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Technological Dramas

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This article examines the technological construction of political power, as well as resistance to political power, by means of an "ideal-typical" model called a technological drama. In technological regularization, a design constituency creates artifacts whose features reveal an intention to shape the distribution of wealth, power, or status in society. The design constituency also creates myths, social contexts, and rituals to legitimate its intention and constitute the artifact's political impact. In reply, the people adversely affected by regularization engage in myth-, context-, or artifact-altering strategies that represent an accommodation to the system (technological adjustment) or a conscious attempt to change it (technological reconstitution). A technological drama, in short, is a specifically technological form of political discourse. A key point is that throughout all three processes, political "intentions," no less than the facticity and hardness of the technology's "impact," are themselves constituted and constructed in reciprocal and discursive interaction with technological activities. Technology is not politics pursued by other means; it is politics constructed by technological means.

The demonstration that technology is socially shaped (MacKenzie and Wacjman 1985) or socially constructed (Pinch and Bijker 1987) is a major achievement of science and technology studies (STS). The constraints of technique, resources, and economics *underdetermine* design outcomes. To account fully for a technical design, one must examine the technical culture, social values, aesthetic ethos, and political agendas of the designers. Technology, then, is at least partly a political phenomenon: Technological innovation provides an opportunity to embed political values in technological

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production process and artifacts, which then diffuse throughout society as a large-scale technological system arises (Hughes 1983, 1987). To the extent that many people come to depend on these processes and artifacts, these embedded values may have far-reaching effects (Staudenmaier 1989). To study these effects, argues the distinguished historian of technology Thomas P. Hughes (1989), is to understand that the American nation—despite the historical emphasis on democracy and free enterprise—has been fundamentally "a *technological* one," characterized by a "creative spirit manifesting itself in the building of a human-made world patterned by machines, megamachines, and systems." The values of this technological polity, moreover, are not necessarily the values expressed in political documents: They are the values of "order, system, and control that [have been purposefully] embedded in machines, devices, processes, and systems" (pp. 3-4).

Echoing this point, Staudenmaier (1989) points out that the designers' values are likely to include the hierarchical values of the Establishment, since a technology's *design constituency*, the groups and individuals who participate in the technology's design, "belong to the group that shares the dominant values and symbols of a society" (p. 154). And this is no trivial matter of mere symbolism. Since technological processes and artifacts are socially shaped, these values may find their way into the actual technical content of technology, in such a way that its technical content includes features that are more or less consciously intended to *coerce* workers and users so that their lives conform to the social visions and fantasies of the technology's creators. The surveillance systems used to track the performance of airline telephone reservation clerks, for instance, were constructed with the designers' conscious assumption that the clerks have little loyalty to the firm, are poorly educated, will try to avoid giving good service, and will quit in a few months anyway; the surveillance tries to transform them into tractable, cooperative cogs in a smooth-running machine. In this sense, one may speak legitimately of the *political* dimension of technological design: The technology is designed not only to perform a material function but also to express and coercively reinforce beliefs about the differential allocation of power, prestige, and wealth in society.

Technology studies scholars have produced several now-classic examples of ways that designers have created technological artifacts with technical characteristics specifically designed to exercise *force*, that is, to coerce obedience and suppress deviance. Winner (1980) called attention to the now-famous low bridges of Long Island, which were specifically designed to keep busses (and therefore the lower classes) out of exclusive residential neighborhoods. Noble (1986) shows how managers hoped that numerically

designed machine tools would deskill lathe operators and transfer process control from the shop floor to management. Barker and Downing (1985) show how networked word-processing technology has been used to erode the work autonomy of typists by monitoring the number of times per hour that a typist presses a key.

There is little question that some artifacts reveal deliberate efforts to project force through technological means. What has not been adequately recognized in technology studies, however, is that the use of naked force alone to compel obedience and suppress deviance has its limitations: It is, as Lincoln says, "effective in the short run," but "unworkable over the long haul" (1989, 4). To illustrate this point, Lincoln points to the example of rapid and violent imperial expansion, in which force is established without the legitimation of ideology to sustain it. In the absence of the construction of a new, encompassing ideology that could legitimate the exercise of force, the dominated groups retain their preconquest loyalties; the result is endemic violence and resistance. Taking a cue from Max Weber, Lincoln argues that force is effective only when it is legitimated by a sufficiently persuasive *discourse*, one that transforms force into *authority*. For Lincoln, the most persuasive discourses are the symbolic discourses of myth, ritual, and classification, rather than the verbal discourse of proposition and argument. As Bloch compellingly argues (1974), the very nature of symbolic discourses such as ritual is to discourage or forbid rational argumentation or reply. As Bloch puts it, and I think very tellingly, "You cannot argue with a song."

This essay recounts an attempt to understand the political dimension of technological invention and innovation, not as an expression of mere force, but much more significantly as force legitimated by the symbolic discourses of myth and ritual. As will be seen, my argument has many affinities with the "technology as text" view advocated by Woolgar (1991), in that I regard the supposed political force of an artifact as little more than what Norman (1988, 9) calls an *affordance*, a perceived property of an artifact that suggests how it should be used. Affordances are inherently multiple: Differing perceptions lead to different uses. You can drink water from a cup to quench thirst, but you can also use a cup to show you are well bred, to emphasize your taste in choosing decor, or to hold model airplane parts (Miller 1985, 1987). An artifact's political affordances are inherently susceptible to multiple interpretations. For this reason, an affordance cannot be sustained socially in the absence of symbolic discourse that regulates the interpretation. In this sense technology resembles a literary genre, in which a text's meaning changes as it falls into new hands and new situations. Discourse, in short, constitutes the "facticity" or "hardness" of the force embedded in an artifact.

I further pursue the technology-as-text metaphor by focusing not only on the usual subject of technological innovation, which can be seen as an opening statement in a technological discourse, but also on the full range of technological activities, such as user appropriation, user modifications, sabotage, and revolutionary alterations, as a series of counterstatements in a historical discourse. My intention is to see technological activity, paraphrasing Richard Brown (1987, 129), as a process of technological communication in which each new technological act is interpreted in terms of acts already performed, as well as in terms of the reciprocal reaction it engenders on the part of the political addressee. These statements and their subsequent interpretations constitute social relations as a polity. I therefore call attention to redressive technological activities, which are interpretive responses to the technological text, to highlight the discursive nature of resistance to technological domination. I call this polity-building process a *technological drama*.

A technological drama is a discourse of technological "statements" and "counterstatements," in which there are three recognizable processes: *technological regularization*, *technological adjustment*, and *technological reconstitution*. A technological drama begins with technological regularization.[1] In this process, a design constituency creates, appropriates, or modifies a technological production process, artifact, user activity, or system in such a way that some of its technical features embody a political aim, that is, an intention to alter the allocation of power, prestige, or wealth in a social formation. The technological processes or objects that embody these aims are cloaked in myths of unusual power, myths that justify regularization by portraying it as an activity fundamental to the preservation of civilization and human dignity. Ford's assembly line, for example, was not only a novel and efficient method of assembling automobiles; by taking control away from the worker and centralizing it in management's hands, it also protected American society from the potentially chaotic and disruptive work force of Southern and Eastern European immigrants by forcing them to accept a work life of regimented, disciplined docility (Staudenmaier 1989, 153). What I especially want to emphasize is that even myths of such power are insufficient to actualize the stratification potential of technological processes and artifacts. As will be seen, regularization is a heterogeneous activity (Law 1987) that involves not only the creation of technologies with embedded political aims but also the creation of fabricated social contexts and rituals that constitute political aims within the fluid field of social relations.

