissed as "trash" by unsympathetic critics. Less visible, at least to journalists, but more significant, there gradually appeared all sorts of other applications of computers to human communication, from business meetings to education, from discussions among medical patients, literary critics, and political activists to online journals and conferences.

How does Borgmann's critique fare in the light of this history? It seems to me there is an element of ingratitude in it. Because Borgmann takes it for granted that the computer is useful for human communication, he appreciates neither the process of making it so nor the hermeneutic transformation it underwent in that process. He therefore also overlooks the political implications of the history sketched above. Today the networks

constitute a fundamental scene of human activity. To impose a narrow regimen of data transmission, to the exclusion of all human contact, would surely be perceived as totalitarian in any ordinary institution. Why is it not a liberation to break such limitations in the virtual world that now surrounds us?

In the second place, Borgmann's critique ignores the variety of communicative interactions mediated by the networks. No doubt he is right that human experience is not enriched by much of what goes on there. But a full record of the face-to-face interactions occurring in the hall rooms of his university would likely be no more uplifting. The problem here is that we tend to judge the face-to-face at its memorable best and the computer-mediated equivalent at its transcribed worst. Borgmann simply ignores more interesting uses of computers, such as the original research applications of the Internet and teaching applications that show great promise (Harasim et al. 1995). It might surprise Borgmann to find the art of reflective letter writing reviving in these contexts.

Consider for example the discussion group on the Prodigy Medical Support Bulletin Board devoted to ALS (amyotrophic lateral sclerosis or Lou Gehrig's disease). In 1995, when I studied it, there were about five hundred patients and caregivers reading exchanges in which some dozens of participants were actively engaged (Feenberg et al. 1996). Much of the conversation consisted of exchanges of feelings about dependency, illness, and dying. There was a long running discussion of problems of sexuality. Patients and caregivers wrote in both general and personal terms about the persistence of desire and the obstacles to satisfaction. The frankness of this discussion may owe something to the anonymity of the online environment, appropriated here for very different purposes than those Borgmann criticizes. Here the very limitations of the medium open doors that might have remained closed in a face-to-face setting.

These online patient meetings have the potential for changing the accessibility, the scale, and the speed of interaction of patient groups. Face-to-face self-help groups are small and localized. With the exception of AIDS patients they have wielded no political power. If AIDS patients have been the exception, it is not because of the originality of their demands: patients with incurable illnesses have been complaining bitterly for years about the indifference of physicians and the obstacles to experimental treatments. What made the difference was that AIDS patients were networked politically by the gay rights movement even before they were caught up in a network of contagion (Epstein 1996, 229). Online networks may similarly empower other patient groups. In fact, Prodigy discussion participants established a list of priorities they presented to the ALS Society of America.

Computer networking may thus feed into the rising demand by patients for more control over their own medical care. In that case, subversive rationalization of the computer would enable a parallel transformation of medicine.

It is difficult to see any connection between these applications of the computer and Borgmann's critique of hyperintelligence. Is this technologically mediated process by which dying people come together despite paralyzing illness to discuss and mitigate their plight a mere instance of "technological thinking"? Certainly not. But then how would Heidegger incorporate an understanding of it into his theory, with its reproachful attitude toward modern technology in general? The ambiguities of the computer are far from unique. In fact they are typical of most technologies, especially in the early phases of their development. Recognizing this malleability of technology, we can no longer rest content with globally negative theories that offer only condemnation of the present and no guidance for the future.

Borgmann's critique of technology pursues the larger connections and social implications masked by the device paradigm. To this extent it is genuinely dereifying. But insofar as it fails to incorporate these hidden social dimensions into the concept of technology itself, it remains still partially caught in the very way of thinking it criticizes. His theory hovers uncertainly between a description of how we encounter technology and how it is designed. Technology, i.e., the real-world objects so designated, both is and is not the problem, depending on whether the emphasis is on its fetish form as pure device or our subjective acceptance of that form. In neither case can we change technology in itself. At best, we can hope to overcome our attitude toward it through a spiritual movement of some sort.[8]

I propose a very different conceptualization that includes the integration of technologies to larger technical systems and nature, and to the symbolic orders of ethics and aesthetics, as well as their relation to the life and learning processes of workers and users and the social organization of work and use. On the essentialist account, one could still admit the existence of these aspects of technical life, but they would be extrinsic social influences

