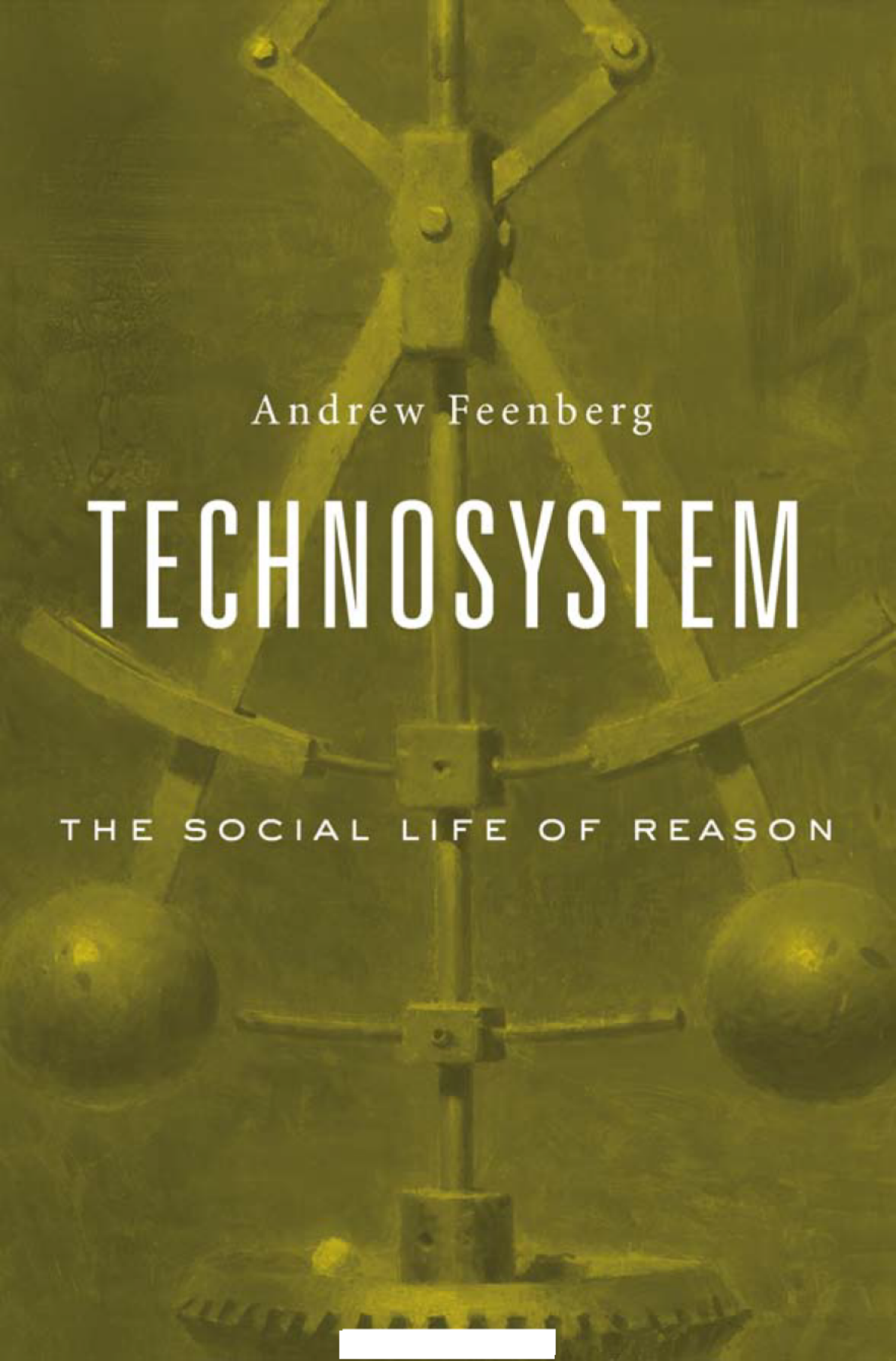
Andrew Feenberg
TECHNOSYSTEM
THE SOCIAL LIFE OF REASON

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The Social Life of Reason

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Harvard University Press
Cambridge, Massachusetts & London, England
2017

Printed in the United States of America

First printing

Library of Congress Cataloging-in-Publication Data

Names: Feenberg, Andrew, author.
Title: Technosystem : the social life of reason / Andrew Feenberg.
Description: Cambridge, Massachusetts : Harvard University Press, 2017. |
Includes bibliographical references and index.
Identifiers: LCCN 2017015489 | ISBN 9780674971783 (hc)
Subjects: LCSH: Technocracy. | Technology—Social aspects. | Reason—Social
aspects. | Constructivism (Philosophy) | Frankfurt school of
sociology—Influence.
Classification: LCC HB87 .F44 2017 | DDC 303.48/3—dc23
LC record available at https://lccn.loc.gov/2017015489

Jacket image: Painting by Walter Murch (1907–1967). Governor, II (detail), 1952. Opaque watercolor and oil on paper, 40 3/8 x 17 3/4 in. (102.6 x 45.1 cm) Whitney Museum of American Art, New York; purchase, with funds from the Wildenstein Benefit Purchase Fund 53.11 © Estate of Walter Tandy Murch. Digital image © Whitney Museum, N.Y.
Jacket design: Jill Breitbarth

For Anne-Marie

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Preface

According to Aristotle, philosophy begins in wonder; indeed, familiarity is the enemy of reflection. Breaking through the obvious is a necessary preliminary to the kind of thinking in which philosophy engages. This book attempts to defamiliarize one commonplace phenomenon: the social function of rationality.

Modernity claims to be a rational form of social life, and it is in fact based on rationally designed technical artifacts and institutions informed by rational technical disciplines. This is unprecedented. Throughout human history rationality has been confined to specific tasks rather than organizing society as a whole. Once noticed, the strangeness of our modern way of life inspires reflection. What is the nature and role of rationality in society today? This book draws on philosophy and sociology of technology to propose a response.

Before continuing, I feel I should anticipate a preliminary objection. "Reason" and "technology" appear in the titles of several of my books, including this one. Do I fetishize these symbols of modernity? Far from it. The point of focusing on these hegemonic themes is to develop what Adorno describes as a "rational critique of reason." This is easier said than done, as it requires reason to turn on itself in its social context. Hegel, Marx, and Nietzsche first set philosophy on this self-reflective path. This book takes further steps along that path in the wake of the Frankfurt School.

This is a timely project. The liberal academic consensus which coexisted more or less peacefully with neoliberal economics and politics

from the 1990s to the crisis of 2008 has now been shattered. No one can be complacent any longer about the threats to progress in domains such as gender and race relations and environmentalism. These threats have taken power in the United States. Victories we thought were irreversible are now in question once again. Struggles will have to be waged on the grounds of rationality, as differently interpreted by reactionary and progressive political forces. Rarely in our lifetime has "the social life of reason" been more fraught.

The chapters that follow develop a theory of sociotechnical rationality and analyze various examples, including the Internet, which is discussed here at length. In my own work, I have focused primarily on technologies and technical systems, but markets and administrations continually show up in the analysis. This version of my approach is generalized to cover all three institutions. For the sake of brevity, I will employ the term "technosystem" to refer to the field of technically rational disciplines and operations associated with markets, administrations, and technologies.

Neither markets nor administrations are conceivable outside a technical framework of some sort. Similarly, no technology is an island; all technology is mediated by markets and administrations. What is more, economic and administrative activity are themselves structured by technical disciplines, various "sciences" of accounting, management, and administration. This is a problematic fruitfully explored by Foucault with his studies of the politics of psychiatry and criminology. The dependence of the systems on technical disciplines and their mutual mediation are essential features of modern societies.

The concrete rationality of all these systems is closely allied. Whether economic, administrative, or technological, it is sociotechnical in essence. This is precisely what Lukács refers to as the reified rationality of capitalism. He argues that the proletariat could "dereify" the system through revolutionary action, although he never explains clearly in what that dereified system would consist. His concept of dereification has been discredited by the failure of proletarian revolution. I attempt here to renew that theory in a different historical context.

This approach makes possible what might be called a "demythologization" of the contribution of the first generation of the Frankfurt School that clearly distinguishes it from Heideggerian antimodernism. The philosophical analysis of modernity is supplemented by a focus on the role of the technosystem in shaping modernity and the social influences on its

design. There is no longer a privileged domain such as Marx's factory in which to study the struggle against domination. Social struggles around issues such as childbirth procedures or toxic wastes also resist the bias of prevailing designs and attempt to impose new social demands. On this basis Critical Theory can enter the debates around a wide variety of technical issues.

The introduction which follows is based on lectures in which I discussed the ethical and political dimensions of modern technology for audiences with no background in either Critical Theory or constructivism. It started out as a talk at the 2009 international conference of the *Rede de Tecnologia Social* in Brasília and has undergone many changes since then. Portions of it were later incorporated into the preface of *Questioning Technology*. Readers familiar with that book may notice some overlap, but there are new elements here. This chapter introduces concepts of technical action and democracy that are developed further in later chapters.

Chapter 1 argues that Foucault's critique of technical disciplines such as criminology and psychiatry has a deep relation to Marx's critique of capitalist economics and technology, though obscured by his polemic against Marxism. His work changes our understanding of Marx.

Chapter 2 is based on a paper delivered at the 2013 Colloque de Cérisy, "Simondon et l'Invention du Futur." It explores Gilbert Simondon's important work on technology, especially his concept of "concretization," which has political applications in critical constructivism.

Chapter 3 focuses on the contribution of science and technology studies (STS) to critical constructivism. This chapter is something of a manifesto for a more politically informed approach within STS. It concludes with methodological suggestions that are applied in the next chapter.

Chapter 4 then provides an application of constructivist methodology in addressing contemporary debates over the Internet.

The final part of the book works out the relation of my approach to that of various theorists and reformulates the instrumentalization theory I have developed in earlier writings.

Chapter 5 situates the argument of the book in a wide philosophical context. It reviews several theories of modernity, including contributions of the Frankfurt School, Lukács, and Hannah Arendt. These theorists all resist the reduction of the social world to functionality.

Chapter 6 traces the philosophical background of the instrumentalization theory in Heidegger and Lukács and shows its relevance to the concept of functionality in an analytic philosophy of technology.

Chapter 7 explores the rationality of public interventions into the technosystem. It applies the theory of judgment that originated in Hannah Arendt's interpretation of Kant's aesthetics to the conflictual dialogue of lay and expert actors engaged in sociotechnical change.

The final chapter sums up the argument of the book in relation to the question of progress as elaborated here and in the debates among critical theorists.

