Techné: Research in Philosophy and Technology ISSN: 2691-5928
24:1 & 2 (2020): 27–40 DOI: 10.5840/techne2020210116

Critical Constructivism, Postphenomenology, and the Politics of Technology

Andrew Feenberg

Abstract: Critical constructivism adds a dimension of collective action to postphenomenology. This paper explains the intervention of collective subjects into technological design. That intervention presupposes communication between lay and expert actors which is made possible by the dependence of technical disciplines on the lifeworld. Understanding the public processes of intervention requires a notion of multiple types of rationality and a social account of technological design.

Key words: critical constructivism, postphenomenology, philosophy of technology

1. Collective Subjectivity

In past comments on Don Ihde's thought I have noted similarities between his postphenomenology and my own critical constructivism (Feenberg 2015). In this paper I would like to work out in more detail the differences and the complementarity between these two approaches.

Like critical constructivism, postphenomenology is a method rather than a doctrine. Both approaches share some basic principles. These include the mutual constitution of technical subjects and objects, the co-construction of society and technology, the mediation of experience by technology, the essential relation of technologies to context and perception and the corresponding rejection of technological determinism. If there is a significant difference it is in the emphasis critical constructivism places on the role of politics in the process of co-construction. The introduction of a political perspective leads to a broader view of social structure and power relations contextualizing the technologies studied. The "critical" aspect of this ver-

Andrew Feenberg, School of Communication, Simon Fraser University, Burnaby, British Columbia V5A 1S6; feenberg@sfu.ca.

sion of constructivism has to do with the unrealized potentials of technologies that could be realized in designs better suited to the needs of users and the general public.

This is the terrain on which some postphenomenologists have ventured with studies of politically inflected design (Rosenberger 2017). But they mostly conceive the design process as an individual endeavor with social consequences. Peter-Paul Verbeek's mediation theory also emphasizes the co-construction of technical subjects and objects (Verbeek 2015). In the background of these empirical phenomena lie cultural assumptions which can be articulated, discussed and criticized. Critical constructivism studies the shaping of those goals and assumptions in the public sphere through political processes.

Postphenomenology modifies Husserl's method by conceiving the subject as embodied and active, and human-world relations as technically mediated. For the most part postphenomenologists follow Husserl in conceiving the subject as an individual. Don Ihde distinguishes four relations between the individual human being, technologies, and worlds. These are embodiment relations, hermeneutic relations, alterity relations and background relations. Each type is characterized by a formula. For example, the hermeneutic relation, in which the subject interprets worldly phenomena through the mediation of a technical device such as a telescope, is schematically represented as

Human→(technology-world).

Some additional models of the human-technology-world relation have been proposed, but all these models are variants on phenomenological intentionality. They all therefore exemplify individual relations to the phenomena.

Since the individual and individual experience have a foundational role in much philosophy and especially in recent social studies of science, this focus has not been seen as a limitation by postphenomenologists, but it is problematic from a social or political point of view. Politics and many other social phenomena concern groups enacting their interests and ideology. Social and political life implicates these collective subjects which have a shared experience of the world. To refuse to acknowledge this emergent phenomenon as do Actor Network Theorists, for example, to reduce all macro categories such as class and social group to individual constituents, is a bit like referring to cups and saucers as atoms and molecules while pouring the tea. Such methodological individualism is reductionist.

Postphenomenology need not take up this reductionist stance. There is no obstacle to substituting a social for an individual point of view in each case on my list of shared principles. In fact the principles are even more convincingly applied to

collective than to individual subjects. The mutual constitution of technical subjects and objects is evident in the shaping of social units by the technical mediations that join their members in a collectivity. There is no seminar without the seminar table, no nation without roads. The mediation of collective experience by the mass media, hence by the technologies of broadcasting, is a familiar subject of study and critique. The dependence of technologies for their meaning and purpose on context and perception implicates the prevailing culture and therefore also the society as a collective subject of culture. And the construction of social worlds depends quite literally on technology.