8. Andrew Light has argued that I underestimate the significance of Borgmann's distinction between device and thing for an understanding of the aesthetics of everyday life. The distinction is useful for developing a critique of mass culture and could provide criteria for subversive rationalizations of the commodified environment. The story of the ALS patients told here could be interpreted in this light as an example of the creation of a meaningful community through the creative appropriation of the hyperreal technological universe Borgmann describes (Light 1996, chap. 9). I am in general agreement with this revision of Borgmann's position, but in some doubt as to whether Borgmann himself would be open to it.

or consequences. Essentialism proposes to treat all these dimensions of technology as merely contingent and to hand them over to sociology while retaining the unchanging essence for philosophy. A certain conception of philosophy is implied in this approach.

INSTRUMENTALIZATION THEORY

The Irony of Parmenides

Heidegger and Borgmann have undoubtedly put their fingers on significant aspects of the technical phenomenon, but have they identified its "essence"? They seem to believe that technical action has a kind of unity that defies the complexity and diversity, the profound sociocultural embeddedness that twenty years of increasingly critical history and sociology of technology have discovered in it. Yet to dissolve the technical realm into the variety of its manifestations, as constructivists sometimes demand, would effectively block philosophical reflection on modernity. The problem is to find a way of incorporating these recent advances in technology studies into a conception of technology's essence rather than dismissing them, as philosophers tend to do, as social influences on a reified technology "in itself" conceived apart from society.[9] The solution to this problem is a radical redefinition of technology that crosses the usual line between artifacts and social relations assumed by common sense and philosophers alike.

The chief obstacle to this solution is the unhistorical understanding of essence to which most philosophers are committed. I propose, therefore, a kind of compromise between the philosophical and the social-scientific perspective. In what follows, I will attempt to provide a *systematic* locus in the concept of essence for the sociocultural variables that diversify technology's historical realizations. On these terms, the "essence" of technology is not simply those few distinguishing features shared by all types of technical practice that are identified in Heidegger and Borgmann. Those constant determinations are not a technological a priori, but are partial moments abstracted from the various concrete stages of a process of development.

I now attempt to work out this historical concept of essence as it applies to technology. Is the result still sufficiently "philosophical" to qualify as philosophy? In claiming that it is, I realize that I am challenging a certain prejudice against the concrete that is an occupational hazard of philosophy. Plato is usually blamed for this, but in a late dialogue Parmenides mocks the young Socrates' reluctance to admit that there are ideal forms of "hair or mud or dirt or any other trivial and undignified objects" (Cornford

9. Like the turtles in Feynman's famous story, the hermeneutics of technology "goes all the way down."

1957, 130C–E).[10] Surely the time has come to let the social dimension of technology into the charmed circle of philosophical reflection. Let me now offer, if only schematically, a way of achieving this.

Primary Instrumentalization: Functionalization

Substantivist philosophies of technology drew attention away from the practical question of what technology *does* to the hermeneutic question of what it *means*.[11] The question of meaning has become defining for philosophy of technology as a distinct branch of humanistic reflection. More recently, constructivism has sharpened reflection on a third range of questions concerning who makes technology, why, and how. My strategy here will consist in incorporating answers to the substantivist and constructivist questions into a single framework with two levels. The first of these levels corresponds more or less to the philosophical definition of the essence of technology, the second to the concerns of social sciences. However, merging them in the framework of a two-level critical theory transforms both.

This approach marks a break with essentialism, which privileges one attribute of technical artifacts—function—over all the others. This choice appears obvious because of the tacit identification of the functional and physical properties of the artifacts. Whereas social attributes such as the place of technologies in vocations are relational and seem therefore not to belong to technical artifacts proper, function looks like a nonrelational property of technology in itself. But in reality function is just as social as the rest. For example, the sharpness of a knife is indeed a measurable physical property, but sharpness is only a function rather than a hazard or a matter of pure indifference, through a social construction. All the properties of technologies are relational insofar as we recognize their technological character. As mere physical objects abstracted from all relations, these artifacts have no function and hence no properly *technological* character at all.[12] But if function is a social property of technological artifacts, then it should not be privileged over other equally important social dimensions.