Several chapters have been published in earlier versions. The introduction was published as "Technology and Human Finitude," in *Moral Education at the Crossroads in Our Age of Highly Advanced Science and Technology: 40th NAS International Symposium*, The National Academy of Sciences, Republic of Korea, 2013, 35–49, 173–187. Chapter 1 is based loosely on "Marxism and the Critique of Social Rationality: From Surplus Value to the Politics of Technology," *Cambridge Journal of Economics* 34, no. 1 (2009): 37–49, doi:10.1093/cje/bep006. Published by Oxford University Press on behalf of the Cambridge Political Economy Society. Elements are also drawn from "Great Refusal or Long March: How to Think About the Internet," in *Critique, Social Media and the Information Society*, ed. C. Fuchs and M. Sandoval (New York and London: Routledge, 2014), 109–124. Chapter 2 was published in an earlier version as "A Critical Theory of Technology," *The Handbook of Science and Technology Studies*, *Fourth Edition,* eds. U. Felt, R. Fouché, C. Miller, and L. Smith-Doerr (Cambridge, MA: MIT Press, 2017), 635–664. Chapter 3 was published under the title "La concrétisation de la philosophie de la technique de Simondon et le constructivisme: Une contribution récursive à la théorie de la concrétisation," in *Simondon et l'invention du futur*, ed. V. Bontems (Paris: Klincksieck, 2016), 317–329. An English version appeared in 2017 as "Concretizing Simondon and Constructivism: A Recursive Contribution to the Theory of Concretization," in *Science, Technology, & Human Values* 42, no. 1 (2017): 62–85. DOI:10:1177/0162243916661763. Chapter 4 was published as "L'Internet en question," in *Espace public et reconstruction du politique*, ed. Pierre-Antoine Chardel, Brigitte Frelat-Kahn, and Jan Spurk (Paris: Les Presses des Mines, 2015), 71–85. An English version appeared as "The Internet in Question," in *The Digital Nexus: Identity, Agency, and Political Engagement*, ed. R. Foshay (Edmonton, Alberta: Athabasca University Press, 2016), 25–48. Chapter 6 appeared originally in a different form as "The Concept of Function in Critical Theory of Technology," in *Philosophy of Technology after the Empirical Turn*,

ed. M. Franssen, P. Vermaas, P. Kroes, and A. W. M. Meijers (Dordrecht, Netherlands: Springer, 2016), 283–303.

I am grateful to many people who helped me to write this book, including the editors and anonymous reviewers for the *STS Handbook* and *Science, Technology, & Human Values*. Discussions with the following people made a major contribution at one point or another in the process of composition; needless to say they are not responsible for the results with which, in some cases, they disagree: Ian Angus, Albena Azmanova, Maria Bakardjieva, Jean-Hughes Barthélémy, Vincent Bontems, Pierre-Antoine Chardel, Steven Galt Crowell, Jodi Dean, Anne-Marie Feenberg, Alessandro Ferrara, Christian Fuchs, David Ingram, Dal Yong Jin, Graeme Kirkpatrick, Jeff Kochan, Clive Lawson, Ricardo Neder, Robert Pippin, Hans Radder, and Jan Spurk. I also thank Maggie MacAulay, Veronika Tzankova, and Selena Neumark for help with the preparation of the manuscript.

TECHNOSYSTEM

Introduction

Technology and Human Finitude

Finitude is an important theme in both the Judaic and Greek sources of the Western ethical tradition. The Bible describes humans as created beings and as such they are enjoined not to worship false gods they have themselves created. The command "Know Thyself," inscribed on the temple of the Oracle of Delphi, instructed human beings to recognize their mortality and not strive beyond their natural limits. The Greek word for such overweening striving is *hubris*. The critique of hubris is the basis for an ethic and a politics of technology.

The more successful our technology, the stronger the temptation to violate the ancient wisdom. Technology gives the illusion of godlike power to master nature and bend it to our will. Dreams of absolute technologies have haunted the human race ever since Archimedes claimed he could move the world if only he had a long enough lever and a place to stand. Contemporary technological fantasies are no less extreme. We are told that we will soon be replaced by artificial intelligence, download our brains into computers, geoengineer the climate, move asteroids out of their orbits, colonize Mars, and more. The most important role for ethics in a technological society is to identify and avoid such hubris.

The environmental crisis reminds us that we are not gods but limited beings. A dramatic example of this realization occurred in the life J. Robert Oppenheimer, the leader of the Manhattan Project in World War II. As he witnessed the test of the first atom bomb in the New Mexico desert, a phrase from the *Bhagavad-Gita* flashed through his mind: "I have become death, destroyer of worlds."[1] Death, or Shiva, is the god of

destruction and for a brief moment Oppenheimer identified himself with that god. However, very soon afterward he realized that the destroyer can be destroyed, that neither he nor even a well-armed America enjoy divine omnipotence. He soon advocated disarmament negotiations with the Soviet Union.

In what follows, I will treat the theme of finitude ontologically and epistemologically. Ontological finitude deals with the nature of technology and our nature as human beings. Epistemological finitude has to do with what we can know. In conclusion I will argue that recognition of finitude implies a democratic ethic of technology and a new concept of nature.

Ontological Finitude

Ontologically considered, all living beings have limits and belong to an environmental niche outside of which they break up and die. The extraordinary power of human beings to modify their niche supports the illusion of independence from the natural world.

Finitude is evident in the structure of human action. For the most part, actors obey a metaphoric equivalent of Newton's third law of motion, according to which every action causes an equal and opposite reaction. This law is verified whenever two billiard balls bounce off each other, and also by much human behavior. It most obviously applies in interpersonal relations where anger evokes anger, kindness elicits kindness, and so on. Our acts return to us in some form from the Other. In acting we become the object of reciprocal action. This is the paradox of action.

As humans we can only act on a system to which we ourselves belong. Any change we make in the system affects us, too. This is the practical significance of our corporeal and social being. We exist in a world of causal powers and meanings we do not fully control. Our body exposes us to the laws of nature. And we are born into a cultural world we largely take for granted. In short, we are finite beings. Our finitude shows up in the reciprocity of action and reaction.

But technical action appears to be non-Newtonian. When we act technically on an object we experience very little feedback, certainly nothing proportionate to our impact. This gives rise to the illusion of technology: the subject is blinded to connectedness and understands it-

self to be autonomous, independent of the world in which it acts. This illusion is less prevalent in traditional societies. Where craft knowledge and everyday experience are in constant communication, the lessons learned from the use of technical devices are absorbed into the tradition and restrict technical activity to a few customary types. From a modern standpoint this appears to obstruct development, but our recent experience with technologies such as nuclear energy and toxic chemicals indicates the wisdom of restraint.

Most modern technology developed under a different dispensation from craft. In a capitalist society, control of technology is transferred from craftsmen to the owners of enterprise and their agents. Capitalist enterprise is unusual among social institutions in having a very narrow goal: profit. The freedom to pursue that goal is not inhibited by regard for the social and natural environment; the lessons of experience are ignored. Throughout the industrialization process workers and others subject to its side effects are silenced. Technological development proceeds unimpeded, guided by sophisticated technical disciplines.[2]

The illusion of technology complements the narrow focus of capitalism and together they assure us that we can act on the world without consequence for ourselves. But only God can act on objects from outside the world, outside the system on which he acts. All human action, including technical action, exposes the actor to causal feedback and effects of meaning.

Consider, for instance, the indifference to side effects which arises from the power of technical action to dissipate or defer causal feedback. The whole point of technology is to change the world more than the actor. It is no accident that the gun kills the rabbit but not the hunter, that the hammer transforms the stack of lumber but not the carpenter. Tools are designed to focus power outward, on the world, while protecting the tool-user from the Newtonian equal and opposite reaction.

But Newton cannot be defied forever. As natural beings, we eventually experience all the causal impacts of our technology, including its waste products. Attention to this nagging aspect of technology is obscured by the seductive illusion of technology. But my metaphoric version of Newton's law states that the feedback that is initially ignored comes into play with a wider or longer-range view. In the case of pollution, Barry Commoner's ecological corollary of Newton's law declares, "Everything must go somewhere."[3] Indeed, all the poisons produced by industry end up in someone's backyard, even if it takes years to notice.

As technology grows more powerful, its negative side effects become more difficult to ignore and today they are impossible to deny.

Our actions not only come back to haunt us through causal feedback; they also change the meaning of our world. New technologies of transportation and communication offer dramatic examples. Railroads, automobiles, and airplanes have radically diminished the experience of distance. The spatial coordinates of our lives, the "far" and the "near," are completely different from what they were for our ancestors. Electronic communication has similarly radical consequences as a multicultural world emerges from the monocultures of old. Thanks to movies, personal encounters with immigrants, and tourism, ordinary people today know more about foreign lands and cultures than all but a few adventurers and colonial administrators a century ago. What is more, the familiar distinctions between public and private, work and home, are subverted as new technology brings the office into domestic life and pushes creative endeavors and private fantasies into public arenas.

Even the meaning of nature is subject to technological transformation. Consider the example of ultrasound, which identifies the sex of the fetus early in pregnancy. In the United States, relatively few parents abort fetuses because of their sex, but the fact that this is possible transforms an act of God into a human choice. What formerly was a matter of chance can now be planned. Even choosing not to seek or use the information has become a choice in favor of "nature," whereas before no choice was involved. Our society has technologized reproduction and has thus changed its meaning for everyone, including those who abjure reproductive technology.[4]

The paradox of action also holds in the case of identity. The hunter kills a rabbit with his gun and feels only the slight kickback from his weapon. But the action does have consequences for him too: he is defined as a hunter insofar as he hunts. This reverse action of technology on identity characterizes everyone's productive activity. In sum, you are what you do.

Consumer society has further consequences for the question of identity. The tools we employ in daily life are not merely useful. They also tell us what kind of people we are. We now "wear" our automobiles, tablets, and smartphones as forms of self-presentation just as we wear clothes and jewelry. Today, not only are you what you do but even more emphatically you are what you buy.

This has unfortunate consequences. For example, automobile own-

ership involves far more than transportation. It symbolizes the owner's status and usurps the role that ought to be played by public transportation. In poor countries, it has an even greater symbolic charge than in rich ones, signifying the achievement of modernity and its vision of prosperity. But that vision must be lived under darkened skies in unbreathable air, a plague that has spread around the globe from Los Angeles and London to São Paolo and Beijing.

In such cases the means are not separate from the ends. Where identity is at stake, possession of the means is already an end in itself. Indeed, assuming a new identity is often the most important effect of technological change, more important than its ostensible, prosaic purpose.

These examples show how deeply we are implicated in the technologies we create. In the twentieth century, these ever more powerful technologies achieve the status of what Michel Serres calls "world objects"—that is, objects that affect the world as a whole and not just a small corner of it.[5] The first such world object was the atom bomb. But even as the atom bomb dramatized human power, fossil fuels were quietly altering the climate. Getting these world objects under control has proven extraordinarily difficult. We control the world with technology, but do we control ourselves?

Epistemological Finitude

Epistemological finitude has to do with the limits of human knowledge. Our ideal of objectivity is a view from nowhere, a God's-eye view of the universe of the sort that we imagine science provides. But knowing is both made possible and limited by time, place, body, culture, prejudices, and all the other contingencies that operate in the search for truth. The philosophical doctrine that grants these limits without denying the possibility of knowledge is called fallibilism.

Fallibilism applies to technology as to every other form of knowledge. Technical disciplines are influenced by traditions and interests and inevitably contain errors. These limits show up in the flaws of technological designs, which may be biased to privilege the interests of a given social group or may contain unsuspected dangers for those who use them.

Chapter 1 discusses the bias of technology. It is often embedded innocently in the blind spots of tradition. Technical designs that appear neutral may actually embody an unconscious preference. Right-handed

tools offer a good example. Scissors that are easy to use with the right hand are clumsy in the left hand. The early makers of scissors were likely right-handed and no doubt unaware of the problem. Similarly, sidewalks with curbs at intersections obstruct the movement of wheelchairs. In recognition of the rights of the disabled, sidewalk ramps have been introduced everywhere in North America. Again, the designers of traditional sidewalks can hardly be blamed for their oversight. The ordinary high curb is no problem for pedestrians. The real question is not technical but asks whether disability is a private or public concern. In such cases the bias is hidden in a technical specification that cannot be suspected of fostering prejudice or self-interest. Yet the apparently innocent specification is biased.