Like texts, the technological processes and artifacts generated by technological regularization are subject to multiple interpretations, in which the dominating discourse may be challenged tacitly or openly. I call such

challenges technological adjustment or technological reconstitution. In technological adjustment, impact constituencies—the people who lose when a new production process or artifact is introduced—engage in strategies that try to compensate for the loss of self-esteem, social prestige, and social power that the technology has caused. When they do, they make use of contradictions, ambiguities, and inconsistencies in the hegemonic frame of meaning to validate their actions. They try to control and alter the discourse that affects them so invidiously, and they try to alter the discursively regulated social contexts that regularization creates. Adjustment strategies include *appropriation*, in which the impact constituency tries to gain access to a process or artifact from which it has been excluded. In technological reconstitution, impact constituencies try to reverse the implications of a technology through a symbolic inversion process I call *antisignification*. Reconstitution can lead to the fabrication of *counterartifacts*, such as the personal computer or "appropriate technology," which embody features believed to negate or reverse the political implications of the dominant system.[2]

Following Turner (1957, 91-94; Turner 1974, 32), I choose the metaphor *drama* rather than *text* to describe these processes. A technological drama's statements and counterstatements draw deeply from a culture's root paradigms, its fundamental and axiomatic propositions about the nature of social life, and in consequence, technological activities bring deeply entrenched moral imperatives into prominence. To create the personal computer, for example, was not only to create new production processes and artifacts but also to bring computational power to the People, to deal the Establishment a wicked blow by usurping its own military-derived tools, and to restore the political autonomy of the household vis-à-vis the Corporation. To emphasize the metaphor of drama, too, is to employ a richer metaphor than text. It is to emphasize the performative nature of technological "statements" and "counterstatements," which involve the creation of scenes (contexts) in which actors (designers, artifacts, and users) play out their fabricated roles with regard to a set of envisioned purposes (and before an audience), and it is also to emphasize that the discourse involved is not the argumentative and academic discourse of a text but the symbolic media of myth (in which skepticism is suspended) and ritual (in which human actions are mythically patterned in controlled social spaces).

This article is intended to illustrate the concept of a technological drama using a variety of examples rather than a single, sustained case.[3] I begin by examining the nature of the political aims that are expressed in a technological drama, and I continue with an examination of a drama's three processes.

The Social Construction of Hegemonic Ideology

Although production processes and artifacts often embody political aims, it would be wrong to see technology as a mere epiphenomenon of politics. To portray technology as just another way of playing politics is to ignore those activities that make technological activities distinctive, compared to other kinds of social activities (paraphrasing Hagendijk 1990, 54). Furthermore, it would be wrong to say that an elite's value system necessarily finds its way into technological processes and artifacts, as if these values could be said to "lie behind" the design process and lend their stamp to technology (Law 1987). I would argue, instead, that the elite's political values are actively produced and defined in recursive interaction with the design process, so that preexisting values may take on surprisingly new forms and some putatively "traditional" values turn out to be de novo values invented to suit the needs of the moment. Technology, in short, is not politics pursued by other means; it is politics pursued by technological means. The burden of my argument is to try to show how these means are distinctive.

This view of the political content of technological systems is inimical to the conspiracy view of technology, in which the design constituency's ideology is assumed to be designed specifically for the tasks of political oppression and the mystification of force. A conspiracy theory might hold, for example, that a computer is little more than a mere artifice of patriarchal capitalism. But as will be seen, conspiracy theories are part of a technological drama: They stem from a redressive strategy of adjustment that I call *countersignification*. To adopt a conspiracy theory, then, is not to analyze a technological drama, it is to join it vicariously. Conspiracy theories, furthermore, can be reconciled with meticulous, historical accounts of elite formation only with difficulty. Echoing this point, Skocpol (1979) and others (see in particular Abercrombie 1980) argue that an ideology arises, not out of a deliberate attempt to mystify the oppressed, but rather to provide nascent elites with a common frame of meaning to overcome barriers to working together. In addition, the ideology provides the elite with a moral justification for its actions.

This processual and interactionist view of ideology is consonant with the actor/network model of technological innovation (Latour 1988; Law 1987; Callon 1987; Carlson 1992). In the actor/network model, a technology's designers succeed in promoting an artifact to the extent that they can adopt, interpret, or create values that unite key support groups. These values can include political values, which envision a differential allocation of power,

wealth, and status in society. All that is distinctive about the construction of political values in a technological medium, I would argue, is the reciprocal and recursive shaping of political values and technological artifacts in the design process, so that the political ideas that shape a polity are those that emerge from a technological crucible.[4] To illustrate this point, I briefly recount an example drawn from my research on the social construction of gravity-flow irrigation technology and peasant settlement schemes in Sri Lanka (Pfaffenberger 1990a).

The story of Sri Lanka's irrigation development begins in the nineteenth century, when colonialism created a nascent, indigenous political elite. Emulating the British, a new class of Ceylonese "Brown Sahibs" arose in the nineteenth century; most were coconut or rubber plantation owners or petty traders. As British tea planters departed in the twentieth century, these highly Westernized elite families stepped into their shoes. They used the plantations as a base for winning seats in Ceylon's Parliament, which from 1932 had a substantial degree of autonomy. Their ethos, like the British tea planters before them, was profoundly anti-industrial, and with reason: Marxist parties had made significant inroads among transport and industrial workers. Members of this elite emphasized agricultural development rather than industry, believing that they could maintain their power only by forestalling the creation of industrial contexts for left-wing political organization. Like the British before them, they feared the growing numbers of landless, unemployed, and highly alienated peasants who had been displaced from the land.

To deflect the Left's criticism and to create a moral justification for their actions, the emerging Ceylonese elite focused on a legislative program of state-sponsored, irrigation-based agricultural development, which sought to settle "landless peasants" in the lightly populated north central provinces of the island country. The technical design they chose for the settlements, one that coupled gravity-flow irrigation works with fixed plots of land, was supposedly founded on the traditional village customs of irrigation technology and landholding. But these "customs" were actually the creation of nineteenth-century British civil servants, who developed a romantic view of traditional Ceylonese irrigation customs that was strongly influenced by their conception of the harmful effects of enclosure legislation in England. Their design actually misinterpreted ancient customs, which focused more on the distribution of water than on the distribution of land. But this error remained concealed and irrelevant; what counted for the Ceylonese elite was the ability to distribute land in nice, neat, countable units.

The Ceylonese elite combined this erroneous (and in the end, dysfunctional) design with a frame of meaning of unusual scope and power: They

portrayed themselves as the true champions of the peasantry, which had been deprived of land by the British plantations. This frame of meaning spoke eloquently to the Ceylonese people, who had suffered three centuries of colonialism. It began by elaborating a myth of the moral and spiritual superiority of traditional Ceylonese culture, which was assumed to be best exemplified by the harmonious, rice-growing peasant village of old. This autonomous and quasi-democratic village, spiritually united by Buddhism and in close contact with nature, was thought to have created luxurious wealth through its focus on intensive rice cultivation, making Ceylon one of the richest countries in Asia. According to this myth, the British plantation system circumscribed traditional Ceylonese villages, bringing land shortages that had disastrous consequences for peasants, including the fragmentation of land plots into ludicrously noneconomic slivers, pauperization and landlessness, economic and ecological catastrophe, and technological retardation. The result was the destruction of the traditional peasantry and the substitution, in its place, of a grotesque and unproductive parody of rural capitalism. (The myth is factually questionable, but it is still accepted virtually without question by most Ceylonese.)