On this account, the essence of technology has not one but two aspects,

10. Compare Latour's account of a similar episode involving Heraclitus (Latour 1993, 65-66).

11. Many of the ideas in this section and the next were first presented in an earlier version in Feenberg (1991, chap. 8).

12. Thus considered as just a thing, an automobile is no better parked with its wheels on the ground than in the air. It is only insofar as it is *assigned* a function that it must be considered as a technical device and placed squarely right side up. The spontaneous confusion between these two levels is no doubt less likely in non-Western societies. One who lives in a Japanese home with both tatami mat and wooden floors is well aware that what's underfoot is not just a thing on which to walk but also a whole national tradition.

an aspect that explains the *functional constitution* of technical objects and subjects, which I call the "primary instrumentalization," and another aspect, the "secondary instrumentalization," focused on the *realization* of the constituted objects and subjects in actual technical networks and devices. Essentialism offers insight only into the primary instrumentalization by which functions are separated from the continuum of everyday life. Primary instrumentalization characterizes technical relations in every society, although its emphasis, range of application, and significance vary greatly. Technique includes those constant features in historically evolving combinations with a secondary instrumentalization that includes many other aspects of technology. The characteristic distinctions between different eras in the history of technology result not only from new inventions, but also from different structurings of these various moments.

The primary instrumentalization consists in four reifying moments of technical practice: decontextualization, reductionism, autonomization, and positioning.

Decontextualization. To reconstitute natural objects as technical objects, they must be de-worlded, artificially separated from the context in which they are originally found so as to be integrated to a technical system. The isolation of the object exposes it to a utilitarian evaluation. The tree conceived as lumber and eventually cut down, stripped of bark, and chopped into boards is encountered through its usefulness rather than in all its manifold interconnections with its environment and the other species with which it coexists. The isolated object reveals itself as containing technical schemas, potentials in human action systems, which are made available by decontextualization. Thus inventions such as the knife or the wheel take qualities such as the sharpness or roundness of some natural thing, a rock or tree trunk, for example, and release them as technical properties. The role these qualities may have played in nature is obliterated in the process. Nature is fragmented into usable bits and pieces that appear as technically useful after being abstracted from all specific contexts.

Reductionism. Reductionism refers to the process in which the de-worlded things are simplified, stripped of technically useless qualities, and reduced to those aspects through which they can be enrolled in a technical network. These are the qualities of primary importance to the technical subject, the qualities perceived as essential to the accomplishment of a technical program. I will therefore call them "primary qualities," it being understood that their primacy is relative to the subject's program. Quantification is the most complete reduction to primary qualities. "Secondary qualities" are what remains, including those dimensions of the object that may have been most significant in the course of its pretechnical history. The

secondary qualities of the object contain its potential for self-development. The tree trunk, reduced to its primary quality of roundness in becoming a wheel, loses its secondary qualities as a habitat, a source of shade, and a living, growing member of its species. The Heideggerian enframing is the reduction of all of reality to such primary qualities.

Autonomization. The subject of technical action isolates itself as much as possible from the effects of its action on its objects. Metaphorically speaking, it thus violates Newton's third law, according to which "for every action there is an equal and opposite reaction." The actor and the object in mechanics belong to the same system, hence the reciprocity of their relations. This is not a bad description of ordinary human interactions. A friendly remark is likely to elicit a friendly reply, a rude one, a correspondingly unpleasant response. By contrast, technical action "autonomizes" the subject. This is accomplished by interrupting the feedback between the object and the actor. In an apparent exception to Newton's law, the technical subject has a big impact on the world, but the world has only a very small return impact on the subject. The hunter experiences a slight pressure on his shoulder as the bullet from his gun strikes the rabbit; the driver hears a faint rustling in the wind as he hurtles a ton of steel down the highway. Administrative action too, as a technical relationship between human beings, presupposes the autonomization of the manager as subject.