The case is more complicated when interests are involved. Class interest interacted with machine design in the course of the Industrial Revolution. Here intention was at work, translated into biased technical specifications that represented the demands of owners and managers for the deskilling of labor and mechanization. I will return to this case in Chapter 1.

Experts hand down these biases from generation to generation. Criticism is difficult insofar as the problems are encoded within technical disciplines independent of public opinion. Even so, progress may come from outside tradition-bound technical fields. Protests, controversies, boycotts, and hacking challenge bias and make it visible.

Technical accidents play a role, too, as in the example of Fukushima Daiichi. Nuclear power is an exceptional case at the limit of technical feasibility. But that makes clear the importance of fallibilism in technical culture.

The Fukushima disaster shows that there are technical problems that are simply too hard to solve. Of course, provisional solutions may be found, but we need permanent ones. When dealing with any complex system, we arrive at such permanent solutions only through experiencing, analyzing, and responding to a succession of unanticipated problems and accidents. This is what the aircraft industry has done over time and as a result flying is now quite safe.[6] The consequences of such a succession of accidents with nuclear power are simply too costly and frightening.

Technological finitude is recognized in the famous precautionary principle of the Rio Summit of 1992: “In order to protect the environment, the precautionary approach shall be widely applied by states ac-

cording to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[7] The precautionary principle is a cure for hubris, but exactly how to apply it remains subject to controversy. It is not intended to arrest all innovation, but it is unclear how to distinguish intolerable risks from tolerable ones.

The real-world test of technology is public acceptance. There must be a "reality check" on the work of technical experts via the everyday experience of workers, users, and, in some cases, unintended victims. This is the ultimate Newtonian feedback from bias and risk. As technology grows more powerful and pervasive, it becomes more difficult to insulate it from the public. Feedback constrains development and reorients its path.

Once mobilized, protesters attempt to impose the lessons of their experience on the technical experts who build working devices in a modern society. This interaction recalls the dynamics of craft development, but modern institutions now create obstacles to communication. Superficially, technical knowledge appears to contradict everyday experience. Technical experts decry what they think of as ideological interference with their pure and objective knowledge of nature, arguing that values and desires must not be allowed to muddy the waters of fact and truth. Protesters on the other hand may make the corresponding error, denouncing the experts in general while nevertheless employing their technology in everyday life.

In fact technical knowledge and experience are complementary. Technical knowledge is incomplete without input from experience. Public protests can reveal the complications caused by aspects of nature and social life overlooked by the experts. Protests formulate values and priorities. Demand for such things as health and safety, skilled employment, recreational resources, or aesthetically pleasing cities all testify to the failure of the existing technology to incorporate significant values. Eventually, these values will guide improved technical designs and the conflict will die down. Indeed, in years to come the experts will forget the politics behind these reforms and defend them as a product of objective inquiry! Chapter 7 shows how protests communicate their insights and demands.

Sometimes the problem is not the harm technology does but the good it might do if only it were reconfigured. This is exemplified by the Inter-

net, the subject of Chapter 4. It was created by the U.S. military to test a new type of time-sharing in networked computers. Note that originally networking meant connecting computers, not people. A lowly engineer on the design team came up with the idea of networking not just computers but also their users via email. Since then, one generation after another has developed new ideas for social interaction online. Bulletin boards and home pages were followed by web forums and then by social sites dedicated to music sharing and photography. These sites were integrated into blogs and now Facebook pulls together a wide array of social resources. At each stage programmers have worked to accommodate the new demands of users with the corresponding technical solutions. This process is a template repeated endlessly as technologies develop.

Values cannot enter technology without being translated into technical language. Simply wishing away inconvenient technical limitations will not work. The results of such a voluntaristic approach are disastrous, as the Chinese discovered in the Cultural Revolution. Experts were sidelined and workers encouraged to raise engine speeds beyond the recommended limits. Productivity rose briefly, until the engines burned out. For something useful to come out of public interventions, experts must figure out how to reformulate values as viable technical specifications. Consider the case of the sidewalk ramp again. The right to circulate is only cast in cement when engineers specify the location, width, and slope of the ramp. This is how a new version of a contested technology responds to its context. Thus values are transformed into technical facts and the technology can better occupy its social and environmental niche.

The structure of this remedial process is a consequence of technical development largely cut off from everyday experience. But experience increasingly influences design despite the obstacles. Today, as we have seen, such interactions are becoming routine, with new groups emerging as "worlds" change in response to technical change. This overall dynamic closes the loop described in the paradox of action: what goes around comes around.

In sum, values are the facts of the future. Values are not the opposite of facts, nor are they mere subjective desires with no basis in reality. Our world was shaped by the values that presided over its creation. Technologies are the crystallized expression of those values. Protests formulated in the language of values express aspects of reality that have not yet been incorporated into the technical environment. Looking forward, these

new values open up established designs for revision. Chapter 2 explores the contribution of science and technology studies to the understanding of this process.

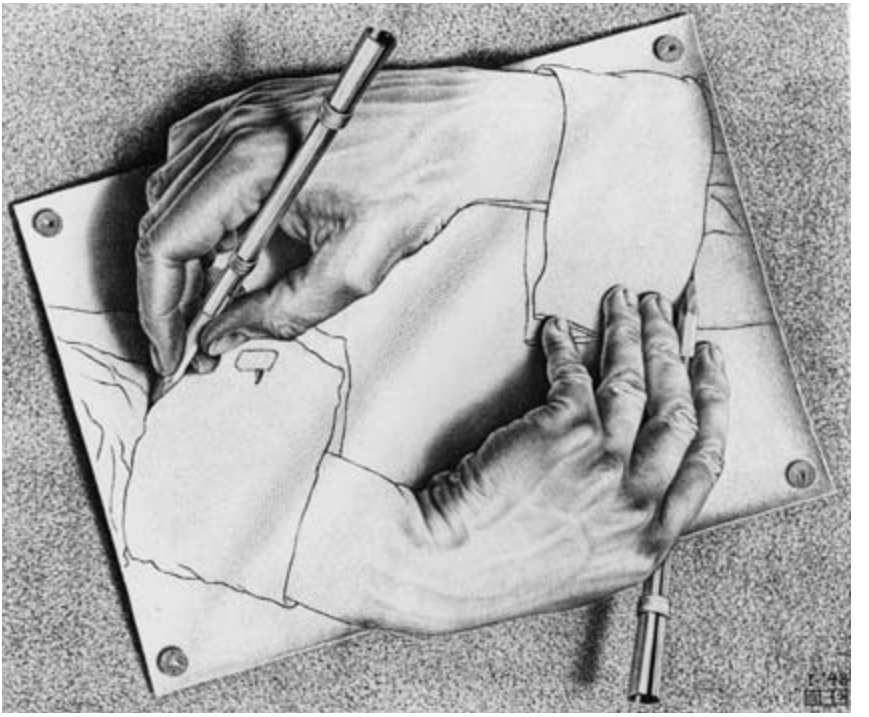
Technology and Democracy

The politics of technology grows out of the technical mediations that underlie the many social groups that make up society. A worker in a factory, a nurse in a hospital, a truck driver in his truck—all are members of social groups that exist through the technologies they employ. Consumers and victims of the side effects of technology form latent groups that surface when they become aware of their shared experience. Encounters between individuals and the technologies that connect them proliferate with a myriad of consequences. Social identities and worlds emerge simultaneously and form the backbone of a modern society. In the terminology of science and technology studies, they "co-produce" each other.

Co-production has a paradoxical structure nicely illustrated by M. C. Escher's famous print *Drawing Hands*. In his book *Gödel, Escher, Bach* Douglas Hofstadter described Escher's self-drawing hands as a "strange loop" and an "entangled hierarchy."[8] These terms refer to an unusual type of logical relation in which top and bottom change places. Artist and drawing stand in a hierarchy, the active side at the top, the passive side at the bottom. In the print both hands play both roles; the hierarchy is entangled in a strange, endless loop.

The famous liar's paradox is similarly entangled. Like all declarative statements, "This sentence is false" refers to an object. The statement itself is the actor at the top of the hierarchy. But the object to which it refers is also itself and in describing itself as false it reverses the direction of action. Now the sentence is true if it is false and false if it is true. A strange loop indeed!

Like these examples of strange loops, society and technology are inextricably imbricated. Social groups exist through the technologies that bind their members together. In this they resemble the drawn hand of Escher's print. But once bound together the members gain a power over the technologies that bind them. They take the place of the hand that draws. Formed and conscious of their identity, technologically mediated groups influence technical design through their choices and protests. In



M. C. Escher, Drawing Hands. *© 2016 The M. C. Escher Company B.V.–The Netherlands. All rights reserved. www.mcescher.com.*

so doing they reiterate the original paradox of democracy: self-rule is an entangled hierarchy. As the French revolutionary Saint-Just put it in 1791, "The people is a submissive monarch and a free subject."[9]

Over the centuries since the democratic paradox was first enacted, its reach has extended from such basic concerns as civil order, roads, and defense to embrace social issues such as marriage and education, and now the technosystem. The struggle over the technosystem began with the labor movement. Workers' demands for health and safety on the job were public interventions into production technology. Socialists generalized these challenges and called attention to the contradiction between democratic ideology and the tyranny of the factory. This was an early instance of technical politics at a time when modern technology was largely confined to a single sector of society. Later, such issues as food safety and environmental pollution widened the circle of public

concerns. Today, debates about privacy and free communication on the Internet continue the process.

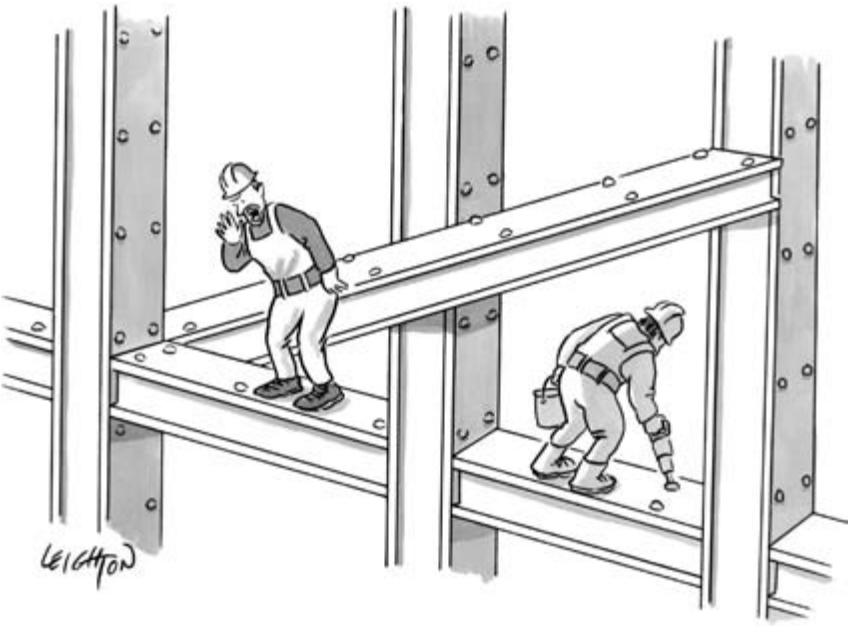
The dream of a socialist technology designed and controlled by those who build and use it has never been fully realized. But today something like that dream is being revived in a new form. Those who demand environmentally compatible production, a medical system responsive to patient needs, a free and public Internet, and many other democratic reforms of technology follow in the footsteps of the socialist movement whether they know it or not. They are broadening democracy to include the whole social terrain covered by the technosystem.