The technical design of state-sponsored irrigation settlements both expressed and tried to reinforce this vision of the harmonious, self-sufficient village. By giving each peasant a fixed and inalienable plot of land, the design sought to prevent the fragmentation and pauperization that was evident in much Ceylonese agriculture. Neatly deflecting attention away from its own prominence in the plantation sector, the elite managed to portray itself successfully as the self-appointed champions of the Buddhist peasant. What is more, in adopting this position, the elite managed to make a thinly veiled appeal to the ethnic chauvinism of the country's ethnic majority, the Sinhalese, who are predominantly Buddhist and constitute an overwhelming three-quarters of the electorate. By establishing what amounted to a renewal of traditional Buddhist Sinhalese villages in the north-central areas, the government would in effect push back the incursion of Tamil-speaking Hindus and Muslims, who had migrated to these regions after the 12th-century collapse of Buddhist civilization there. The Sri Lankan government claims that land is available for Tamil as well as Sinhalese people, but very few Tamils have actually been given land in the settlements. What is more, the projects have made Sinhalese people the majority in several districts that were traditionally Tamil.

Sri Lankan irrigation technology may have succeeded in its political aims of legitimating the elite's status, discouraging industrial development, and packing the landless off to the settlements, where they could do no harm. But

the technology's unintended consequences have brought the country to its knees. The irrigation-based settlements actually contributed to peasant pauperization because the high-end plots were better watered than the tail-end ones; therefore, there was plenty of rationale within the settlements themselves for reproducing the peasant stratification that had bedeviled the rural sector generally. The Sinhalese colonization of Tamil districts is one of the chief *casus belli* in the country's civil war, in which more than 25,000 people have died. The huge scale of the irrigation and settlement works has led to massive environmental degradation and deforestation. The enormous loans needed to construct the dams and canals have plunged future generations into debt, and the lure of profits in construction reduced industrial investment to the point that Sri Lanka has actually experienced significant deindustrialization during the past twenty years. But so much of Sri Lankan society has become committed to this technology that there is no going back.

What can we conclude from this example about the distinctive nature of politics accomplished through technological means? First, it is specious to say that elites express their political values through technology. The metaphor that underlies this statement is wrong: It envisions the technological design process as a conduit through which preexisting political values can be transmitted without being affected or altered. The Sri Lankan example suggests, in contrast, that the nascent elite, the supposedly "traditional" values, and the technological artifacts are reciprocally and recursively constructed in interaction with each other, producing an outcome that ideally generates both political authority and a technological system. This neat trick is accomplished by investing technological activities with cultural aspirations that are also constructed in this eminently creative process. To farm a three-acre plot in the North-Central Province is not only to grow rice; it is also to lay claim to the ancient patrimony of the Sinhalese people, to right the wrongs of colonialism, and to push the Tamils out of the ancient heartland of Sinhala civilization. This view suggests that technological innovation is perhaps the major contributor to what Foucault (1972) would call *discontinuities* in the reproduction of culture: the technological production of "villages," "Buddhism," "irrigation," and most of all, the "Sinhalese Buddhist identity" has generated phenomena that only remotely resemble what might be assumed (wrongly) to be their direct ancestors.

This example suggests a second distinctive characteristic of politics pursued by technological means. Hughes (1983, 1987) and others have shown how designers try to shape the legal and legislative environment into which they will project their artifacts, and the Sri Lankan example echoes this point. But shaping the law is a goal of all or most political action. What

makes technopolitics distinctive is the enormous attention paid to shaping the social contexts and space into which the production processes and artifacts of the technology will be projected.[5] This phenomenon is obvious in the case of Sri Lanka's irrigation settlements, in which virtually every aspect of social life, including family life and worship, was designed along with the dams and canals. It is equally evident in personal computing. The personal computer cannot ensure autonomy in software selection and applications, for instance, unless the artifacts are projected into autonomous and free contexts of use, the home and the user's club, in which the demands of mainframe system standardization and the regulation of data-processing managers are absent. It is the reciprocal construction of political aims and artifacts, coupled with the deliberate fabrication of controlled social contexts, that characterizes what is specifically technological about technological politics. These are the constitutive features of technological regularization.

Technological Regularization

In technological regularization, a design constituency creates, appropriates, or modifies a technological artifact, activity, or system that is capable of signifying and coercively implementing a constructed vision of a stratified society, one in which power, wealth, and prestige is differentially allocated. This social vision arises reciprocally and recursively in interaction with the technological design process. These production processes or artifacts or both are projected into a spatially defined, discursively regulated social context, which is crucial to actualizing the technology's constructed cultural and political aims.

A Typology of Regularization Strategies

One distinctive characteristic of technology as a political activity is the projection of fabricated social contexts, which are units of technologically defined geographic and social space, into the social worlds of day-to-day life.[6] From this point, it is possible to elaborate what might be called a typology of contextual strategies of regularization.[7] Although this list is surely incomplete, I offer it to indicate the pervasiveness of context-fabrication as a key element in technological regularization.

- *Exclusion*: Access to the technology and its social context is denied to persons who fit into certain race, class, gender, or achievement categories. Despite

official protestations to the contrary, the Sri Lankan government overwhelmingly favors Sinhalese families in selecting settlers for newly irrigated lands. The irrigation settlements are distinctively Sinhalese social spaces.

- *Deflection*: The technology provides compensatory goods or services to people in an attempt to deflect attention away from what is really going on. In Sri Lanka, for example, the land-to-the-peasant strategy effectively masked the elite's acquisition of plantations, and the North Central Province is a long way from both tea and Marxists.
- *Differential incorporation*: The technology is structured so that people of different social categories are incorporated into it in ways that reflect and attempt to reinforce their status. Furthermore, the context is designed so that both groups engaged the artifacts in hierarchically structured interaction. The Victorian hallway bench (Ames 1978; Forty 1986) provides a telling example. The hallway was the only space in the Victorian house likely to be used by both masters and servants. Masters and visitors of the masters' class would pass through the hall, while servants and tradesmen would be asked to sit there and wait. Hallway artifacts, therefore, had to serve two purposes: They had to be visually appealing to the master class as they passed through the hall, but if they included seats, they had to be austere, without upholstery, and uncomfortable, befitting the lower social status of the messenger boys, book agents, census personnel, and soap sellers who were made to wait there. The Victorian hallway bench, which often included an ornate mirror and delicately carved hat hooks, provides a perfect example of the dual incorporation strategy of these artifacts. The handsome mirror, pleasant to look at, contrasted sharply with the plain, uncomfortable bench, on which servants were to sit. The bench reminded servants of their inferior status, as did the plain and austere furnishings of servant's quarters.
- *Compartmentalization*: Access to the technology and its benefits is in principle open to all, but access is rigidly structured to keep some persons at arm's length. In early 1960s corporate computing, for instance, mainframe computers were the exclusive possessions of data-processing professionals, who did all they could to keep the machines at arm's length from scientists, engineers, managers, and other users. One data-processing official posted a sign at the entrance of the computer room stating that no one could be admitted to the room without placing little white cloth booties over his or her shoes. The manager later admitted that there was no need for the booties, but "it sure kept people out of the computer room" (Nelson 1974, n.p.).
- *Segregation*: Access to the technology and its benefits is in principle open to all, but it is so expensive or so difficult to obtain that few can enjoy it. One needs no further comment on this strategy than Veblen's *Theory of the Leisure Class*—or the *Sharper Image* mail-order catalog in the United States. Segregation defines the prestige of social contexts whose status-elevation potential lies far beyond the means of most people.
- *Centralization*: Access to the technology and its benefits is in principle open to all, but the system is constructed so that users have little autonomy and significant decisions are reserved for central management. The result is a social context in which autonomy is high at the center and diminishes toward the periphery. In U.S. corporations, for instance, management frequently sees a new computer system, not merely as an opportunity to increase productivity,

but also as a chance to increase management's control over employees and subordinates. As managers consult with the design team, they may affect the technical content of the artifact, pushing the theme of surveillance to such an irrational extreme that it interferes with the function of the system. Likening management's conception of information technology to Bentham's panopticon, a penal artifact that allows total 24-hour surveillance of prisoners, and thus emphasizing the ritual and regulatory character of the systems she describes, Zuboff (1988, 324) highlights the efforts of managers to "colonize an already functioning portion of the technological infrastructure and use it to satisfy their felt needs for additional certainty and control."