Positioning. Technical action controls its objects through their laws. There is thus a moment of passivity with respect to those laws in even the most violent technological intervention. The technical conforms with Francis Bacon's dictum "Nature to be commanded must be obeyed." The laws of combustion rule over the automobile's engine as the laws of the market govern the investor on the stock market. In each case, the subject's action consists not in modifying the law of its objects, but in using that law to advantage. Of course there are considerable differences between these two examples; for one thing the engine is an artifact designed in conformity with natural law whereas the investor can only adopt a strategic position with respect to the objective process of the market. Location, as they say in real estate, is everything: fortunes are made by being in the right place at the right time. By positioning itself strategically with respect to its objects, the subject turns their inherent properties to account. The management of labor and the control of the consumer through product design have a similar situational character. There are no natural laws of worker and consumer behavior that would allow one to design them as one would a machine, but one can position oneself so as to induce them to fulfill preexisting programs they would not otherwise have chosen. In these social domains, Baconian obedience is a kind of navigation in the turbulent

waters of interests, expectations, and fantasies that cannot be controlled only anticipated and used.

Secondary Instrumentalization: Integration

The primary instrumentalization lays out in skeletal fashion the basic technical relations. Far more is necessary for those relations to yield an actual system or device: technique must be *integrated* with the natural, technical, and social environments that support its functioning. The process of integration compensates for some of the reifying effects of the primary instrumentalization. Here technical action turns back on itself and its actors as it is realized concretely. In the process, it reappropriates some of the dimensions of contextual relatedness and self-development from which abstraction was originally made in establishing the technical relation. The underdetermination of technological development leaves room for social interests and values to participate in the process of realization. As decontextualized elements are combined, these interests and values assign functions, orient choices, and ensure congruence between technology and society at the technical level itself.

On the basis of this concept of integration, I argue that the essence of technique must include a secondary instrumentalization that works with dimensions of reality from which abstraction is made at the primary level. This level of includes four moments: systematization, mediation, vocation, and initiative.

Systematization. To function as an actual device, isolated, decontextualized technical objects must be combined with other technical objects and reembedded in the natural environment. Systematization is the process of making these combinations and connections, in Latour's terms, of "enrolling" objects in a network (Latour 1992). Thus individual technical objects—wheels, a handle, a container—are brought together to form a device such as a wheelbarrow. Add paint to protect the wheelbarrow from rust and the device has been embedded in its natural environment as well. The process of technical systematization is central to designing the extremely long and tightly coupled networks of modern technological societies but plays a lesser role in traditional societies where technologies may be more loosely related to each other functionally, but correspondingly better adapted to the natural and social environment.

Mediation. In all societies, ethical and aesthetic mediations supply the simplified technical object with secondary qualities that seamlessly embed it into its new social context. The ornamentation of artifacts and their investment with ethical meaning are integral to production in all traditional cultures. The choice of a type of stone or feather in the making

of an arrow may be motivated not only by sharpness and size, but also by various ritual considerations that yield an aesthetically and ethically expressive object. Heidegger's chalice exemplifies such expressive design. By contrast, production and aesthetics are differentiated in modern industrial societies. The goods are produced first, and then superficially styled and packaged for distribution. The social insertion of the industrial object appears as an afterthought. From this results the unfortunate separation of technique and aesthetics characteristic of our societies; unfortunate, I would argue, because no one denies the prevailing ugliness of so much of our work and urban environment. Ethical limits too are overthrown in the breakdown of religious and craft traditions. Recently, medical advances and environmental crises have inspired new interest in the ethical limitation of technical power. These limitations are eventually embodied in modified designs that condense considerations of efficiency with ethical values. A similar condensation appears in the aesthetics of good industrial design. Thus mediations remain an essential aspect of the technical process even in modern societies.

Vocation. The technical subject appears autonomous only when its actions are isolated from its life process. Taken as a whole, the succession of its acts adds up to a craft, a vocation, a way of life. The subject is just as deeply engaged as the object—Newton is vindicated—but in a different register. The doer is transformed by its acts: the individual of our earlier example, who fires a rifle at a rabbit, will become a hunter with the corresponding attitudes and dispositions should he pursue such activities professionally. Similarly, the chopper of wood becomes a carpenter, the typer at the keyboard a writer, and so on. These human attributes of the technical subject define it at the deepest levels, physically, as a person, and as a member of a community of people engaged in similar activities. "Vocation" is the best term we have for this reverse impact on users of their involvement with the tools of their trade. In traditional cultures and even in some modern ones, such as the Japanese, the concept of vocation or "way" is not associated with any particular kind of work, but in most industrial societies it is reserved for medicine, law, teaching, and similar professions. Perhaps this is an effect of wage labor, which substitutes temporary employment under administrative control for the lifelong craft of the independent producer, thereby reducing both the impact of any particular skill on the worker and the individual responsibility for quality implied in vocation.