Democracy is a recognition of finitude. Citizens give up the claim to know and control everything. They accept the limits of their knowledge in submitting to a process of discussion. It is appropriate to address the problem of technological hubris with a democratic alternative. But the concept of the strange loop, it turns out, is not paradoxical enough. We must introduce a paradox into the paradox.

Hofstadter titles one of the last sections of his book "Behind Every Entangled Hierarchy Lies an Inviolate Level."[10] The strange loop is not ultimate but is always produced in the normal way, where up is up and down is down. The creator of the strange loop occupies an "inviolate" level that is not entangled with the strange loop he or she creates. The person who says, "This sentence is false," is not entangled in the paradox. Escher draws without himself being drawn.

The notion of an inviolate level has its place in logic but not in modern social life. In fact this notion precisely defines the illusion of technology. It gives rise to the popular belief that through technology we "conquer" nature. But human beings are natural beings and so the project of conquest is self-contradictory. As F. Scott Fitzgerald remarked in another context, "The victor belongs to the spoils."[11] The conqueror of nature is despoiled by his own violent assault. This paradox has two implications. On the one hand, when "humanity" conquers nature, it merely arms some individuals with more effective means to exploit and oppress others who, as natural beings, are among the conquered subjects. On the other hand, as we have seen, actions that harm the natural environment come back to haunt the perpetrators in the form of feedback from the system to which both conqueror and conquered belong. In sum, the things we do to nature we also do to ourselves.

This inability to stand above and outside our creations is illustrated in a cartoon, which implies a paradoxical answer to Escher.[12] As the



Robert Leighton's Critique of Escher, "Escher! Get your ass up here." *Robert Leighton/The New Yorker Collection/The Cartoon Bank/Condé Nast.*

cartoon shows, there is no inviolate level, no equivalent of "Escher" in the real world of co-production, no godlike agent creating technology and society from above. All the creative activity takes place in the world that activity creates. The technical actor—in this case, Escher—can thus always be called to account. He is responsible for his creations. Responsibility is democratic accountability in the technical sphere. Only in our fantasies do we transcend the strange loops of technology and experience. In the real world there is no escape from the logic of finitude.

The Two Natures

In the popular imagination, science appears to occupy the inviolate level as an absolute spectator on existence. By contrast, everyday experience involves active persons in the contingent movement of events and ideas.

The nature discovered by science seems indifferent to humanity, while the nature we experience is saturated with anthropomorphic qualities. We moderns believe in science. By contrast we think our ordinary understandings of nature are subjective. Nature as natural science understands it does not harbor the beauty we detect in a flower; beauty, as we say, is "in the eye of the beholder." If scientific knowledge alone is true, then the experienced world holds no ontological or epistemological significance. It is a mere practical detail as Descartes long ago explained, convenient for getting around in everyday life but erroneous in itself.

How then to account for the democratization of technology in response to social movements such as environmentalism? Science is supposed to inform and guide experience, not the other way around. The strange loop is at work in the crisis of scientific expertise unleashed by environmentalism. This is the most dramatic demonstration of finitude in our world today. The hierarchy of knowledge is confounded where public protest alerts science to its own limitations.

This takes us beyond the moral question of hubris to confront an existential dilemma of modern life. What is ultimate reality—the object of science or the world of experience? It is no longer possible to decide in principle between our two relations to nature, our lived experience, so full of error but able on occasion to instruct us in the failures of science and technology, and our scientific knowledge of nature, which shapes our entire material existence through its technological applications.

Science criticizes and transcends lived experience. It separates itself from our experience through rigorous critique. Its discoveries are not just an improved representation of nature similar in kind to the representations found in everyday life. The nature we encounter in our experience of the world is left behind as a cultural or psychological residue. The scientific idea of nature involves a systematic negation of experience; appearance and reality stand opposed.

Modern scientific knowledge claims to be universal, and, indeed, it can be substituted for traditional knowledge everywhere, the success of technology confirming its validity. But scientists are all fallibilists; they do not believe in absolute truth. Understood epistemologically, scientific method organizes the discovery of "truths," or at least what scientists use for truths while they last. But understood in ontological terms, something very different is involved, not the construction of more or less true representations but the constitution of the disenchanted object we call "nature." That object has properties that do not change with every new theory but which are essential to modern science as such. For example,

physical theories come and go but their objects continue to be quantifiable. The ultimate power of science lies in this ontological construction, not in any particular truth or technological application.

The process of disenchantment is not entirely successful. To the extent that modern societies occupy the disembodied stance of science and act on its disenchanted nature, they undermine their own basis in the natural world. Western culture has followed this path for several centuries. Scientism, the claim that only science is true, meets its limit in the harm that accompanies "development" around the globe.

Science and technology influence our understanding of our experience, but the reverse is also true. Modern technology provokes countertendencies, the protests of technical citizens who insist on the validity of their own lived experience. The breakthrough to a democratic relation to technology depends on reevaluating that experience. This reevaluation is no more infallible than scientific-technical knowledge, but it, too, can claim a kind of universality for the values motivating movements for environmental protection, livable cities, or safe and interesting work. These are values all human beings recognize as valid. They correspond to realities science may not yet understand, indeed may never understand, but which are surely real.

Environmental politics is changing the technology inherited from industrialization and the changes are significant. They include protections for air, water, and food, and, more recently, innovations in renewable energy. Progress is uneven and will no doubt be judged insufficient in the future. However, it has already influenced opinion and attitudes profoundly. The ever-turning circle of technology and its effects has begun to widen. This is the negation of the negation practiced by science in separating itself from experience. It leads us back to an understanding of ourselves as part of nature, limited like our objects and dependent on them.

This understanding is dialectical rather than hierarchical. Neither daily experience nor natural science has the last word. This persistent dualism offends against our strong wish for an ultimate principle. Were we able to identify such a principle we would share in the wisdom of God, if not his power. However, this is the final measure of our finitude: we cannot choose between the two ontological principles—science and experience—that operate in our civilization and culture. We must learn to live with the ambiguity. Truth is always subtly eccentric with respect to the real.

METHOD

The three chapters that make up this section introduce critical constructivism and explain its approach to the study of the technosystem. The chapters review contributions of Foucault and Marx, the Critical Theory of Adorno, Horkheimer and Marcuse, Simondon, and two main currents of science and technology studies (STS), social constructivism and actor-network theory (ANT).

To Marx, Foucault, and the Critical Theorists, we owe the notion that modern societies are organized around rational institutions and artifacts. These thinkers contest the notion that rationality is singular and pure, and situate its various forms within social contexts that establish their powers and limits. This provides an opening for reevaluating public interventions into the technosystem in the course of social movements such as environmentalism. These movements can be shown to represent contexts excluded in the original design of the technosystem now striving for inclusion.

In the wake of these earlier critical theories, STS has shown us how to study technology, one such context-bound realization of rationality. STS argues that technological design cannot be fully explained by the technical principles it realizes but that social forces play a role in the definition, selection, and application of those principles. This claim validates empirically one of the principal intuitions of the critical theorists of rationality. The argument can be generalized to cover the whole technosystem. It then suggests methodological approaches to understanding the social struggle over the design of modern life.

But constructivism is relativistic and critique and struggle presuppose a normative process of development to which they attempt to contribute. Simondon's philosophy of technology is based on the immanent tendencies of technical development. His concept of "concretization" is an empirically informed approach to understanding technical progress. Concretization consists in the multiplication of functions served by the structures of an artifact, leading to a higher level of integration and efficiency. This notion lends itself to a constructivist reinterpretation where functions are seen to represent the demands of social actors, each with its own identity and needs. Simondon's concept is thus adapted to the study of progressive struggles over the technosystem.

In sum, this first part of *Technosystem* combines a socially situated understanding of rationality with constructivist methods and Simondon's concept of technical development. The resulting philosophy of technology is critical in the sense that it recognizes the limits of the rational organization of modern society. But it does so not in terms of a generalized concept such as Max Weber's "rationalization" but in the empirically oriented form introduced by constructivism. The normative deficit of the constructivist approach is compensated by ideas drawn from Simondon and Critical Theory.

■ CHAPTER ONE ■

Marx after Foucault

Introduction: Marx and Foucault

Our understanding of the past is shaped and focused by present events. This is no less true of intellectual history than of social and political history. We cannot read Aristotle's views on women and slaves in the same spirit as his contemporaries, nor is it reasonable to judge him from our present standpoint. Similarly, we cannot read Plato after Kant as he was read before, nor Marx after the Russian Revolution. But the effects of a new context are not always immediately apparent. Sometimes subtle shifts go almost unnoticed for long periods, rendering obsolete much theoretical work that continues to adhere to outdated assumptions. I believe this to be the case with Marxism.

Even as Marxists struggle to adjust to major changes in the composition and consciousness of the working class in the postcommunist and postcolonial world, another type of theoretical challenge is largely ignored. This challenge is represented by the work of Michel Foucault and constructivist science and technology studies (STS). They have brought the question of social rationality to the fore, suggesting new readings of Marx's work. In this chapter I seek out the ways in which our perception of Marx should be changed by our reading of Foucault.

Given Foucault's critical remarks on Marxism and a long history of anti-Marxist polemic inspired by his work, a preliminary clarification is in order. Foucault's opposition to Marxism was related to his own ideological context, in which the French Communist Party played a prominent role. Its scientific pretensions and statist ambitions were legitimate targets of critique. At the same time, his many positive references to the

work of Marx and to the Frankfurt School show that he saw himself as operating on a terrain first fruitfully explored by Marx and certain Marxists—with many reservations and an original contribution, to be sure.[1]

The point I intend to make here is not that Foucault is a Marxist or replaces Marx as a theorist of resistance to capitalism but rather that his work suggests a reinterpretation of Marx's theory that shifts the overall emphasis and supplements certain deficiencies. The new contextualization allows us to generalize Marx's approach beyond the economic limits of his mature work. In this chapter I develop this argument around five themes:

- Marx's critique of the irrationality of capitalism is supplemented by a related critique of capitalist rationality.
- Marx's conception of the "concrete" object as a synthesis of multiple determinations is generalized in a genealogy of technosystem design.
- Marx's discussion of the relation between meaning and economic function is developed and generalized through multiplying the contexts within which objects function and take on meaning.
- Marx's dialectic of "real subsumption" and proletarian resistance is generalized in a theory of co-production and participant interests.
- Marx's ideas on working class consciousness and socialism take on new significance when compared to Foucault's notions of subjectification and governmentality.

In each case Foucault's ideas suggest a reevaluation of texts that are not always central to the interpretation of Marx's thought. Once these texts are brought into focus, Marx's method converges in important respects with Foucault's and with the constructivist approaches discussed in the next chapter.

Power/Knowledge

The conventional understanding of Marx's work emphasizes the irrationality of the capitalist economic system and the determining role of technology in shaping social relations and institutions. This is the Marxism

that inspired Soviet socialization policy, based on economic planning and forced industrialization. We know how that story ends. Clearly, either Marx was terribly wrong about both economics and technology or badly misinterpreted. In this chapter I will argue for the latter conclusion.