- *Standardization*: Access to the technology and its benefits is in principle open to all, but at the price of conformity to zealously maintained system standards and rules of procedure, which diminish local autonomy and marginalize local culture. If a community wanted a railroad station in nineteenth-century America, it had no choice but to accept standardized time, standardized architecture, and all the other characteristics of the metropolitan corridor (Stillgoe 1983) as it was thrust through the idiosyncrasies of local life.
- *Polarization*: Different versions of essentially the same artifact are created for no other reason than to reflect and to reinforce race, class, gender, or achievement categories. In 1895, Montgomery Ward and Company offered 131 pocket knives for sale, and 17 of them were specifically described as ladies' knives. There was no apparent difference in the cutting ability of the knives, but the ladies' knives were smaller and had curved pearl handles. The men's knives, in contrast, were larger and many had angular handles made of horn. Examining these and other gender differences in household artifacts, Forty (1986) concludes that they reflected the Victorian notions of female and male characters ("Nature," wrote an American quoted by Forty [66], "made woman weaker, physically and mentally, than man, and also better and more refined. Man compared with her is coarse and strong and aggressive"). Such quotidian artifacts serve to structure and differentiate household spaces (e.g., the kitchen vs. the workshop).
- *Marginalization*: Inferior versions of an artifact are expressly created for or distributed to persons of subordinate race, class, gender, or achievement categories; this strategy both reflects and reinforces the status distinctions and stigmatizes the contexts in which such artifacts are found. The furniture of a servant's room was as bare and uncomfortable as that of a penal colony so that the servant would have no occasion to compare herself favorably with the mistress of the house (Forty 1986).
- *Delegation*: A technical feature of an artifact is deliberately designed to make up for presumed moral deficiencies in its users and is actively projected into the social contexts of use (Akrich 1987; Latour 1988). Victorian children's furniture, for example, was specifically designed with rigidly straight backs to prevent children from "acquiring a habit of leaning forward, or stooping" (Forty 1986, 69). Photocopying machines automatically reset themselves to one copy after an interval of nonuse, on the assumption that users are morally irresponsible and will not reset the number- of-copies setting after finishing a copy run, thus inconveniencing the next user, who might inadvertently make unwanted copies.

- *Disavowal*: An artifact that is specifically developed for menial or poorly compensated occupations is actively avoided or rejected by those of higher status, thus reinforcing the status distinctions. Attorneys, very much at pains to disavow the clerical side of their profession, exhibit the "quill-pen mentality" and avoid typewriters (and computer keyboards) at all costs.

Do Artifacts Have Politics?

The artifacts projected into the fluid world of social relations by technological regularization are designed to manipulate social space in various ways, as the preceding "grammar" of sociospatial strategies suggests. We can therefore ask Winner's (1980) famous question: Are (some) artifacts inherently political because political values are embedded in them? The answer, I would like to suggest, is clearly no, and for the following reason: It is by no means sufficient merely to project the artifact into the fabricated social context. As will be seen in this section, the artifact must be *discursively regulated* by surrounding it with symbolic media that mystify and therefore constitute the political aims. For example, an elaborate Victorian myth of hygiene mystified the differential incorporation strategy of Victorian hallway artifacts: You did not have a plain bench in the hall to humiliate the servant class, you put it there because the people who sit there have been on "public conveyances" and would therefore soil upholstery with the filth of the streets. But myth alone is not sufficient. Technologically defined social spaces seem to become staging grounds for elaborate *secular ritual* (Moore and Myerhoff 1977), the function of which is to regulate social behavior so that the artifact's political intentions come to life. The prominence of secular ritual in technologically defined social spaces provides another rationale for describing this activity as a form of discourse rather than mere force.

The Victorian hallway bench, with its political aim of differential incorporation, well illustrates this point. Many antique collectors place Victorian hallway benches in their homes, without the slightest idea that, for Victorians, the contrast between the ornate mirror and the hard, plain bench both represented and constructed the Victorian class system. These people would certainly never ask anyone, of whatever class, to sit on such a bench to await the master of the house! What made the hallway bench into a political artifact in the nineteenth century was the ritualization of the hallway space: Profound decorum standards called for members of the master's class to be admitted straightaway into the interior of the house, while members of the servant's class were seated on the bench, signifying their inferiority. The artifact embodies political intentions, but these intentions do not come to life in the absence of ritual.

To cite another example of the ritualization of technologically defined social space, Tennekoon (1988) describes the ceremonies carried out by government officials as they open new tracts of irrigated land in the Mahaveli Development Scheme, the latest of Sri Lanka's state-sponsored irrigation development projects. Quite consciously, the Mahaveli officials attempt to carry out virtually every transaction involving the transfer of capital or land in a ritual context that signifies ancient Sinhala culture; land donations, for instance, are recorded like those of ancient kings, in rock inscriptions. At the opening of each new tract of land, Mahaveli officials carry out a rite known as *jala puja*, originally a Buddhist rite intended to secure the fertility of the earth; as Tennekoon observes, however, what is now signified is all the ancient richness and greatness of traditional Sinhala civilization as it is being recreated (or so it is fantasized) in the Mahaweli project (and tacitly against the interests of the Tamils, into whose traditional homelands the Mahaweli projects partly extend). The ritual nakedly symbolizes and reinforces the exclusion strategy that underlies Sri Lanka's irrigation technology: No Tamil could possibly witness such a ceremony without, at the minimum, feeling like an outsider—or the potential victim of violence. Indeed, the Sinhalese-dominated irrigation settlements have always been hotbeds of ethnic rioting during Sri Lanka's periodic civil disturbances, and one such disturbance—the riots of 1977—actually began in an irrigation settlement.

Why does ritual seem to play so prominent a role in technological regularization? The point of ritual is not merely to represent and reinforce social statuses but, rather, to act them out in such a way that any argument against their implications runs up against a sedulous blockade of decorum standards. For this reason, rituals do not merely reflect and reinforce a social formation (or a social fantasy), as Lukes has so compellingly argued, they "*define away alternatives*" (1975, 305, emphasis mine). In a ritual setting, even the mildest verbal critique of a ritual, any unwillingness to go along with the game, is considered to be utterly tasteless and tantamount to declaring open war on the whole system. Ritual creates a controlled environment, a specially constrained place and time, in which it is very difficult to express opposition or open critique. Ritual, in short, is a prime agent of what Hodge and Kress (1988) call *logonomic control.*

The term *logonomic*, which is a neologism constructed from the Greek *logos* (thought or system of thought) and *nomos* (control or ordering mechanism), refers to

> a set of rules prescribing the conditions for production and reception of meanings, which specify who can claim to initiate (produce, communicate) or know (receive, understand) meanings about what topics under what circum-

> stances and with what modalities (how, when, why). Logonomic systems prescribe social semiotic behaviors at points of production and reception, so that we can distinguish between production regimes and reception regimes.... Logonomic rules are specifically taught and policed by concrete social agents (parents, teachers, employers) coercing concrete individuals in specific situations by processes which are in principle open to study and analysis. They are challenged by social agents—e.g., children, students, employees. Logonomic systems cannot be invisible or obscure, or they would not work. They become highly visible in politeness conventions, etiquette, industrial relations, legislation, and so on. (Hodge and Kress 1988, 4)

It is when technological processes or artifacts come within the compass of logonomic control that they become effective political artifacts. By itself, an artifact that embodies political intent—like a word-processing minicomputer that shows a supervisor how many keys are pressed per hour—is incapable of political action. When such an artifact is placed within a ritual context, however, the artifact's political potential is socially constituted. Logonomic police (e.g., supervisors and managers) shape the ritual environment (e.g., the word-processing pool), so that things are performed the way the police think they *ought* to be (the typists are loyal and hard working) instead of the way the police think they *are* (the typists will work three weeks and quit, and they are lazy anyway). The technical feature of the system that records the number of keystrokes per hour is an affordance of considerable utility for regularizers, but even such a "hard" feature does not necessarily determine the outcome: It could be ignored or successfully opposed by unions or subverted by a clever hacker. The logonomic police are still necessary, and they must even police and mystify themselves, lest political affordances lie latent. For this reason, the term *artifact* should be minimally defined as not only the technological process or object but also its constituting myth, its fabricated social context, and its rituals of logonomic control.[8] A refusal to recognize the logonomic and social dimensions of an artifact is a form of fetishism, which is itself an attribute of technological regularization (Pfaffenberger 1988b).