The constitution of a social subject takes many forms. Here are four common examples. *Political* subjects emerge from organizing and educational work. They engage in protests and often succeed in influencing political leaders. The movement of gays in the 1980s for access to experimental drugs is a well documented case of this type. Gay activists intervened successfully to modify experimental protocols (Epstein 1996). *Representative* subjects are small groups that are granted status or achieve recognition as standing in for a larger public. Citizen juries, for example, have received a great deal of support in Europe (Revel et al. 2007). *Viral* subjects emerge from the success of a meme in mobilizing public opinion around a perceived abuse or potential. They have little structure but share a common attitude relayed through the media. This describes many boycotts. The great tuna boycott that led to the redesign of nets and the creation of the Dolphin Safe label exemplifies this type of intervention. *Adopters* form another relatively uncoordinated mass subject that takes up the product of hacking or other innovations introduced by non-standard actors. The success of human communication on computer networks is due to widespread adoption of such illegal or marginal innovations. All four examples show the public intervening in the design process on the basis of an interpretation of technological failure, danger or unrealized potential.

Critical constructivism has focused on *the collective process of transforming* technology in which these subjects are engaged. That process which I call "democratic intervention" brings collective perceptions to bear on design. The collective subjects enter into a variant of the hermeneutic relation. But instead of the world interpreted through technology, it is technology that is interpreted within a world. That interpretation is critical in the case of democratic interventions and leads to design changes in response. Were it to be schematized as a human-technology-world relation it would look like this:

Humans→(world-technology).

I will call this the *feedback relation* because it involves feedback to technologists from users and victims of an initial design released into the world with dire or unexploited consequences.

2. Democratic Interventions

Since the 1970s, democratic interventions have played a role in imposing new goals on technological design, determining technological trajectories in fields such as energy production and environmental protection. This is the most persuasive reason to doubt the dystopian conclusions of technophobes inspired by Heidegger, Ellul and Adorno. Far from evolving autonomously under its own power, technology has changed in response to public demands. We are living in a version of advanced capitalism quite different from the one foreseen in the 1950s when a political science textbook could rank the development of societies in terms of energy expenditure per capita. Today we seek progress in energy efficiency rather than the reverse. Democratic interventions have stifled the nuclear industry which once promised "unmetered power," and instead have privileged renewal energy. That the outcome of environmental politics makes sense technically is remarkable. It implies not only that determinism is incorrect but also that the public possesses valid understandings that enable it to intervene in rational ways that do not break the system.

From a critical constructivist standpoint it is clear that technology is extremely flexible. Contrary to Heideggerian assumptions, it can accommodate values other than domination. And contrary to the Frankfurt School, the reified form of scientific-technical rationality is not an absolute obstacle to change. Technology and technical disciplines change under public pressure by translating public demands, not by a more radical transformation of the very concept of rationality. The changes are only visible in their social import from a broad perspective on their origin and purpose, not from within the disciplines. Thus the engineering innovations that save lives by reducing exhaust pollution look like just another wrinkle in the technical design until one considers their source in public protests and their implications for human life. Respect for the human lungs and heart is implicit in the new design but it can be made explicit by social analysis.

The political issues are not the ones identified by Heidegger and the Frankfurt School but the historical heritage of industrialism and the asymmetry of fact and value in the public sphere. At the time the industrial system was introduced the voices of its victims were effectively silenced. The privileged technological trajectories yielded healthy profits even though they had disastrous consequences

for the environment and human health. Today we are undoing this heritage and reconstructing industrialism in response to the now articulate protests of those once silenced voices.

As those voices are raised the established facts of industrial life are challenged by protests articulated discursively in the course of democratic interventions. But the flawed achievements of the past are solid realities while the demands of protesters appear as mere talk. An apparent conflict between values and facts haunts every public protest. Conservatives reject "ideological" interferences in technical processes best managed undisturbed by experts. The protesters' values are disqualified by the mere fact that they are not facts. This technocratic argument mirrors the usual bias in favor of official institutions such as government agencies or courts. In the absence of strong opposing evidence their pronouncements are usually believed. The technocrats enjoy a similar favorable bias although in their case, by contrast with bureaucratic or legal resistance to change, it is backed not by mere policy and law but by technological realities that claim a scientific basis.