While the conventional understanding of Marx's work is not without substantial textual support, it does not compass his deepest insight. That insight was first formulated unambiguously by the early Marxist Lukács. His theory of reification identifies the intrinsic limitations of capitalism considered as a *rational* system. "The whole structure of capitalist production rests on the interaction between a necessity subject to strict laws in all isolated phenomena and the relative irrationality of the total process."[2] The rationality of capitalism—its law-governed "necessity"—is the basis of its irrationality. This is most obvious in the contrast between the rational ordering of production within the factory and the "anarchy" of the market. But the market too has a rational form described in political economy. Lukács extended Marx's approach to the bureaucracies and technology of capitalism, the entire technosystem. He interpreted Marxism as the theory of the crisis of the reified rationality of the technosystem. The critique of instrumental rationality in the first generation of the Frankfurt School developed Lukács's insight.

As a critical theory of rationality, Marxism has much in common with Foucault's critique of the scientific-technical disciplines that underlie modern organizations. For Foucault, the essential innovation of modernity is the reliance on forms of knowledge that are simultaneously forms of power.[3] And like Marx and Lukács, Foucault claims that resistance to the system is an inevitable consequence of the suffering it imposes on its human objects.

Foucault's approach supplements Marx's emphasis on markets under capitalism. Both thinkers argue that a specific type of reified rationality meets its limit in resistance from below. The romantic influence is obvious, but they do not propose to substitute passion for reason as an existential stance, much less as a principle of social organization. Both thinkers are engaged in what Adorno describes as a "rational critique of reason."[4] This has paradoxical implications and fruitful applications.

Before developing this theme in more detail, I will provide a brief summary of Foucault's theory of "power/knowledge." This is the key to his critique of rational domination. He argues that knowledge in modern societies is conjoined with power and that together they are productive of individual subjectivity and the social order. Power/knowledge is a web

of social forces and tensions in which everyone is caught as both subject and object. This web is materialized in techniques, in architecture or devices, and embodied in practices, organizations, and standardized roles. These do not so much coerce and suppress individuals as guide them toward productive activities.

Foucault writes "that power and knowledge directly imply one another; that there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations. These 'power-knowledge relations' are to be analyzed, therefore, not on the basis of a subject of knowledge who is or is not free in relation to the power system, but on the contrary, the subject who knows, the objects to be known and the modalities of knowledge must be regarded as so many effects of these fundamental implications of power-knowledge and their historical transformations."[5]

Foucault's theory focuses on rational forms of domination not by attacking science as such but by deconstructing those sciences in which human beings are both object and subject of knowledge. These social, political, medical, and administrative sciences are deeply embedded in the power relations of modern societies. They achieve the unquestioned authority of a cultural system but not in the form of customary beliefs. Rather, it is through the practical realization of their historically relative "truths" in institutions such as prisons and hospitals that they are placed beyond criticism as a kind of second nature. Undermining their claims to cognitive purity provides both a guiding thread for understanding modernity as a cultural system and theoretical support for new forms of political resistance on the terrain of knowledge.

In sum, "Truth is a thing of this world."[6] Technical disciplines such as criminology, psychiatry, and the administrative sciences arise along with institutions of confinement and control. They reshape their human objects through disciplinary procedures and so create a modern society. The later theory of governmentality extends this approach to procedures that incite cooperative and productive behavior in the context of the "biopolitics" of the modern state.

Although this sounds a bit like Max Weber's theory of rationalization, Foucault is critical of Weber. He argues that rationality is not singular but multiple. The concept must be disaggregated and contextualized. There is not one rationalization but many, corresponding to the many domains of social life. The task is understanding the functioning

of rational procedures in each domain and the constitution of the related fields of knowledge in which true and false are distinguished.[7]

Foucault's theory explains why the social imperatives of modernity are experienced as technical constraints rather than as political repression. Surveillance, disciplinary power, normalization—all make modern life possible. They "condense" technical and social functions at the level of everyday artifacts and behavior. These constraints are embodied in systems that determine individuals' actions more effectively than political authority by determining their reflexes, skills, and attitudes.

The Bias of Rationality

Foucault claims that his theory differs from Marxism's understanding of power and knowledge. He argues that Marxism conceives of power as "sovereign"—that is, as repressive. In this conception, power stands opposed to truth. The bourgeoisie rules as did kings and nobles formerly. And as in the struggle against feudalism, so in the struggle against capitalism, reason is a powerful weapon. According to Foucault this is an outdated conception.

Although some of Marx and Marxists' discussions of class and the state conform with this notion of sovereignty, Marx's original contribution is his critique of the impersonal domination of the market, interpreted as a form of social rationality. This approach extends a radical strand of Enlightenment critique stemming from Rousseau, whose early theory of private property inspired the Jacobins and Babeuf's "conspiracy of equals" during the French Revolution. Marx's critique is much more sophisticated, as it is based on a systemic analysis of capitalism. But he too views rational social arrangements as biased by the effects of power.[8] Foucault's explicit critique of rationality brings out the implications of Marx's similar but implicit critique.

In support of this claim I must first explain what I mean by a "rational" social system and then revise the notion of bias accordingly. Let me begin with the concept of "sociotechnical rationality" which I introduced in an earlier book to identify the peculiar character of many modern institutions.[9]

Our modern notion of rationality is modeled on science and mathematics. Of course no institution is rational in exactly the same way as these disciplines. Institutions are not held together by logic but by causal

and symbolic relations that lack the rigor of experiment and equation. Nevertheless, procedures that bear a certain resemblance to those of science and mathematics have tremendous importance for modern societies. As Foucault explains, rational institutions play the "game of truth . . . an ensemble of procedures which lead to a certain result, which can be considered in function of its principles and its rules of procedures, as valid or not, as winner or loser."[10] Although in his later work Foucault resists describing general rational principles operating across domains, I think there are at least three such principles applied by organizations and institutionalized in systems. These are exchange of equivalents, classification and application of universal rules, and the adjustment of means to ends (efficiency).

Each of these principles looks "rational" as we ordinarily understand the term. The market, like calculation, is an exchange of equivalents. Administrations resemble science in classifying objects and treating them uniformly under rules. And like science they measure their objects ever more carefully to achieve their goals. Business, like technology, is based on the pursuit of efficiency. What is more, technical disciplines inform the work of professional personnel in every domain. These disciplines too strive for scientificity, at least in form. Social life in our time thus appears to mirror science. The consequences for critical method have been brought out by Foucault, but he was by no means the first critical theorist of rationality. His work suggests a rereading of the critical tradition.

Foucault's argument that regimes of truth depend on relations of power is an attempt to overcome the impotence of Enlightenment critique in the face of modern institutions. The Enlightenment taught us to identify bias where prejudices, emotions, and pseudo-facts influence judgments that ought to be based on rational standards. I call this "substantive bias" because it rests on a content of belief such as, for example, the idea that some races possess inferior intelligence. The philosophers of the Enlightenment appealed to rational foundations, facts and theories unbiased by prejudice, and on that basis they refuted the narrative legitimations of feudal and religious institutions. There is no doubt that the critique of substantive bias played and still plays an important emancipatory role. However, it has a significant limitation. The appeal to reason against feudal and religious bias grants the neutrality and universality of institutions that claim a rational foundation. This is the case, for example, with the market, which is justified not by myths, stories, or

emotional appeals but by the dry logic of the equivalence of money for goods.

Rousseau was the great exception to the Enlightenment enthronement of reason. He proposed two different critiques of rationality in his two famous *Discourses*. These critiques foreshadow the main alternatives explored in the following centuries and are still represented by different critical styles. His first, *Discourse on the Sciences and the Arts,* deplores the progress of knowledge at the expense of virtue. "We have physicists, geometers, chemists, astronomers, poets, musicians, painters; we no longer have citizens."[11] This is a romantic critique of the existential consequences of specialized knowledge and division of labor. In later romantic critique, passion and love often stand in the place Rousseau assigned to virtue and citizenship. The "philistine" choice of reason over passion testifies to a preference for a safe, conformist bourgeois existence. The critique of that lifestyle is associated with artistic and political milieux that have vast cultural influence but little direct impact on the organization of modern societies.[12]

A similar critique is found in some postmodernist and postcolonial theory. But whenever rationality is reduced to a nonrational origin such as Western or patriarchal ideology, or mere power relations, its special characteristics *qua* rational are overlooked.[13] This critique implausibly attributes substantive bias to rational systems and thereby denies the rationality of rationality as such.

Marx encountered this approach on the left of his day, for example in Proudhon, who titled his most famous book *Property Is Theft*. But if property really is theft, the coherence and survival of capitalism are incomprehensible. No social order can be based on simple plunder, certainly not one as complex as the capitalist system. The effective critique of rational systems such as markets, technology, and administration requires a different approach. A subtler analysis must find the bias in the concrete realization of the rational form.

Rousseau's *Discourse on Inequality* introduced a critical strategy for addressing the resistance of rationality to critique. The text explores the question of the origin and legitimacy of the state. In a world of conflicting interests, the state represents the principle of cooperation and morality; it supplies a rational framework of civil order. But Rousseau argues that the social contract which creates the state protects de jure the unequal division of property imposed de facto before the introduction of a legal system. Thus the rational form of the state hides an irrational

content inherited from a violent past.[14] In fact, Rousseau does not claim that the social contract was a real event but rather implies that every existing state inherits the gains of illegitimate violence. In preserving the consequences of violence the state constantly reinscribes its inherent injustice even as it founds a moral order.

What is new about Rousseau's argument is the demonstration that rationality and bias can coexist rather than standing opposed as alternatives. Marx extended a similar critical strategy to the economy and technology with much more sophisticated analytic tools. His approach requires a new concept of "formal" bias, by which I mean a critique of the discriminatory effects of a rational order. Formal bias hides in aspects of rational systems that only become visible in the light of historical and contextual analysis. It is not a matter of prejudice based on pseudo-facts or narrative myths; rather, the design of the system objectifies the discriminatory principle. For example, those who administer and grade a culturally biased test need not themselves be prejudiced for it to produce a biased outcome. To be sure, the claim that the test is fair is ideological but belief in the ideology is not the cause of the discrimination as in the case of substantive bias; rather, the test itself discriminates.

Similar considerations are involved in Marx's critique of the market. He acknowledges the rational coherence of the market, as explained in the bourgeois political economy of his day. According to that doctrine, on average everything is sold at its value, including labor. But already in 1844 he cites "a contemporary economic fact. The worker becomes poorer the more wealth he produces."[15] This fact suggests a hidden bias which Marx attributes to the structure of the labor market. But how to uncover that bias given the rule of equal exchange? Habermas has succinctly summarized the problem Marx faced in developing his critique: "The institution of the market promises that exchange relations will be and are just owing to equivalence. . . . The principle of reciprocity is now the organizing principle of the sphere of production and reproduction in itself."[16] The market is legitimated as both natural and good by the coincidence of mathematical equivalence and moral reciprocity.

Marx overcame the obstacle to critique in his theory of surplus value. I recall his argument here not to revive Marxist economics but as an example of a methodological innovation that anticipates Foucault's approach. In the ideal model of the capitalism Marx derived from political economy the value of goods consists in the labor required to produce them. Labor power itself is a good and the labor required to produce it is

measured by the cost of food and other necessities. But because the capitalist owns the factory he has the power to set the length of the working day independent of the contribution of the labor power he hires. During the working day workers produce goods worth more than the cost of their wages and so they enrich the capitalist to whom their product belongs. Meanwhile, the workers themselves remain at a level sufficient to reproduce their labor power.