Initiative. Finally, strategic control of the worker and consumer through positioning is to some extent compensated by various forms of tactical initiative on the part of the individuals submitted to technical control. Before the rise of capitalist management, cooperation was often regulated

by tradition or paternal authority, and the uses of the few available devices so loosely prescribed that the line between producer programs and user appropriations was often blurred. It is capitalism that has led to the sharp split between positioning and initiative, and the marginalization of the latter. Nevertheless, a certain margin of maneuver belongs to subordinated positions in the capitalist technical hierarchy. That margin can support conscious cooperation in the coordination of effort and creative user appropriation of devices and systems.

We have examples of alternatives to bureaucratic control in the collegial organization of certain professionals such as teachers and doctors. Refined and generalized, collegiality might be able to reduce the operational autonomy of management, substituting complex self-organization for control from above.[13] In the sphere of consumption, we have numerous examples, such as the computer, where creative appropriations by users result in significant design changes. As noted above, this is how human communication became a standard functionality of a technology that was originally conceived by computer professionals as a device for calculating and storing data.

The secondary instrumentalization constitutes a *reflexive metatechnical practice* that supports the reintegration of object with context, primary with secondary qualities, subject with object, and leadership with group. It treats functionality as raw material for higher-level forms of technical action. There is of course something paradoxical about this association of reflexivity with technology; in the substantivist framework technical rationality is supposed to be blind to itself. Reflection is reserved for another type of thought competent to deal with such important matters as aesthetics and ethics. We have here the familiar split between nature and *Geist* and their corresponding sciences.

CAPITALISM AND SUBSTANTIVE THEORY OF TECHNOLOGY

Substantivism identifies technology in general with modern Western technology. There are undoubtedly universal achievements underlying that technology, many of them borrowed from other civilizations in the first place. However, the particular form in which these achievements are realized in the West incorporates values that are not at all universal but belong to a definite culture and economic system. Modern Western technology is uniquely rooted in capitalist enterprise. As such it privileges the narrow goals of production and profit. The enterprise organizes the technical control of

13. For a discussion of this theme in the context of modern production, see Hirschhorn 1984.

its workers and dispenses with the traditional responsibilities for persons and places that accompanied technical power in the past. It is this peculiar indifference of modern capitalism to its social and natural environment that frees the entrepreneur to extend technical control to the labor force, the organization of work, and aspects of the natural environment that were formerly protected from interference by custom and tradition.[14] To define technology as such on these terms is ethnocentric.

What does a broader historical picture show? Contrary to Heideggerian substantivism, there is nothing unprecedented about our technology. Its chief features, such as the reduction of objects to raw materials, the use of precise measurement and plans, the management of some human beings by others, large scales of operation, are commonplace throughout history. The same could be said of Borgmann's device paradigm. It is the exorbitant role of these features that is new, and of course the consequences of that are truly without precedent.

Those consequences include obstacles to secondary instrumentalization wherever integrative technical change would threaten the maximum exploitation of human and natural resources. These obstacles are not merely ideological but are incorporated into technological designs. Only a critique of those designs is adequate to the problems, and only such a critique can uncover the technical potential available to solve them. If we define technology exclusively in terms of the dimensions privileged by modern capitalism, we ignore many currently marginalized practices that belonged to it in the past and may prove central to its future development. For example, before Taylor, technical experience was essentially vocational experience. Using technology was associated with a way of life; it was a matter not just of productivity but also of character development. This link was broken when capitalist deskilling transformed workers into mere objects of technique, no different from raw materials or machines. Here, not in some mysterious dispensation of being, lies the source of the "total mobilization" of modern times.