Thus the question of the legitimacy of democratic intervention is often raised. A popular technocratic ideology excludes it in principle. The public, it is said, lacks the relevant expertise and so can only muddy the waters with its complaints and protests. Undoubtedly the public makes mistakes but so do scientists, engineers, physicians and other experts. High levels of specialized training enable one to act in technical domains, but do not guarantee success in achieving public purposes. Ordinary people acting on the basis of their own relatively untutored experience have sometimes identified problems or potentials overlooked by experts. Expertise and experience are therefore complementary rather than opposed.

3. Constructivist Premises

Constructivist science and technology studies has resources for understanding scientific-technical controversies. I will briefly sketch a philosophy of technology that does justice to protest, based loosely on constructivist premises.

The social constructivist concept of symmetry is relevant. Recall that constructivism holds that winners and losers in scientific controversies should be treated "symmetrically," that is, unprejudiced by the outcome. In sum, the winners are not to be evaluated asymmetrically as more rational simply because their side of the argument was victorious. Democratic interventions involve a related problem of symmetry. The arguments of the official actors, for example, a polluting corporation, may be privileged in law and rest on science-based technology, but for the purpose of the analysis, they must not be treated as intrinsically

superior to the arguments of those protesting pollution. The protesters' demands may someday be realized in the legal and technological "facts" and so have their own anticipatory claim to legitimacy. As I have argued elsewhere, values are the facts of the future, not mere talk that can be dismissed as irrelevant to technical concerns (Feenberg 2017, 9).

The concept of underdetermination is central to the argument for symmetrical treatment. This concept originated in philosophy of science where it signified the possibility that the available evidence could support more than one theoretical explanation. Thus theory could be said to be "underdetermined" by evidence. In its application to technology the concept of underdetermination refers to the multiplicity of possible designs of a similar device, each technically rational but with different social consequences. Underdetermination is illustrated by the famous example of the two main types of bicycles at the end of the nineteenth century. One type privileged speed and the other, stability. Both alternatives were "bicycles" and both made perfect technical sense to different users pursuing different goals. The consequences for design are visible in the differing sizes of the wheels in the two cases. No "rational" technical or economic argument determined a "right" size. Hence the application of the concept of underdetermination in this case (Bijker 1995). Critical constructivism adopts this general approach from social constructivism while enlarging the framework to include cultural and political mediations.

Actor-Network Theory offers resources for a more general approach to symmetry and underdetermination. Latour and Callon propose a second principle of symmetry between human and non-human "actors" involved in technical networks. Here I will appropriate their network concept in my own idiosyncratic way. According to this theory, networks consist in materials and human beings connected causally and symbolically. The materials are decontextualized and simplified to form a system that serves a program which, under the second principle of symmetry, need not be formulated by a human being but could also emerge from the agency of non-human actors (Latour 1992). This is admittedly a very abstract way of talking about something familiar, but it serves a purpose in understanding the limitations of the dominant instrumentalist view of technology.

Think of building a house as a "program" served by a "system" of boards which themselves emerge from the activity of logging in which trees are "decontextualized," that is, ripped from their place in nature, and "simplified" by being stripped of bark and branches. The network implicated in the building of the house includes the boards and the trees from which they are made, but it extends beyond these intended targets to the forest which is significantly altered by the builder's

program. Suppose that logging provokes problems with ground water flow, interfering with a nearby farm. That farm too is then recruited unwittingly to the network. As the example shows, networks are not bounded by the animating programs that call them into being. They invariably include elements and have effects unrelated to the system constituted by the program. Programs are thus selective appropriations of relevant aspects of the larger networks of people and things they attempt to organize around a goal. But other programs and systems can emerge within the network.