Redressive Strategies and the Exploitation of Ambiguity

Technological regularization projects artifacts and ritualized social contexts into the fluid world of social relations, and in so doing, "recollects" the political vision of its designers. As regularization occurs, some people find that their power, prestige, or wealth is enhanced, while others find or believe that they lose in some way: The process creates what Staudenmaier (1989)

would call an "impact constituency," the individuals, groups, and institutions who lose as a technology diffuses throughout society.

Technological regularization plays a significant role in structuring a social formation. But it would be wrong to view even a highly successful regularization strategy as a total victory for its political promoters: Most regularization efforts fail to suppress redressive social processes. The nature of regularization is that it creates areas of inconsistency, ambiguity, interpretive flexibility, and outright contradiction. Moore (1975) has emphasized this point in arguing that the more some people try to project regularization into social life, the more the people affected by regularization resist it by trying to "arrange their immediate situations (and/or express their feelings and conceptions) by exploiting the indeterminacies in the situation, or by generating such indeterminacies, or by reinterpreting or redefining the rules or relationships. They use whatever areas there are of inconsistency, contradiction, conflict, ambiguity, or open areas that are normatively indeterminate to achieve immediate situational ends" (pp. 234-35). People adversely affected by a technology can find in these "gray areas" adequate rationale to legitimate the redressive strategies of technological adjustment and reconstitution. When they engage in these redressive strategies, they reinterpret the symbolism of regularization, finding in the ideology that oppresses them the sources of a coherent and persuasive justification for their actions.

Even those who engage in regularization may have reason to escape its implications. While discussing the caste system with a very conservative and high caste Indian student once as we lunched at a Midwestern hamburger stand, I pointed out that he was eating beef. He replied, "These [American] cows aren't like those cows." A manager was quite content with a system that quantified his subordinates' performance but was opposed to a higher-level system that would track his performance. The supposedly Universal Good of computer performance tracking, in short, applied to everyone else but him. Realizing that he was voicing precisely the same fears as his subordinates, he said self-mockingly, "Well, of course, when my people say it, it doesn't matter, but when I say it, it really *is* a problem" (Zuboff 1988, 339). To the extent that even the agents of domination must resort to adjustment strategies, the coherence and logic of domination are undermined, and the pathway for redressive action becomes clear.

The ideologies crafted in the course of technological innovation are inherently ambiguous and susceptible to multiple interpretation for another reason: Their ambiguity serves well to unite the design constituency. As the rallying mythos of personal computing, "open architecture" could be interpreted in many ways, thus appealing simultaneously to hardware hobbyists,

programmers, and political activists who felt that social justice could not be secured without democratizing technological expertise. The purpose of such ideologies is to unite the design constituency and provide a moral basis for its actions; given the aim of unification, the goal of keeping the ideology logically consistent takes a back seat. The more heterogeneous the ideology, the more susceptible it is to multiple interpretations, the better the job it is likely to do in uniting the constituency.

The ideologies of technological regularization are also ambiguous because they draw from what Turner (1974, 64) called *root paradigms*. Consciously recognized (but far from consciously grasped), root paradigms are cultural models for behavior, maps for interpreting social relations in terms of cultural meanings, that are at once deeply resonant and logically inconsistent. Root paradigms

> go beyond the cognitive and even the moral to the existential domain, and in so doing become clothed with allusiveness, implicitness, and metaphor—for in the stress of vital action, final definitional outlines become blurred by the encounter of emotionally charged wills. Paradigms of this fundamental sort reach down to irreducible life stances of individuals, passing beneath conscious prehension to a fiduciary hold on what they sense to be axiomatic values. . . . One cannot escape . . . their presence or consequences. (1974, 64)

Deep as they are, root paradigms justify a wide variety of actions. "Root paradigms are not systems of univocal concepts, logically arrayed; they are not, so to speak, precision tools for thought. Nor are they stereotyped guidelines for ethical, esthetic, or conventional action" (1974, 64). They provide a means of mapping deeply rooted cultural beliefs and world-view propositions onto social relations, but without specifying precisely how one should act. What is more, a culture's stock of root paradigms is a riot of inconsistency; the heterogeneous ensemble of root paradigms grows by accretion from such processes as migration, immigration, pilgrimage, tourism, acculturation, borrowing, culture contact, colonialism, conquest, the formation of generational cohort cultures, and—by no means the least significant—technological activity itself, which shapes and redefines root paradigms in reciprocal interaction with design processes.[9] A human culture, in short, does not consist of a logical set of worldview premises that have a one-to-one mapping to social behaviors. A culture is much more accurately described partly as a set of characteristic problematics, a set of unresolved dilemmas or conundrums, as well as a diverse repertoire of root paradigms that can generate a profusion of action strategies, all of which can be presented as legitimate.

For technology studies, the significance of Turner's root paradigm concept is to show why technological activities so frequently seem to embody the enthusiasm of social movements (Carey and Quirk 1970), and why such enthusiasm is prominent not only in regularization, when people draw on root paradigms to create order through technology, but also in the redressive phases of adjustment and reconstitution. The cultural resources are flexible enough to legitimate both the creation of order and challenges to order. In American culture, for instance, the stock of cultural problematics includes the Faustian pursuit of self-interest and wealth versus the sacredness of the wilderness (Staudenmaier 1989), as well as the pursuit of industrial and corporate efficiency versus the preservation of the autonomous household in contact with Nature (Marx 1964). Technological enthusiasm can build when an artifact seems to resolve a cultural problematic: The mainframe computer, an artifact of technological regularization, solved the control problem of the corporation by utilizing the same conception of information and control that underlies order in Nature (Beniger 1986). The personal computer, an artifact of reconstitution, sought to correct the imbalance of power between the corporation and the household by equipping the home with the corporation's own information-processing tools. In both cases, the technological "resolution" of American cultural problematics generated technological enthusiasm; those who carry out regularization, no less than those who carry out reconstitution, can see themselves as engaging in activities that are deeply meaningful, drawn as they appear to be from the deepest wells of their culture. But I would emphasize that, just as Turner shows how root paradigms come to the fore and take on new complexions, these cultural resources are reinterpreted and fundamentally altered in recursive and reciprocal interaction with technological activities. The democratization-of-information paradigm that emerged from the electronic data base industry, for example, is only a caricature of the rich and democratic one that energized the public library movement with enthusiasm (Pfaffenberger 1990b).