Marx makes no reference to prejudice and discrimination in this critique of capitalism. Surplus value is produced by the rational workings of the system itself. Property is not theft because labor power is paid at its value. This is why Marx objected to early union demands for "fair" wages. The problem, he claimed, is not with the rate of wages but with the structure of the labor market which leaves the length of the working day to the discretion of the capitalist. However, Marx's argument does effectively refute the normativity the market acquires when it is viewed as a pure exchange of equivalents, outside the context in which it actually functions as a mechanism of exploitation.

The concept of formal bias explains how capitalist rationality realizes social domination. This view contrasts with the claim that capitalist relations of production are based on the sovereign power of a ruling class. This is certainly wrong as a general description of a system which has endured through so many generations of change and development and which, to a considerable extent, follows rational principles.

Like Foucault's critique of social and medical sciences, Marx's critique of political economy responds to the same limitation of the Enlightenment. It is puzzling then that Foucault did not make the connection. He came close in a short text from 1981 in which he argues that it was Marx (after all!) who first discovered that "a society is not a unitary body in which a single power, one and the same, is exercised, but it is in reality a juxtaposition, a liaison, a coordination, a hierarchy too, of different powers which each has its specificity. . . . Society is an archipelago of different powers."[17] Marx made this discovery in detailing the different workings of armies, slavery, factories, property, and so on, each with its own specific "technologies of power."

But if power and truth are intertwined, as Foucault argues, Marx's theory of power must correlate with a critical theory of truth. What is that theory? Foucault does not tell us, but it must be the critique of political economy. Why did Foucault fail to articulate the connection? His failure has something to do with the striking absence of any refer-

ence to Lukács and the Frankfurt School in French epistemology during his training. Foucault remarks on the failure of the Frankfurt School to influence French thought during World War II, despite the passage of its exiled members through Paris. These German thinkers explored the "knowledge" side of power/knowledge in their interpretation of Marx's work. Foucault's own belated discovery of their critique of rationality came too late to inspire an alternative interpretation of Marx.

Genealogy: Object and Meaning

Foucault's genealogical method derives from Nietzsche. Following Nietzsche, he argues against the Aristotelian concept of substance according to which an essence endures through accidental changes. Nietzsche writes, "The actual causes of a thing's origin and its eventual uses, the manner of its incorporation into a system of purposes, are worlds apart; that everything that exists, no matter what its origin, is periodically reinterpreted by those in power in terms of free intentions; that all processes in the organic world are processes of outstripping and overcoming, and that, in turn, all outstripping and overcoming means reinterpretation, rearrangement, in the course of which the earlier meaning and purpose are necessarily either obscured or lost."[18]

The genealogical approach can be applied to the technosystem. Institutions and artifacts consist in assemblages of components joined by their functional role in society rather than by an intrinsic essence. The technosystem resembles a palimpsest: multiple layers of influence coming from different regions of society and responding to different, even opposed, logics inscribe a shared object or institution. As Foucault says, genealogy "operates on a field of entangled and confused parchments, on documents that have been scratched over and recopied many times." "Behind things," he continues, lies "not a timeless and essential secret, but the secret that they have no essence or that their essence was fabricated in a piecemeal fashion from alien forms."[19]

Foucault further argues that the assemblages that constitute social objects depend on practices and exhibit a rule-governed form. He is at his most Nietzschean in asserting that practices impose an interpretation on their objects. "Interpretation," he writes, "is the violent or surreptitious appropriation of a system of rules, which in itself has no essential meaning, in order to impose a direction, to bend it to a new will, to

force its participation in a different game, and to subject it to secondary rules."[20]

Marx too presents an antiessentialist analysis of social objects. In the introduction to the *Critique of Political Economy* he writes, "The concrete is concrete, because it is a combination of many objects with different destinations, i.e. a unity of diverse elements. In our thought, it therefore appears as a process of synthesis, as a result, and not as a starting point, although it is the real starting point and, therefore, also the starting point of observation and conception."[21]

Like Nietzsche and Foucault, Marx rejects the Aristotelian concept of substance. The history of an artifact or institution cannot rely on an a priori definition but must trace transformations in its construction out of "diverse elements." This is a dereifying approach that treats social "things," such as artifacts, institutions, and laws, as assemblages of components held together by their functional roles. The components disaggregate and recombine as society changes. Marx's example in this text is money, which has a different form and meaning at different stages in social development. It is not composed of the same "stuff" nor does it have the same role, and yet it is still "money." Dereifying analysis must identify the ontological differences in the construction and meaning of objects at each stage in their development.

Both Marx and Foucault argue that social reality depends on an interpretation that is impersonal, subjectless. In Marx this impersonal source is the capitalist system. It takes the form of a theoretical paradigm in Foucault's early work, and later, when practices are incorporated into his genealogy, it includes the anonymous diffusion of techniques of power. The effects of the dominant interpretation can be traced throughout the institutions and forms of knowledge that constitute the social world.

However, the subject does not disappear from the scene. On the contrary, in modern societies the exercise of a dominating power "subjectifies." It shapes productive individuals who may also resist the very power to which they owe their individuality. Marx attributes the proletarian movement to a similar "productive" effect of power while Foucault mentions the many resistances generated by the different institutions across which power is dispersed. These resistant subjects are "actors" in the sense given this term in constructivist science and technology studies. In Chapter 2 I will explore the significance of this connection in more detail.

The genealogical interpretation of Marx is supported by another as-

pect of his method which anticipates the constructivist concept of interpretive flexibility, also discussed in Chapter 2. In a suggestive passage in *Wage Labour and Capital,* he writes, "A negro is a negro. He only becomes a slave in certain circumstances. A cotton-spinning jenny is a machine for spinning cotton. Only in certain circumstances does it become capital. Torn from these circumstances it is no more capital than gold is money or sugar the price of sugar."[22] This passage distinguishes the thing *qua* thing from its meaning in capitalist society.

The idea is commonly explained in social ontology, for example by Searle, in terms of the "distinction between those features that we might call *intrinsic* to nature and those features that exist *relative to the intentionality of observers, users, etc.*"[23] The chair has a function as a thing on which to sit only insofar as it is recognized as a chair—that is to say, only insofar as its meaning is apprehended by potential users. Assignments of meaning depend on a human subject.

But Marx has a different approach: he attributes the assignment of meaning to the economic system and argues that the function depends on the "relations of production in their totality."[24] Those relations he explains as more than economic, as the basic pattern of a way of life. The "mode of production must not be considered simply as being the reproduction of the physical existence of the individuals. Rather, it is a definite form of activity . . . a definite *mode of life*."[25] Thus the practices underlying a way of life support the function/meaning relation constitutive of the world in which that way of life goes on. Meaning is the *form of objective appearance* of these human relations. Furthermore, the analysis of the lawlike form of the appearances under capitalism grants those relations an order and independence of subjectivity quite different from the observer- or user-relative meanings described by Searle.[26]

Marx's basic insight is valid, the notion that things become what they are through their relation to a system, an order, a totality, but he identifies that system exclusively with the economy. Foucault generalizes his approach to social meanings of all sorts (i.e. to the cultural system). Marx had no theory of culture. Later work on the theory of culture deploys various methods for analyzing it too as a system.[27] Cultural meanings belong to a way of life just as do economic meanings. They are not independent of economics but become visible in a different cross-section of society.

Foucault's most important difference with Marx has to do with the consequences of the cultural turn. He argues that a power based on

knowledge and embedded in techniques cannot be overthrown by a political revolution. Modern society exists through the effects of power/knowledge and a change of government policies and personnel would leave those effects intact. What is possible is both less and more than such a change. Foucault argues for "the subversive recodification of power relations" underlying the structure and methods of the sciences in order to integrate the subjugated knowledge possessed by those on the bottom of the hierarchy.[28] "Those who resist or rebel against a form of power cannot merely be content to denounce violence or criticize an institution. Nor is it enough to cast the blame on reason in general. What has to be questioned is the form of rationality at stake."[29] The aim is not to abolish power but to find a way "which would allow these games of power to be played with a minimum of domination."[30]

The generalized concept of cultural system has important applications in critical constructivism. As Foucault argues, resistances have the power to alter meanings and thereby introduce a different range of functions that orient future developments. Actors have a variety of resources they can bring to bear to further their interests. Ownership is of course an important resource, overwhelmingly so in the case of production technology as Marx observed, but it is not the only resource and at times is overshadowed by social and political factors in domains where the market is less central. I will discuss the Internet on these terms in Chapter 4. It is a good example of the resulting hermeneutic ambiguities. Indeed, what is the meaning of the Internet? What are its primary functions? We could paraphrase Marx: "The Internet is a machine for transmitting data. Only in certain circumstances does it become capital or alternatively a democratic medium, a sex machine, etc."

Technology

On Foucault's account, technology is just one among many similar mechanisms of social control, all based on apparently neutral knowledge, all having asymmetrical effects on social power. The panopticon is Foucault's one developed example of the place of artifacts in his theory. Of it he writes, "The exercise of power is not added on from the outside, like a rigid, heavy constraint, to the functions it invests, but is so subtly present in them as to increase their efficiency by itself increasing its own points of contact. The panoptic mechanism is not simply a hinge, a point

of exchange between a mechanism of power and a function; it is a way of making power relations function in a function, and of making a function function through those power relations."[31]

A whole theory of technology is implied in this enigmatic passage. This theory is in fact also implicit in Marx's work although there it has a narrow application to production. Foucault liberates it from this limitation to become a general approach to the understanding of the politics of technology. Power, he argues, is not "added on from the outside," but is present in the very design of the technology. The panopticon is not a mere physical thing used to exercise power. Rather, the panopticon's design is essentially bound up with its function of surveillance. It is not a neutral tool available for a variety of uses; it *is* its function and that function has a specific social meaning, in this case the exercise of power through surveillance.

Of course in certain contexts the panopticon is a mere physical object—for example, in its relation to the weather. But the truth of the panopticon is not revealed in such contexts, any more than the essence of a human being is revealed on the operating table. The privileged context in which to understand a technology is the one in which it functions. And that context may involve, as it does in the case in question, an exercise of power.

How does this theory relate to Marx? Marx wrote his major works at a time when the Industrial Revolution in England promised to transform the world. The central role of science and technology in human history was suddenly visible. This inspired the still widely held deterministic view according to which technical progress depends on knowledge and not on political, social, or cultural influences. Scientific advance drags technology along in its wake and technology in turn determines social life. And because the most efficient design always wins out, there is a sense in which technology shares the rational necessity of scientific knowledge.

Marx was not a technological determinist despite having written some famous passages in which he says that the forces of production determine the relations of production and the superstructures. How Marx understood that determining role is in dispute, but one line of interpretation feeds directly into the concerns of this chapter.[32] According to this view Marx conceived of technology as contingent on social relations. Technology would thus have to be understood very much along the lines of Foucault's analysis of the panopticon.

Marx argues in several passages that the design of industrial technology reflects the requirements of capitalist production. He writes for example that science "is the most powerful weapon for repressing strikes, those periodical revolts of the working class against the autocracy of capital."[33] And further "it would be possible to write quite a history of inventions, made since 1830, for the sole purpose of supplying capital with weapons against the revolts of the working class."[34] These passages suggest that science and technology are shaped by the interests of the capitalist class. As a result productive labor is deskilled and replaced with machines.