The elements of the network that do not fit into the dominant program may provide a basis for interventions by actors with other goals formulated in alternative programs. The farmers whose land is damaged may introduce an ecologically inspired "anti-program" opposed to that of the builders (Latour 1992, 251). This anti-program might consist in a lawsuit aimed at protecting the forest. Is there any particular reason to privilege one of these programs over the other? It is customary to privilege the builders' because they possess a legal claim to harvest the wood and manage technologies of forestry and construction. The farmers' complaint may appear dubious by contrast, a sentimental attachment to nature or NIMBY-ism. There are strong reasons to favor the owners' interpretation of the situation, but critical constructivism insists on a symmetrical evaluation of the various programs. I call this the third symmetry of program and anti-program (Feenberg 2017, chap. 2).

4. Lay and Expert

The feedback relation involves communication between lay actors and technical experts who alone can transform designs in accordance with public demands. In many cases that communication is further mediated by expert advocates who inform public opinion and political actors with the power to regulate industry. The introduction of the collective subject and the symmetrical treatment of its claims thus opens a wide range of phenomena to research.

Although technocratic ideology is incorrect, it does bring an important consideration to the surface, namely, the essential role of rationality in the construction of modern technology. Modern technology in every domain is based on technical disciplines that draw on or are modeled on natural science. They often employ mathematical tools and measurements. They are rational in the everyday sense of the term, that is, they are based significantly if not wholly on precise evidence, formal reasoning, and in some cases scientific theory. The important role played by such disciplines distinguishes modern technology from premodern craft.

Although craft too requires specialized skills, it is not based on disciplines couched in a technical language inaccessible to the general population. In fact the guilds maintained secrecy around their methods to avoid appropriation by unauthorized individuals. Furthermore, the designs implemented by craft workers were more closely bound up with the stable aesthetic and ethical norms of premodern societies than are modern designs. Our technology depends on technical disciplines that exclude explicit normative claims. Ethical and aesthetic values do not appear as such in these disciplines. The result is greater freedom with respect to the culture, greater flexibility and a more rapid pace of change. However, norms are incorporated into the disciplines implicitly through underdetermined choices between alternatives with different normative implications. Democratic interventions play on these underdetermined choices, often in conflict with business and government.

The interaction of program and anti-program takes place in a unique discursive field that reflects the different status of the parties to the controversy. For example, the technical status quo is often defended by reference to technical requirements or efficiency in opposition to ethical arguments for change. In other cases official institutions base their decisions on quantitative measures such as cost/benefit analysis in opposition to claims of citizens or professionals who rely on qualitative evaluations based on experience. Bridging the gap between these different discourses is challenging and yet we know it happens regularly from the success of many democratic interventions.

The communication process joining the lay public to technical experts is peculiarly complex because the latter must translate demands posed in vernacular terms into technically viable specifications. The structure of technical reasoning is fundamentally different from the everyday discourse in which protests and demands are formulated. The engineer adheres strictly to a cause-effect logic. Every affirmation is a proposition and every proposition can be reduced to an "if-then" statement of some sort. This form of reasoning depends on stripping away most of the complexity of ordinary language in which many different speech acts co-exist, ambiguity is normal, and normative and factual statements are often combined. None of these features of ordinary language are compatible with technical work as it is practiced in modern societies, but translation is possible because technical disciplines are based on refinements of the categories of ordinary language.

Consider, for example, the significance of a term such as "consistency" in the two types of discourse. From a scientific-technical standpoint, the term has no ethical or normative implications but refers to an objective property of objects

incorporated into systems; for example, electric plugs designed for American sockets must be consistent with the requirement that they have two flat pins of a specific size at a specific distance. But "consistency" in everyday discourse is also used to refer to fairness: equal pay for equal work is a demand for consistency in the treatment of people of different genders or races. This normative use of the concept is excluded from scientific-technical discourse.

The interference between the two uses of the term played a role in the demand of the citizens of Flint, Michigan for clean water. No white community in Michigan suffered the conditions under which this black community suffered. The inequity is slowly rectified under intense political pressure with means that have always been well within the technical resources of the authorities, but which were not deployed for reasons that surely had something to do with race. Public demands for equal treatment were easily communicated because the language of protest was intelligible and justified by both simple observation and scientific tests.