Technological Adjustment

People who covertly or openly challenge technological regularization find ample areas of inconsistency and ambiguity, which they can exploit to interpret technological artifacts and contexts in a different way. In technological adjustment, the key goal is to make life bearable in the face of regularization; adjustment is therefore a way of interpreting artifacts and

contexts such that the invidious status implications of regularization are neutralized or eliminated. I here discuss three characteristic themes of technological adjustment: (1) *countersignification*, in which those whose status is diminished by an artifact attempt to substitute a more favorable frame of meaning, in which their self-esteem does not suffer; (2) *counterappropriation*, in which those deemed unsuited to possess an artifact get their hands on it anyway; and (3) *counterdelegation*, in which impact constituencies try to subvert the coercive function of a technological delegate.

Countersignification

The context-fabrication strategies of differential incorporation, standardization, centralization, and polarization place people in ritual contexts that both symbolize and adversely structure the inferior status of impact constituencies: For example, furnishings remind Victorian servants of their inferior status, just as the standardized architecture of a large-scale technological system reminds a community of its declining autonomy. Each of these strategies is associated with powerful, mystifying myths, which embody an attempt to frame a moral justification for the stratification the technology engenders. And in the face of these myths, members of the impact constituency may be stigmatized as unworthy, uneducated, morally deficient, dirty, violent, or otherwise unworthy of full incorporation.

A person whose status is invidiously affected by one of these strategies chooses from a variety of potential responses. Beyond passivity, apathy, and resignation, he or she may attempt countersignification, in which he or she covertly substitutes a myth or root paradigm that contradicts the mythos of regularization. Countersignification is an act of mythos substitution that decomposes and rehistoricizes the meanings embodied in artifacts. In so doing, it creates a conspiracy theory of regularization, the very one that we tried so hard to avoid in the earlier section on the social construction of hegemonic ideology! I return to the example of Victorian hallway artifacts to show how countersignification creates a conspiracy theory of technological regularization. The anthropologist June Nash recalls (personal communication) how, as a little girl, she and her friends were made to wait in the hallway of a particularly conservative and formidable neighbor, an experience that was initially oppressive and fearful. And yet the atmosphere of oppression collapsed when it was discovered that the mistress's cat had soiled one of the hallway chairs! The whole edifice of fear gave way to irreverent mirth, and much mocking of the mistress's uptight approach to life. Another example: It is impossible to miss the kindred tone of sarcasm in the reminis-

cences of Margaret Powell, a former servant, who described the rationale for plain and uncomfortable servant furnishings: "It was the opinion of 'Them' upstairs that servants couldn't appreciate good living or comfort, and therefore must have plain fare, they must have dungeons to work in and to eat in, and they must retire to cold Spartan bedrooms to sleep" (cited in Forty 1986, 84). For servants, the uncomfortable bench may have been intended to reinforce social inferiority, but it may have been interpreted by servants—once they had seen beyond the cloaking language of hygiene—as yet another sign of the disgusting insensitivity and pathetic inhumanity of the master class, which could not feel comfortable in its own status without making a pointless but sedulous effort to degrade the status of servants.

In substituting one discourse for another, countersignification amounts to a substituted metalanguage that undermines the moral authority of an artifact and establishes the superior morality of those who are adversely signified in material meanings. Countersignification gives people a way to live within the system without suffering unhealthy losses of self-esteem. In this sense, it is a form of accommodation to regularization. But by creating a conspiracy theory of technology, countersignification can provide a persuasive rationale to groups prepared to challenge the system openly. In Sri Lanka, for example, radical Tamils interpret the tacit exclusion strategy of state-sponsored irrigation as a compelling example of the fundamentally racist intentions of all Sinhalese and of the Sinhalese-dominated Colombo government, and this interpretation has persuaded thousands of Tamil youths to join violent separatist movements, such as the Liberation Tigers of Tamil Edam. Their interpretation certainly goes too far. There is indeed a tacit appeal to racism in the technology's mythos. But the emphasis on Sinhalese peasants, rice, and Buddhism was crafted in the first instance to unite the emerging Ceylonese elite and to provide a moral justification for its actions (e.g., the recreation of the glorious rice civilizations of the ancient past). And throughout the history of state-sponsored irrigation, by no means have all individuals and groups within the Colombo government looked on peasant settlement in a racist way, for example, as a means of displacing Tamils from their homelands. By creating a conspiracy theory and making all the members of an elite equally guilty, however, countersignification lays the foundation for a potential explosion of violent resistance, in which every member of the dominant group becomes a potential target for revenge. In sum, the political ideologies of the redressive phases of a technological drama are constructed in reciprocal and recursive interaction with technological activity, just like the hegemonic ideologies of regularization.

Counterappropriation

Many of the sociospatial strategies of regulation (specifically, exclusion, compartmentalization, segregation, marginalization, and stigmatization), structure access to an artifact in invidious ways. For those deemed unworthy to possess an artifact, the key problem is how to prove one's worthiness to appropriate the artifact. Counterappropriation is an adjustment strategy pursued by impact constituencies who, for one reason or another, are deemed unworthy to possess or to operate a technological artifact. The strategy involves a reinterpretation of the dominant discourse in such a way that their access to the technology is morally legitimated. It may also involve attempts to acquire and to operate the artifacts. As will be seen, however, counterappropriation may play into the hands of regularization. Typically, it rejects only some of the negative status implications of regularization. It accepts others to the extent that properly reinterpreted, they can legitimate access to the artifacts. Ample grounds for co-option emerge in counterappropriation strategies.

The cultural history of aviation, so richly described by Corn (1983), provides telling examples of a co-opted counterappropriation process. The early mythos of aviation presented flight as an inherently masculine activity, pursued by birdmen who possessed "an extraordinary combination of active energy, courage, decision of purpose, a quick eye, clearness of judgment, the utmost presence of mind, and great physical dexterity" (as one popular magazine put it in 1908, cited in Corn 1983, 74). As aircraft took on roles in warfare, the intrepid birdman was echoed by the ace, a "fatalistic and chivalric aerial warrior," whose daring, masculine stunts were replicated by barnstormers. As flying became safer and an air transport industry became possible, however, the masculine mythos of aviation became a liability to the industry, a liability that female pilots exploited to the hilt. They looked on aviation as an exciting new opportunity for freedom and accomplishment, a way of escaping from the unfree female role. Paradoxically, it was by emphasizing traditional feminine stereotypes, such as frailness, that female pilots broke into aviation. Louise Thaden, the winner of a major flying competition in 1936, put the point this way: "Nothing impresses the safety of aviation on the public quite so much as to see a woman flying an airplane." If a woman can do it, she suggested, it must be "duck soup" (cited in Corn 1983, 75). The aviation industry welcomed and sponsored "lady fliers" in an attempt to persuade the public that flying was easy and safe. As Corn observes, however, the lady-flier strategy preserved sexist stereotypes at the same time that it gave women access to aircraft. While the lady-flier strategy opened aviation to some women, it also marginalized their role in aviation in ways from which women pilots are only now beginning to recover.

Counterdelegation

Counterdelegation is an adjustment strategy that leads to the actual technical modification of artifacts, albeit on a small scale. The modification attempts to thwart a delegation strategy by disarming, muting, or otherwise suppressing the operation of a technical delegate. A technical delegate is a technical feature that seeks to compensate for the moral deficiencies of users by technical means (Akrich 1987; Latour 1988). In U.S. cars, for instance, a buzzer—often one with an obnoxious sound—reminds drivers and passengers to fasten their seat belts, on the assumption that they will not do so unless reminded. Most car dealers are quite happy to assist car owners in the counterdelegation strategy of disarming the buzzer.