Similarly, the old craft guilds with their collegial forms of organization have been replaced by capitalist management. Collegiality, like vocational investment in work, survives only in a few specialized and archaic settings such as universities. Not the essence of technology but the requirements of

14. It is important to resist the temptation to dismiss capitalism as a factor on the grounds that Soviet communism and its imitators did no different and no better. These regimes never constituted an alternative; they followed the capitalist example in essential respects, importing technology and management methods, and in some cases, such as protection of the environment, carrying its irresponsibility even further. I have discussed this problem in more detail in Feenberg 1991, chap. 6.

capitalist economics explain this outcome (Braverman 1974; Noble 1984). A different social system that restored the role of the secondary instrumentalizations would determine a different type of technical development in which it would be possible to recover these traditional technical values and organizational forms in new ways. Thus reform of this society would involve not merely limiting the reach of the technical, but building on its intrinsic democratic potential.

Because its hegemony rests on extending technical control beyond traditional boundaries to embrace the labor force, capitalism tends to identify technique as a whole with the instrumentalizations through which that control is secured. Meanwhile, other aspects of technique are forgotten or treated as nontechnical. It is this capitalist technical rationality that is reflected in the essentialism of Heidegger and Borgmann. Because they characterize technology by the privileged instrumentalizations of capitalist modernity, they are unable to develop a socially and historically concrete conception of it. They take their own labor of abstraction, by which they eliminate the sociohistorical dimensions of technical action, for evidence of the nonsocial nature of technology.

CONCLUSION: THE GATHERING

In conclusion I would like to return briefly to Heidegger's critical account of our times to see how it stands up to the theory I have presented. For Heidegger modern technology is stripped of meaning by contrast with the meaningful tradition we have lost. Even the old technical devices of the past shared in this lost meaning. For example, Heidegger shows us a jug "gathering" the contexts in which it was created and functions (Heidegger 1971). The concept of gathering resembles Borgmann's notion of the "focal thing." These concepts dereify the thing and activate its intrinsic value and manifold connections with the human world and nature. Heidegger wants to show us the way back to another mode of perception that belongs to the lost past or perhaps to a future we can only dimly imagine. In that mode we share the earth with things rather than reducing them to mere resources. Perhaps a redeemed *techne* will someday disclose the potentiality of what is rather than attempting to remake the world in the human image.

The undeniable insight here is that every making must also include a letting be, an active connection to what remains untransformed by that making. This is Heidegger's concept of the "earth" as a reservoir of possibilities beyond human intentions. In denying that connection the technocratic conception of technology defies human finitude. The earth, nature, can never become a human deed because all deeds presuppose it (Feenberg 1986, chap. 8). Yet I would like to share David Rothenberg's interpretation,

according to which Heidegger would also want us to recognize that our contact with the earth is technically mediated: what comes into focus as nature is not the pure immediate but what lies at the limit of *techne* (Rothenberg 1993, 195 ff.). Despite occasional lapses into romanticism, this is after all the philosopher who placed readiness-to-hand at the center of *Dasein*'s world.

The cogency of Heidegger's critique thus ultimately comes down to whether technology is *fundamentally* Promethean. Only then would it make sense to demand liberation from it rather than reform of it. It is true that the dominant ideology, based on a narrow functionalism, leaves little room for respect for limits of any kind. But we must look beyond that ideology to the realities of modern technology and the society that depends on it. The failure of Heidegger and other thinkers in the humanistic tradition to engage with actual technology is not to their credit but reveals the boundaries of a certain cultural tradition.[15]

Beyond those boundaries we discover that technology also "gathers" its many contexts through secondary instrumentalizations that integrate it to the world around it. Naturally, the results are quite different from the craft tradition Heidegger idealizes, but nostalgia is not a good guide to understanding technology. When modern technical processes are brought into compliance with the requirements of nature or human health, they incorporate their contexts into their very structure, as truly as the jug, chalice, or bridge that Heidegger holds out as models of authenticity. Our models should be such things as reskilled work, medical practices that respect the person, architectural and urban designs that create humane living spaces, computer designs that mediate new social forms. These promising innovations all suggest the possibility of a general reconstruction of modern technology so that it gathers a world to itself rather than reducing its natural, human, and social environment to mere resources. It is now the task of philosophy of technology to recognize that possibility and to criticize the present in the light of it.

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15. For a discussion of that tradition as it shapes philosophy of technology, see Mitcham 1994.

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ERIC HIGGS, ANDREW LIGHT, AND DAVID STRONG

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