Citizen demands for equal treatment were couched in terms of a norm, consistency, which was not only social but simultaneously technical. The ethical meaning of consistency had to do with racial equality. The operational meaning of consistency was the equivalence of a measure of purity with a number written into federal environmental regulations. Ultimately, justice came down to the addition of certain chemicals to the water to protect lead pipes from corrosion. One could say that that is the operational meaning of justice in this case.

Democratic interventions will not always produce such desirable results. Technocrats, politicians and the general public are all fallible. The anti-vaccination movement is evidence of the danger of ill informed democratic interventions. However, emphasizing examples such as this while ignoring the many problems associated with the dominant system of technical control is ideological. Mutual correction is essential to correct the biases of both technical disciplines and public opinion (Wynne 2011).

The efficacy of such corrective action is an empirical question. It is dogmatic to assume that the public is unqualified to make a contribution. This may satisfy some academics and is certainly welcomed by business, but it is historically inaccurate. Movements such as the environmental movement were propelled by public opinion and social protest against strong opposition from business and politicians. Similarly, human communication on computer networks was introduced by outsiders and hackers rather than by IBM. Recent trends are admittedly unfavorable with the proliferation of "fake news" on social networks. But a counter-attack is taking shape at this time. For this reason it is too soon to condemn democratic

interventions into technical issues, especially since the rising struggle of young people against climate change promises to accelerate the adoption of science based solutions.

5. Multiple Rationalities

Although phenomenology has never been applied to such phenomena, its theory of the relation of the lifeworld to science is relevant. Husserl writes in the *Krisis*, "As life-world the world has, even prior to science, the 'same' structures that the objective sciences presuppose in their substruction of a world which exists 'in itself' and is determined through 'truths in themselves'….[These] categorial features of the life-world have the same names but are not concerned, so to speak, with the theoretical idealizations and hypothetical substructions of the geometrician and the physicist" (1970, 139–40).

The fact that the objects and categories of the life-world reappear refined and idealized in science insures the possibility of communication between lay and expert. Husserl argued that the scientific idealizations required grounding in the life-world categories from which they were derived. This is equally true of technical concepts. Democratic interventions reverse the direction as the life-world attempts to redefine the scientific-technical objects and categories to encompass aspects of experience left behind in the construction of the scientific abstractions. This is the sense in which democratic interventions are rational without being formalized in a discipline.

Herbert Marcuse introduced a political version of the phenomenological relation of the life-world to science. It is not entirely successful but it offers further hints for a theory of democratic interventions. He argued that the dependence of science on the life-world limits it to reproducing the dominant social relations in a capitalist society (1964, 164–65). The quasi-dystopian conclusion of *One-Dimensional Man* rests on this theory, but there is a flaw in the argument.

True, capitalism shapes everyday thought and action. It privileges a particular form of instrumental action in which objects are reduced to a fungible stuff, mere raw materials. Marcuse argued for an alternative science and technology that would respect the intrinsic potentialities and limitations of the object, and he welcomed the early environmental movement as an anticipation of this goal. But he was unable to explain clearly in what his alternative instrumentality would consist. His mistake was trying to separate the capitalist and socialist forms of instrumentality. In fact, there are not two strictly separated forms, the one assigned to capitalism and the other to socialism. Gardening, for example, realizes the potentialities of

the seeds, but it does so using products of conventional industry. Surgery reduces the human body to a fungible stuff, but that is not a reason for complaint. Where democratic interventions demand respect for the potentialities and especially the limitations of the object, they proceed through redirecting technology along lines compatible with the existing science.

But if Marcuse's call for a new science is no longer appealing, his new concept of reason describes the rational basis of democratic interventions. Public reason does not rely exclusively on scientific concepts and data, although these are certainly relevant on occasion. In addition, the public also references the "existential truths" revealed in what Marcuse called "unpurged, unmutilated experience" (1972, 2017). This everyday experience makes no sharp distinction between facts and values. Objects are perceived as having a certain substantiality, as possessing intrinsic potentialities and limitations. These can motivate changes in technology experts can implement. The informal rationality of the vernacular discourse of protest and demand thus conforms to Marcuse's concept of a new form of reason insofar as it incorporates these normative features of experienced reality. His demand for a new science is replaced in critical constructivism by the idea of translation between public and scientific-technical rationality.