People to whom delegation strategies are addressed are often motivated to acquire technical expertise, such as figuring out how the system works, to thwart the delegate. Typists in word-processing pools, for instance, quickly learn that the system cannot distinguish purposive from random typing, so they can enjoy a brief chat or a moment's mental rest as long as they keep pressing the space bar. Zuboff reports that one group of workers subverted a computer performance-tracking system through the technically astute expedient of getting a computer password, logging on to the system, and changing a performance-rating multiplier so that the system always rated their performance as excellent (1988, 353). To cite another example, some hackers have acquired so much expertise about computer system security delegates that companies have actually hired ex-hackers to protect themselves against system intrusion.

Like countersignification and counterappropriation, counterdelegation involves recourse to root paradigms that challenge the mythos of regularization. Various efforts to get Americans to use seat belts, for example, are challenged by root paradigms of individual freedom, which are interpreted to suggest that an individual should be free to engage in dangerous behaviors as long as they do not harm others (the impact of accidents on insurance rates, however, is conveniently ignored).

Technological Reconstitution

Adjustment strategies do not openly attack the foundations of technical regularization, although by creating conspiracy theories and by fostering access and technical expertise, they may lay the foundation for such an attack at a later time. And with the exception of counterdelegation, they do not attempt to reshape the artifacts of regularization but merely seek access to

them or a limited amount of control over them. Technological reconstitution is, however, another matter. In technological reconstitution, impact constituencies actively reshape technological production processes or artifacts guided by a self-consciously "revolutionary" ideology, producing what I call *counterartifacts*. This ideology is produced by means of a symbolic inversion called *antisignification*.

Antisignification

I draw the term *antisignification* from Brown's *Society as Text* (1987, 130-32), in which he analyzes the unsuccessful attempt by Peter the Great to Europeanize Russian society. According to Brown, Peter did not so much introduce European culture as he inverted or negated the terms of pre-Petrine Russian society. In pre-Petrine culture, for example, foreigners were prohibited from wearing Russian clothes, while European clothes were used for masquerade costumes and mocking ceremonies. Peter reversed the signification by requiring Russians to wear Western clothes except for masquerades or mockery. Brown concludes, "Peter's actions did not constitute a social revolution so much as an antisignification within the same social-textual boundaries. His actions make sense as negations or contraries of the dominant pre-Petrine signs, but all the while operating within the same syntactic system" (p. 132).

Brown's analysis of Peter the Great raises a compelling question. If technological reconstitution is merely a form of antisignification that tacitly reproduces the underlying syntactic system, is it really capable of accomplishing its designers' objectives of introducing real change in society? Peter the Great's reforms were opposed by the Russian peasantry, who concluded he was the Antichrist. But to the extent that reconstitution thinkers are thinking technologically, they will craft not only counterartifacts but countercontexts as well, in which the counterartifact's new social implications can become manifest. The context is crucial; it can even overcome the regularization strategies embedded in artifacts. In Scandinavia, for instance, numerically controlled machine tools have no stratifying effects because workers are taught how to program them, and they are used in the context of a management more liberal and benign than its American counterpart. As we examine reconstitution, we will see that successful reconstitution strategies involve not only the creation of counterartifacts but also countercontexts and even counterregularization strategies to enforce them. Regularization can indeed become a tool of reconstitution; it can be used to enforce change as well as continuity.

Technological reconstitution appropriates and modifies technological artifacts using antisignification as an ideological rationale and guide. For contemporary technological reconstitution, the Bible is Illich's *Tools for Conviviality* (1973), a book that was widely read by the people who created personal computing. According to Illich, scientific and technological innovations produce great social good at first, but as they become increasingly bureaucratized, they exhibit disutility. Modern medicine, for instance, consumes vast amounts of social wealth prolonging the lives of medically dependent people. The automobile, once a congenial alternative to public transportation, has almost wholly derailed public transport and has become a serious threat to environmental and social welfare. A new generation of engineers and scientists must seek to reformulate technology so that it is convivial: "Convivial tools are those which give each person who uses them the greatest opportunity to enrich the environment with the fruits of his vision. Industrial tools deny this possibility to those who use them and they allow their designers to determine the meaning and expectations of others. Most tools today cannot be used in a convivial fashion" (Illich 1973, 21): They are centralized, hierarchical, differentially distributed, administered by professional elites, and restricted to the purposes of bureaucracy. Convivial tools, in contrast, are decentralized, egalitarian, universally distributed, controlled by users, and open to the purposes of the individual.

Antisignification is clearly evident in Illich's notion of convivial tools, as is the recognition that the artifact's built-in political implications cannot be completely realized in the absence of a convivial social context. A convivial society, argues Illich, is a social context in which only one resource is universally distributed: personal energy under personal control (1973, 12). In such a society, one will find "social arrangements that guarantee for each member the most ample and free access to the tools of the community and limit this freedom only in favor of another member's equal freedom." It is only in a convivial society that convivial tools can become widely used.

Antisignification and the construction of an alternative social context are clearly evident in the social construction of the personal computer (Pfaffenberger 1988a). If mainframe computers were expensive, powerful, cumbersome, slow to respond, hard to program, and restricted to corporate purposes, the personal computer would be the precise inverse: inexpensive, just powerful enough for an individual, easy to use, fast to respond, easy to program, and open to whatever purposes an individual envisioned. What is more, the social context of the personal computer was to be the home and the users' group, far from the meddling of data-processing professionals and other agents of computational regularization.

Another example of antisignification and the creation of alternative social contexts comes from Sri Lanka's Sarvodaya organization, which is attempting to create an authentic, indigenous development program (Pfaffenberger, forthcoming). Sarvodaya's development strategy self-consciously inverts the Western development paradigm: It is based not on self-interest but the principles of Buddhism, such as nonviolence, noninterference, and respect for all sentient life. It offers its own particular mix of antisignification rhetoric, which appeals uniquely to Sri Lankans' sense of their own history: If economic development has failed because it has been urban in locale, capital-intensive in technology, and foreign in origin, Sarvodaya will cure the problem by creating a labor-intensive and Buddhist development technology, which will be deployed in the least Westernized context, the rural village. Sarvodaya's founder offers the following narrative to explain the movement's purposes:

> Sri Lanka was the victim of Western colonialism for well over four centuries. The prime motivation of the colonial powers for the expansion of their political empire was the scope for economic exploitation of the conquered peoples. . . . During the period of industrialisation in Europe . . . production of wealth was a material and mechanical process where spiritual and humanistic considerations were absent or ignored. . . . We cannot . . . work on this theory. . . . The dilemma we are faced with today is how we may harmonise modern economic theory with the age old spiritual wealth we have inherited. . . . Sri Lanka is a country of villages. . . . The village community acted more or less as a large family . . . [following the principles] of sharing, pleasant speech, constructive activity, and equality. These four principles governed our socio-economic life for ages past until the colonial powers came and disrupted our social structure. . . . The strength of a people as opposed to the authority of a bureaucracy was prevalent in this system. . . . The Sarvodaya Shramadana Movement is only a humble attempt to re-vitalise this thought and culture. (Ariyaratne 1970, 1-24)

The early history of online bibliographic data bases (Pfaffenberger 1990b) provides another example of antisignification in action. The online bibliographic data base industry had its origins in the rebellion by some librarians against what they saw as the unscientific, unsystematic, and technically conservative ethos of librarianship; they offered, in its place, computerized information-retrieval systems that would substitute automatic computerized indexing and retrieval for the librarian's fusty, unsystematic, and arcane procedures. Refusing to identify with librarianship, the designers of these early systems in the 1950s and 1960s called themselves "documentation specialists" and, later, "information scientists." They tried to create new, alternative social contexts for their computational artifacts, such as interlibrary consortia and private-sector firms, in which the mentality and influence of librarians were less intrusive.