Marx calls this process "real subsumption."[35] Once labor becomes wage labor, its tasks are simplified and parceled out. Production units no longer have a quasi-natural character rooted in community and family and supported by craft guilds and their traditions. The workers have no economic interest in the firm and deskilling eliminates intrinsic interest in work. Even understanding the work plan becomes difficult for those who implement it. As Andrew Ure writes in 1835: "By the infirmity of human nature it happens, that the more skillful the workman, the more self-willed and intractable he is apt to become, and, of course, the less fit a component of a mechanical system, in which, by occasional irregularities, he may do great damage to the whole. The grand object therefore of the modern manufacturer is, through the union of capital and science, to reduce the task of his work-people to the exercise of vigilance and dexterity."[36] Ure defines what I call the capitalist "design code" (or "technical code" in some earlier presentations). A social demand, in this case a demand of capital, presides over the Industrial Revolution and orients innovation throughout the nineteenth and twentieth centuries.

Marx shows how deskilling leads to mechanization. The analysis and breakdown of workers' tasks into simple fragmented gestures prepares the transfer of work to machines. Much of the capitalists' supervisory role can be objectified in such machinery, which is the appropriate technical form of capital. Mechanization transforms concrete labor into abstract and measurable units of labor power that can be supplied by anyone. Marx's analysis explains how, in Foucault's words, power relations come to "function in a function." Power/knowledge *avant la lettre* appears to be at work in Marx, although it would be an exaggeration to say he developed his theory explicitly along these lines.

Deskilling and mechanization are such general features of invention over the last few centuries that they appear to be essential to economic

development. Technical progress is defined in the dominant culture by the substitution of machines for humans. The technically rational form taken by this kind of progress makes it difficult to perceive its contingency. As a result old ideas about progress shared by Marxists and liberals alike prevailed until the 1970s when Harry Braverman's pathbreaking book *Labor and Monopoly Capital* renewed and developed Marx's critique of deskilling.[37]

Foucault's contribution supports a generalization of Marx's theory. In Marx's day most technology was deployed in factories and therefore struggle over technology was class struggle. Today Marx's approach can be applied beyond the factory setting. Technology is everywhere, including social domains remote from production. Administrative hierarchies that increasingly resemble capitalist management accompany technical mediation. The deskilling of manual labor and its total submission to management foreshadows the spread of similarly authoritarian relations between administrators and their employees/clients in technologically advanced societies during the twentieth century. This is the "control revolution" of technologized administration.[38]

From a constructivist standpoint, all this has to do with design because the design process brings together meaning and matter. It is a terrain on which social groups express their worldview materially and advance their perspectives and their interests. Design proceeds through bringing together layers of function corresponding to the various meanings actors attribute to the artifact. The study of the technosystem must identify the layers and explain their relations. This yields a "concrete" account in Marx's sense. It reveals the co-production of the social groups formed around the technology and the design that forms them.

An artifact's line of development appears to reveal the implications of a preexisting essence that unfolds with each improvement in its technical basis. Paths of development can be traced resembling the evolutionary progress of biological species. But in fact changes respond not just to objective conditions but to the purposes of the dominant actors. Designs are complicated by the multiplicity of interests they serve. The interventions of influential actors intersect and interact with unpredictable consequences. The result may block some familiar affordances and bring out others that lie undetected until new contexts support them or new actors discover them.

Technologies thus display some of the ambiguity we associate with social institutions despite their apparently rational form. Looking back

from the standpoint of the successful branch we project the criteria of development it fulfills back onto the origin, which then appears to initiate a teleological process. But this is an illusory teleology. A proper social history would uncover transformations rather than assuming stabilities, just as Marx, Nietzsche, and Foucault claim.

A Polytheism of Reason

Max Weber introduced a singular concept of rationalization to explain many of the processes Marx had earlier identified as central to capitalist modernity. But whereas in Marx rationality was conceived as potentially dual—capitalist or socialist—Weber argued that it had the same form in all modern societies. This led to the emphasis on the universality of capitalist modernity in Parsons and modernization theory. Modernity was conceived as a uniquely rational culture, transcending the provincial limitations of all previous culture through science and democracy.

Foucault breaks with this rationalist "monotheism" and questions Weber's simplification and its consequences in the sociological tradition. Foucault's notion of multiple "encodings" of modern life suggests that we should talk of rationalizations in the plural rather than the singular. He argues that there is no predestined outcome to technical or social development. The future, closed by the certainties of social science, opens up anew.[39]

Marx anticipated Foucault's essential point—namely, that a critique of modern civilization must include rationality in its purview. From a Foucauldian standpoint the workers' movement was simply the initial instance of a more general politics of rationality following the rise of the technosystem. There are hints in Marx of a critique of bureaucracy, but a developed theory was only formulated in the twentieth century. Once technical mediation spreads over the whole surface of society, a much wider range of struggles emerges, as is clear from the contemporary politics of the environment, medicine, and computerization.[40]

Each of these domains constitutes a network of interconnected institutions, objects, and individuals engaged in specific practices. To participate in such a network is to be implicated in power relations which may on occasion lead to resistance and revolt. Participants have what I call a "participant interest" in lessening the burden of participation. This was obvious to Marx, who assumed the existence of a class interest generated

by the situation of factory labor. Proletarian resistance was motivated by the exploitation and petty tyrannies of the factory.

Marx never developed a promised theory of class consciousness, but it would surely have highlighted the perspective from below, independent of the official knowledge systems of the bourgeoisie. Although they work at different levels of generality, there is an obvious similarity between the contributions of Marx and Foucault. What in Marx is class interest, struggle, and consciousness finds its parallel in Foucault's notion of an inherent resistance of life to power guided by "subjugated knowledges" reflecting the experience of subordinate participants in sociotechnical networks.[41] Subjugated knowledges are not formalized in technical disciplines and raise issues that cross the line between specializations where formal knowledge ignores salient connections in the real world. This experiential knowledge is responsive to a broad range of values, not simply efficiency and control. It inspires resistance to the dominant organization of the networks as does working class consciousness.

In this new situation social struggle disseminates, following the pattern set by the technosystem. The Marxist analysis of the factory appears too narrow to encompass the scope of contemporary technical politics. Social theory must follow technical struggles wherever they appear. The result is a broadening of the very concept of politics. While this is not a revolutionary theory of the Marxist sort, it offers a perspective on democratization lacking in most Marxist theory.

The struggle over prison conditions in which Foucault participated stands as an example of the generalization of technical politics beyond the realm of technology proper to administrative institutions based on technical disciplines. The design code of the prison system, determined and legitimated by the discipline of criminology, remains an important object of critique today.[42] Similar struggles over the environment, and in medicine, policing, and urban planning, show the entanglement of politics in the design of technologies and bureaucratic organizations. The very definition of *politics* is in flux as rationality is implicated in more and more contested issues.

The new politics of the technosystem can be understood as a struggle over design codes. For example, the Internet has been largely shaped by hackers and users who have made it into a medium of free and open communication. They continually disturb emerging patterns and prevent the naturalization of the technology. Popular resistance to business strategies still plays an important role in protecting this remark-

able achievement. The environmental movement has had a tremendous impact on public attitudes and on the design of industrial technologies. More than any other social movement, environmentalism has revealed the social contingency of technology. These unprecedented struggles and innovations testify to a growing will on the part of the citizens of advanced societies to shape their own technical destiny.[43]

Despite the modest results of these struggles so far, they have had a significant impact on the technosystem. Where formerly the continuum of technical progress, extending from the origins of industrialism down to the present, appeared unquestionable and inevitable, we now know that it is relative to a specific organization of society. This knowledge is not only academic but reaches a broad public. Controversy has replaced certainty, enlarging the public sphere to embrace a host of new issues. We are only at the beginning of the transformations promised by this change. Difficult as it is to imagine a world in which technical rationality is viewed as the question rather than the answer, that is where we are headed. Marx and Foucault have prepared this outcome. They have undermined one of the most important cultural certainties of the preceding century—the myth of progress. To paraphrase Freud, where rationality was, there politics will be. Marx called this "human control of history." It is still the task.

A Socialist Governmentality?

What are the prospects for a democratic alternative based on knowledge from below? Technical politics has become a commonplace phenomenon. Under the impact of democratic interventions, capitalism has become more humane and better able to take into account the needs of the underlying population, at least in the advanced capitalist societies. Democratic legitimations are gradually replacing technocratic forms, although this is primarily a rhetorical phenomenon so far. Think of all the talk of democratic management and flattened hierarchies—and the limited realities.

There is an inherent tension in the democratic legitimation of capitalism. The appeal to democracy undermines the centralized technical power essential to the system.[44] Growing economic inequality testifies to the fact that this power has not diminished. On the contrary! Democratic legitimation might liberate the potential for a new form of techno-

logically advanced society based on power relations incompatible with capitalism. At this early stage in the development of technical politics, there is no way to know if this is a realistic prospect, but it is at least interesting to contemplate.

Contemplating it I am reminded of a suggestive remark in Foucault's lectures on neoliberalism. He describes the difference between the early modern state, which attempted to regulate social life, and the liberal state that rules through opening a domain of free economic exchange. These are two "arts of government" or systems of "governmentality" in his terminology. Suddenly, Foucault digresses, as he often does in these lectures, to exclaim that socialism lacks a comparable art of government. It merely imitates the attempt at universal regulation of the early modern state, or limits to some extent the domain of free exchange established by the liberal state, but it has no original art of its own.[45]

After the failure of the Soviet Union, those who continue to speculate on socialist alternatives have indeed mostly sought regulatory and market-based alternatives, confirming Foucault's critique. But perhaps technical politics adumbrates a specifically socialist art of government already present today in embryonic form. Foucault himself described struggles around medicine and prisons that resemble contemporary technical politics in counterposing a subjugated knowledge from below to the official sciences. Such struggles were confined to a few institutions in Foucault's day but now they have spread in more or less conflictual forms to a great many more. These struggles are, to be sure, nonrevolutionary. They are far less disruptive than classic labor struggles, but they have significant effects on the quality of life. Most importantly, they bring different forms of knowledge into communication. That is something new for societies with advanced technology and administrative systems. I will return to this issue in Chapter 7.

These struggles produce reforms, not revolutions. Think of changes such as the new roles of women, environmental reforms, and the appropriation of the Internet by its users for human communication. It is normal for these changes to be absorbed by a still vigorous capitalist system, able to adjust to new constraints. But only a total failure of imagination can dismiss such epoch-making changes as merely "reformist" because the capitalist framework persists.[46]

The existence of democratic interventions would have still more far-reaching consequences in a socialist society that avoided the rigid bureaucratization that destroyed the Soviet experiment. Some antibu-

reaucratic measures are familiar from experiments in workers' control. While necessary, democratization of the enterprise is insufficient. Its relevance is challenged by the growing role of specialized knowledge in every area of modern life. Furthermore, it does not address the increasingly threatening externalities of modern technology.

But suppose that an antibureaucratic socialism opened administrations to challenges such as those Foucault analyzed. This would transform technical politics from a disruption of technical normality into a standard aspect of technical life. Under these conditions might a socialist society develop an original art of government based on the fluid interactions between lay and expert participants in the institutions of the technosystem?