In public debate norms are brought to bear on issues of all kinds, including technical issues, but technical issues have a special character because of the role of expertise in translating demands formulated in ordinary language. The translation is possible because, as Husserl might have argued, the normative claims put forward in public argument over technology and the principles of technical construction are both rational in their own way and mutually related. As we have seen, basic technical categories such as "consistency" are refined versions of vernacular categories familiar to everyone and it is this which bridges the gap between expert and lay discourses. The double aspects of rationality transcend the gap between "ought" and "is." The analysis of cases must follow not just the actors, as Latour suggests, but also the actors' *reasons*.

6. Instrumentalization Theory

The double aspects of rationality are reflected in the nature of technology. I have presented this argument in more detail than I can do here in *Technosystem: The Social Life of Reason*. I call my approach the instrumentalization theory (Feenberg 2017, chaps. 6–7). According to this theory technical devices and systems have correlated causal and symbolic-hermeneutic or cultural dimensions. Both the dimensions are necessary: the object must "work" at the causal level and it must

be integrated to society through appropriate and understandable meanings. Every technical object can therefore be analyzed at both levels. The causal associations between components that yield a working device must correlate with the systematizations determined by the program that presides over the technical work. How a technology works and what it means must be congruent. Causal and cultural dimensions must be coordinated, simultaneously in the best of cases, or through social processes or political protest in cases like the Flint water crisis.

Here are some other examples, offered to drive home the difficult distinction between causal and cultural dimensions of technology.

A complete analysis of automotive technology would not stop at an engineering description but would show how various design features correspond to the social status of likely users, their aesthetic preferences, and environmental and safety considerations. The associated components form an imbricated system that responds to the programs of a variety of actors, for example, business people seeking to display their success and environmentalists determined to reduce emissions. These aspects of the automobile can be read off its design by ordinary people although the implementation involves complex engineering decisions.

In this hypothetical analysis of the automobile the division between the two dimensions—hermeneutic and technical—is analytic as it is in the home building example introduced earlier. Even the logging work that supplies the raw materials has its cultural aspect. The trees of the forest are reduced to usable lumber through a drastic simplification, but the work cannot be understood in exclusively causal terms because it is subject to mediation by legal and aesthetic considerations integrating the product to society. Only certain trees can be legally harvested and the size of the boards into which they are cut is prescribed by a building code and an aesthetic. One finds the trace of both dimensions—association of components and systematization under a program—in every board, but the dimensions can be formulated separately in a technical discipline and legal and architectural discourses.

In premodern craft the distinction between these causal and symbolic dimensions is often blurred. The right way to make a technical object often includes aesthetic features that belong to the cultural dimension but are considered by the craftsman just as essential as causal properties. The differentiation of technical disciplines in modernity results in a sharp distinction between engineering and aesthetics, the one considered technically necessary while the other is viewed as mere ornamentation. It is this which seems to justify the technocratic rejection of democratic intervention. Yet the cultural meanings and values these interventions uphold may be realized eventually in changes in technical disciplines and new

designs. Then considerations which are initially socially differentiated and which possess different ontological status trade places. Today we look down on the enthusiasm with which *Fortune Magazine* once celebrated the capacity of American rivers to carry away the waste products of industry as the consequence of an irresponsible ideology, but in the 1950s it reflected standard technical procedures now replaced after a generation of environment protest by more or less effective waste treatment technologies. Once again we encounter the symmetry of program and anti-program.

7. Conclusion: The Gestalt Switch

The instrumentalization theory responds to the same double aspects of technology that inspire the Dual Natures project but it also opens up an approach to culture and democratic interventions (Kroes and Meijers 2002). Categories deployed in protest can be analyzed as the vernacular form of a future scientific-technical realization. In this way the possibility and the success of democratic interventions becomes understandable.