Technological reconstitution uses antisignification as a guide to create counterartifacts and alternative social contexts. In so doing, it too takes on a discursive quality: it reaches deeply into a culture's stock of root paradigms, and as it does, it portrays itself as a unique and compelling solution not just to technological problems but to what appear to be broader and dramatic political issues of human existence. (Few realize that these issues are themselves a product of technological dramas; the culture's stock of root paradigms is discontinuously reproduced, as Foucault would put it, in reciprocal interaction with specifically technological activities.) The personal computer was to enable stand-alone application computing. But even more, it enabled a heroic struggle in which Establishment's own artifacts were appropriated and modified to serve the needs of the People. Sarvodaya sought to increase agricultural production. But even more, it is part of a heroic quest for Third World cultural and economic authenticity in the face of a world system of industrial and neocolonial domination.

Reintegration

Like counterappropriation, reconstitution seems susceptible to co-option, in a form I call reintegration (after Turner 1974). Reintegration is the response made by the agents of regularization to the new, problematic counterartifacts. Its goal is to gain control over these artifacts by bringing them back into the controlled and ordered space of regularization and then performing technical modifications that blunt their revolutionary potential. The fate of the personal computer provides a telling example.

Early personal computers were deliberately designed with a form of technical antisignification: Unlike IBM mainframes, which used expensive, proprietary communication devices and a proprietary IBM character set, personal computers would employ simple, "plain Vanilla" communication facilities and the ASCII character set. These features made it both easy and simple to employ PCs for data communication purposes, such as bulletin boards, PC-oriented online services, and user-to-user data exchange, but they also made it very difficult to link PCs and IBM mainframes. Here, antisignification is thus cleverly coupled with counterregularization. The political aim was to preserve the autonomy and democracy of personal computing (in the face of the centralization strategy of data-processing professionals, who try to dictate which applications people will use and how they will store and retrieve their data). Data-processing professionals clearly and immediately perceived the intent of these features, and for years their trade magazines were filled with articles bemoaning the "chaos" that personal comput-

ing was about to introduce into the corporate environment. The PC's Achilles' heel in this regard, however, is its open architecture, which makes it quite easy to equip the computer with high-speed networking accessories. These accessories enable the machine to be used even in formerly incompatible mainframe networks. Once technically modified and contextually controlled within the corporation or large organization, data-processing managers can once again dictate software and data format choices to personal computer users. In many companies, personal computing has become impersonal computing once again.

The history of online bibliographic data bases also illustrates the nature of reintegration (Pfaffenberger 1990b). The documentation specialists who developed automatic information-retrieval systems found that they could develop their machines only with the cooperation of librarians, who controlled funding and information-related institutions. Librarians feared that computerized information-retrieval technology, with its potential for automatic subject indexing, would deskill librarians by rendering their subject classification expertise irrelevant. The negotiated outcome was a "hybrid" system that employed automatic indexing as well as manually developed subject classifications. The result was an information-retrieval system that requires at least some subject classification expertise to use fruitfully. That is one reason computer literature searching is still done mostly by search intermediaries, who are mainly reference librarians with subject classification expertise.

Designification

In presenting an "ideal-typical" model of a three-stage drama, I have oversimplified the many possible permutations of a technological drama: reconstitution, for instance, can lead to a new round of regularization, replete with redressive replies; in South Asia, for instance, the emphasis on appropriate technology has often led to the formation of technological bureaucracies of formidable power and destructive impact, and redressive responses are well under way. But the drama can drop out of the technology: The connection between technological activities and social meanings seems susceptible to erosion. As unanticipated consequences, environmental degradation, competing technological systems, and social change erode the connection between activity and meaning, designification may occur. Corn notes that by 1950 aviation artifacts had all but lost their symbolism of world peace and social progress: "When adults looked at a boy with a model

airplane . . . they no longer thought automatically of a better tomorrow. All they saw was a kid with a toy" (1983, 133).

For all the loss of meaning that occurs in designification, however, the artifacts, their contexts, and our social behaviors remain; they become taken for granted, routine, and part of the natural attitude of everyday life. This phenomenon has worrisome implications. Paradoxically, it is in the stage of designification that technological artifacts and systems have reached their greatest social penetration. All around us today are artifacts that were generated in the technological dramas of their time: railways, canals, aviation artifacts, radios, and more. And yet their meaning, together with their location in what was formerly a deeply felt grammar of political action, is utterly lost; in their place is what appears to be nothing more than a material record of "technological progress." What was once the conscious product of human cultural and political action, passionate and meaningful, is now a silent material reality within which we lead our daily lives, mutely acting out patterns of behavior that once had obvious connections to the root paradigms of our culture. The refrigerator hums, but we do not know why (MacKenzie and Wacjman 1985). To become fully aware of the political circumstances of their lives, new generations of students, at every level of education, must be trained (as Hughes suggests) to "fathom the depth of the technological society, to identify currents running more deeply than those conventionally associated with politics and economics" (1989, 4).[10] Because STS offers a way to recontextualize technological artifacts, it is therefore the political philosophy of our time, and it deserves to stand at the center of any curriculum that teaches political awareness and civic responsibility.

Notes

1. I draw the concept of regularization from the work of the legal anthropologist Moore (1975). Regularization, as Moore defines it in the context of legal anthropology, is a form of social discipline: It is an attempt to "fix social reality, to harden it, to give it form and order and predictability" (1975, 234), generally by attempting to coerce people into following fixed rules, regulations, and status models within the fluid world of social relations.

2. From all that has been said, it must be concluded that all forms of scholarly analyses of technology, to the extent that they represent interpretations of technological activity, are acts in a technological drama. To portray technological activity as a drama of cultural production, as I do in this article, is to undercut the facticity of the political intentions embodied in both technological regularization and its redressive responses; as will be seen, such a move is in fact practiced by actors in the system who do more than just write scholarly books and journal articles. A reflexive analysis of this article would probably include a process called *dramatization* under one or more headings of this article.

3. For in-depth case studies informed by the model, see Pfaffenberger (1988a, on the personal computer) and Pfaffenberger (forthcoming, on the nonindustrialization of Sri Lanka). More case studies are needed to explore this model's implications fully, and this article should be understood as a preliminary statement of it. Nevertheless, I believe it is sufficiently interesting to bring it before the STS community for discussion and debate.

4. There are enough neologisms in this essay already, so I will not refer to such a polity as a technopolitical formation.

5. Technology is thus doubly duplicitous for the STS analyst: Not only does it deny that contextual analysis applies, it also covertly fabricates social contexts of enormous complexity and sophistication.

6. I find it remarkable that this characteristic of technological innovation has not received more attention. But scholars of technology think verbally, which may explain why we scholars have emphasized the construction of legal and legislative artifacts to support the emerging system. Technologists, however, think visually and spatially. It is far from surprising that their social artifacts would have pronounced spatial qualities.

7. I thank Mikael Hård for suggesting several of the terms that follow.

8. A very sad implication of this point is that the "artifacts" collected in museums are mostly worthless for analysis since three-fourths of the real artifact was not collected.

9. I emphasize this point because Turner, an anthropologist, sometimes takes a draft from the anthropologists' drug of choice, cultural determinism. For its time, Turner's work is remarkably processual and constructivist, but on occasion in *Dramas, Fields, and Metaphors* (1974), he talks about the "paradigmatic patterning" of social behavior, a concept that I would argue is not very useful for technology studies. Like hegemonic ideology, the root paradigms that emerge in technological dramas are those that have been recursively and reciprocally shaped in interaction with technological activities.

10. One might call this strategy *redramatization*, suggesting that designification perhaps is not the last phase in a technological drama. Once designified in the fluid field of social relations, professional interpreters – museum curators, authors of scholarly journal articles, historians of technology, and the like – take over the cultural job of deciding what it all should mean, and for whom.

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