Critical constructivism argues that modernity is characterized by a dominant form of rationality. This rationality is not universal but is context-bound like other aspects of culture. The context carries cultural meanings and values into the design process at every stage, for example, in the initial definition of the problem and in the designation of the legitimate means available for solving it. It is not necessary to invoke extrinsic values to get at the normative aspect of technology because it is implied in the nature of the programs that preside over technical creation from the very beginning.

This approach to the politics of technology is compatible with postphenomenology. In *Technology and Lifeworld*, Don Ihde discusses environmental problems but he resists solutions that depend on a renewal of spiritual values or a Heideggerian god. He argues instead that "a gestalt switch in sensibilities will have to occur from *within* technological cultures" (1990, 200). By this he means that the mythos of scientific-technical domination of nature must give way to an engagement with nature that respects what I have called earlier its potentialities and limitations. Ihde outlines some promising tendencies such as the growing awareness of the environment, but he stops short at the level of ideological change. Critical constructivism proposes a way of understanding the gestalt switch as it manifests itself in the public contestation of the industrial heritage. The politics of technology both reinforces ideological change and influences technical design. Tracing these effects should belong on the agenda of postphenomenology.

References

Bijker, Wiebe. 1995. *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. Cambridge, MA: MIT Press.

Epstein, Steven. 1996. *Impure Science*. Berkeley: University of California Press.

Feenberg, Andrew. 2015. "Making the Gestalt Switch." In *Postphenomenological Investigations: Essays on Human-Technology Relations*, ed. Robert Rosenberger, and Peter-Paul Verbeek, 229–37. Lanham, MD: Lexington Books.

Feenberg, Andrew. 2017. *Technosystem: The Social Life of Reason*. Cambridge, MA: Harvard University Press. https://doi.org/10.4159/9780674982109

Husserl, Edmund. 1970. *The Crisis of European Sciences and Transcendental Phenomenology: An Introduction to Phenomenological Philosophy*, trans. David Carr. Evanston, IL: Northwestern University.

Ihde, Don. 1990. *Technology and the Lifeworld: From Garden to Earth*. Indianapolis: Indiana University Press.

Kroes, Peter, A., and Anthonie W. M. Meijers. 2002. "The Dual Nature of Technical Artifacts: A Presentation of a New Research Programme." *Techné: Research in Philosophy and Technology* 6(2): 110–16. https://doi.org/10.5840/techne2002626

Latour, Bruno. 1992. "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts." In *Shaping Technology/Building Society: Studies in Sociotechnical Change*, ed. Wiebe Bijker, and John Law, 225–58. Cambridge, MA: MIT Press.

Marcuse, Herbert. 1964. *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society*. Boston: Beacon Press.

Marcuse, Herbert. 1972. "Nature and Revolution." in *Counterrevolution and Revolt*, 59–78. Boston: Beacon Press.

Marcuse, Herbert. 2017. "The Rationality of Philosophy." In *Transvaluation of Values and Radical Social Change: Five Lectures 1966–1976*, ed. Peter-Erwin Jansen, Sarah Surak, and Charles Reitz, 1–16. Philadelphia: International Herbert Marcuse Society.

Revel, Martine, Cécile Blatrix, Loïc Blondiaux, Jean-Michel Fourniau, Bertrand Hériard Dubreuil, and Rémi Lefebvre, eds. 2007. *Le Débat Public: Une Expérience Française de Démocratie Participative*. Paris: La Découverte.

Rosenberger, Robert. 2017. *Callous Objects: Designs Against the Homeless*. Minneapolis: University of Minnesota Press. https://doi.org/10.5749/9781452958538

Verbeek, Peter-Paul. 2015. "Beyond Interaction: A Short Introduction to Mediation Theory." *Interactions* 22(3): 26–31. https://doi.org/10.1145/2751314

Wynne, Brian. 2011. *Rationality and Ritual: Participation and Exclusion in Nuclear Decision-Making*. London: Earthscan.