■ CHAPTER TWO ■

Critical Constructivism

Mapping Critical Constructivism

This chapter explores the relation of critical constructivism to its two principal sources, Frankfurt School Critical Theory and early work in science and technology studies (STS).[1] Critical constructivism is concerned with the threat to human agency posed by the technosystem. Two early trends in STS, social constructivism and actor-network theory (ANT), addressed this threat implicitly, through challenging positivist and determinist ideologies that left little place for democratic control of technology. Critical constructivism agrees with STS that technology is neither value-neutral nor universal while proposing an explicit theory of democratic interventions into the technosystem. Critical constructivism thus puts STS in communication with the Frankfurt School. It is not so much an alternative to STS as an invitation to open the field to a wider range of philosophical and social theories of modernity.[2]

Before the emergence of STS, the social study of technology was associated with Marxism, pragmatism, Heideggerian phenomenology, and various sociological theories of modernity. These broad and often speculative theories focused on the relation of technology to society. They attempted to understand the specificity of modernity in terms of the scientific and technological revolutions and on that basis to account for the many ills of modernity, especially the decline of human agency in a technologized society. Their themes are familiar: technocracy, the tyranny of expertise, the substitution of knowledge for wisdom and information

for knowledge, a vision of society as a complex of functional systems, the meaninglessness of modern life, the obsolescence of man, and so on. Lost amid these vast concerns was technology itself.

STS has been largely successful in supplanting earlier approaches with empirical case studies of actual technologies. Today, few look to Mumford or Dewey, Heidegger or Marcuse for insight into technology. However, when STS turned to case studies it lost their wider social and political concerns. Of particular relevance to the argument of this chapter is the decreased emphasis on the contradiction between political agency and technocratic rationality.

The abstention of STS from political controversy was due to what Wiebe Bijker called the "detour into the academy," deemed necessary to establish the field as a social science.[3] Of course not everyone made the famous detour, but STS was sufficiently marked by it to trouble some who belonged to the earlier critical tradition. Langdon Winner spoke for them in an article significantly entitled "Upon Opening the Black Box and Finding It Empty: Social Constructivism and the Philosophy of Technology."[4] I responded differently by revising Critical Theory to accommodate the methodological innovations of STS.[5] Rather than calling for STS to adopt the critical spirit, I adopted the antideterminism and antipositivism of STS to support a critical version of constructivism.

The concerns of STS broadened as widespread controversies over medical care, the Internet, and the environment directly implicated technology in so many aspects of contemporary life. In response STS has become political, although sometimes with an unconvincing concept of politics.[6] ANT and the work of Sheila Jasanoff, Brian Wynne, and many others has had a broad influence on attempts in STS to understand the politics of technology.[7] Studies of hybrid forums and co-production challenge narrow understandings of democracy prevalent in philosophy and political theory.[8] Some STS researchers have now also become aware of the politicized approaches favored in the developing world, especially Latin America.[9] But how can the prior achievements of STS, exemplified in so many brilliant case studies, be preserved in the context of politically charged investigations of controversial issues? For reasons rooted in the origins of STS, this poses problems.

As STS has responded in recent years to the emergence of public participation in determining technology policy, it has moved closer to the concerns of critical constructivism.[10] But critical constructivism is still distinguished from most contributions to STS by the concept of domina-

tion it draws from early Frankfurt School Critical Theory. Horkheimer, Adorno, and Marcuse argue that instrumental rationality is bound up with domination but hold out hope for its transformation in a future free society. The crucial difference between STS and Critical Theory thus has to do with rationality. Is there such a thing, and if so what is its significance? The previous chapter showed that Foucault affirms the connection of instrumental rationality to domination while disaggregating it into a multiplicity of socially specific types. But domination largely disappears from STS research. Some STS scholars deny the very pertinence of the concept of rationality and reduce it to a variety of nonrational procedures.

Critical constructivism draws on STS while placing the issues in the context of the Frankfurt School's critique of modernity. In so doing it attempts to reconcile Critical Theory and STS with Foucault's genealogical method and critique of context-free rationality. The reconciliation is possible because Critical Theory characterized the rational system of domination of advanced industrial society as a contingent social achievement rather than as an essential consequence of rationality as such. It ought to be possible to disaggregate this critique and elaborate it empirically.

Like the modernity theorists, STS reacted against technocratic ideology but it did not embrace sweeping philosophical critique. The key alternative concepts proposed by social constructivism are the notions of actors, underdetermination, interpretive flexibility, and closure. Critical constructivism incorporates these concepts along with the concepts of program, delegation, and co-production drawn from actor-network theory. Although introduced to account for particular cases, these concepts lend support to the critique of technocratic ideology. But that critique is incompatible with the most radical conclusions of STS theorists, such as the symmetrical treatment of disputants in technological controversies and the symmetry of humans and nonhumans.

The first sections of this chapter will map the relation between critical constructivism and some of the major scholars and methodological innovations of STS and the Frankfurt School. Next, the chapter explains my reservations concerning the concept of symmetry which was central to early STS scholarship. The succeeding sections will explain the principal concepts and methods of critical constructivism and its political implications. In conclusion I will interpret an interesting STS case study and discuss the methodological implications of the combined theory.

On Critical Theory

The term "Critical Theory" is ambiguous, not only because many trends with no connection to the Frankfurt School have appropriated it but also because the Frankfurt School itself is traversed by a sharp divide between its first and later generations. In this section I explain why I remain convinced that despite Habermas's important contributions, only the first generation provides a starting point for a critical constructivism able to address the politics of the technosystem.

Critical Theory was originally developed by German Marxists in the 1920s and 1930s. Its most famous members were Max Horkheimer, Theodor Adorno, Herbert Marcuse, and Walter Benjamin. They were influenced by Georg Lukács, whose concept of "reification" described the reduction of complex and dynamic social relations to apparently law-governed (social) things.[11] Lukács argued that the members of a reified society understand themselves as isolated individuals. As such they cannot change the laws of social life, only use them as the basis of technical manipulations. The Frankfurt School continued this line of criticism, demystifying reified institutions and opening up possibilities of critique foreclosed by the tendentious appeal to social and economic laws.

Increasingly, from the mid-1930s on, the Frankfurt School focused on the collapse of both bourgeois culture and the proletarian movement in the face of mass culture and fascism. The dominant liberal ideology of the post–World War II era continued these trends, placing technocratic claims at the center of public discourse. Social arrangements were justified by reference to their rational character and opposition dismissed as sentimental nonsense. With *One-Dimensional Man* Marcuse distinguished himself by the popular success of his critique of American society as a highly integrated system governed by "technological rationality."[12] His book resonated with the concerns of youth in the advanced capitalist world. The technical details of the theory were not widely studied or understood at the time, but today it has surprising relevance. He not only claimed that technology has been shaped by the capitalist social forces that presided over its creation, but he argued for the possibility of technological change under the influence of progressive social forces.

Marcuse's critique of "technological rationality" as a legitimating ideology updated the earlier Marxist critique of market rationality. Social life in our time appears increasingly not only to depend on science

and technology but also to mirror scientific and technical procedures. Efficiency is said to be rational and commands respect in every area of social life. Rationality thus serves as the justification and alibi for domination. The "mantra of efficiency" draws strength from this connection even as it has disastrous consequences for some of those affected.[13] Critique is disarmed before it can get off the ground by a blanket accusation of irrationality. Who dares question the universality, the neutrality, the progressive contribution of science? Luddites and other "romantics" are easily dismissed with a reference to the overwhelming success of modern science and technology.

Marcuse's version of Critical Theory recapitulates the essential content of Lukács's concept of reification, the notion that capitalism imposes a rational culture that privileges technical manipulation over all other relations to reality. It narrows human understanding and lives to conform with the requirements of the economic system. Capitalism thus determines social interaction and experience. Marcuse writes, "When technics becomes the universal form of material production, it circumscribes an entire culture; it projects a historical totality—a 'world.'"[14]

The second and third generations of the Frankfurt School are overwhelmingly influenced by the work of Jürgen Habermas. He rejected the first generation's critique of modernity and its utopian *point d'honneur* in favor of a modest hope in gradual social progress. Habermas transformed Critical Theory with ideas drawn from contemporary social science, especially systems theory and communication theory. He divided modern societies into two spheres—a "system" consisting of the administrations and markets and a "lifeworld" based on communicative interaction.[15] This dualistic framework continues the critique of domination of the early Frankfurt School while rejecting its totalizing, dystopian conclusions.

According to Habermas two different rationalities organize modern societies. The system coordinates social action through the rational organization of markets and administrations. This vastly simplifies social life and makes possible a complex, large-scale modern society. Individuals have no need to meet and reach agreement in a modern market based on monetary exchange. Similarly, administrations applying standard rules and procedures need not negotiate each case individually. The system domains are said to be "delinguistified" in the sense that they require only standardized speech forms aimed at sale and purchase, command and obedience. The "success-oriented" practices of economic

and administrative agents correspond to a specific type of rationality, instrumental rationality, which is properly confined to the system. The lifeworld operates according to another type of rationality. This "communicative rationality" aims not at success but at mutual agreement. As such it holds the democratic potential of modern societies.

Habermas concludes that the problems of modernity are not due to inherent flaws in instrumental rationality as the first generation theorists believed but rather to its overextension into spheres of life, such as the family and politics, that ought to be organized through communicative interaction.

This theory implies an essentialist concept of system rationality. Habermas seems to believe that systems such as the market have intrinsic requirements that flow from their nature. Fulfilling these requirements is rational and obstructing them irrational and regressive insofar as they represent progress over premodern forms of life. The general concept of instrumental rationality, which founds the two system rationalities, is neutral and nonsocial. Its application should be limited only by the legitimate limits of an orientation toward success. Instrumental rationality has an appropriate sphere of application, the system (i.e. markets and administrations), and an inappropriate sphere, the lifeworld.

Habermas literally redefined Critical Theory. Attempts to continue the legacy of the first generation went nowhere as the debate turned exclusively on the implications of this new approach. Critical Theory became synonymous with Habermas, his followers, and his loyal opposition, the latter engaged in debate around issues he had ignored, such as gender, but also indifferent to the earlier critique of technology.

During the same period in which Habermas reshaped Critical Theory, the study of science and technology was radically transformed by a new generation of constructivist scholars. They rejected the prevailing positivism in philosophy of science and determinism in sociology of technology. Positivism and determinism hold that science and technology are value-neutral products of inquiry, exogenous influences on social life. The constructivists argue to the contrary that scientific-technical rationality is through and through marked by social influences and beliefs. This led to relativistic and indeterminist positions that were in harmony with the increasingly skeptical attitude of the public toward expert authority in the 1970s and 1980s.

Habermasian Critical Theory had little to contribute to these debates since it ignored technology and treated the system as a sphere of ratio-

nal action with a logic independent of the lifeworld. The fear of falling back into a quasi-Heideggerian antimodernism blocked the realization that constructivism and the environmental movement had undermined the very basis of Habermas's division of society into separate spheres. Marcuse, the great critic of technological rationality, whose utopian aspirations were explicitly formulated, was eclipsed even as his critique of progress was proven increasingly prescient.

Habermas's theory has been subjected to a wide variety of criticisms. I base mine on the peculiar historical situation in which the most powerful modernity theory completely ignored the growing challenge to the technological underpinnings of modernity. In response to this situation I began in the 1980s to develop a "critical theory of technology." I argued that the early critique of instrumental reason could be saved from the charge of antimodernism if it were presented in more concrete and empirical terms through applying the methods of constructivist science and technology studies. Today it seems appropriate to call the theory I developed "critical constructivism" given the significance of constructivist methods for my current formulation.

On Habermasian terms, this means that system and lifeworld can no longer be distinguished as separate spheres, and social critique is no longer confined to establishing the boundaries between them. Instead, instrumental and communicative rationality interpenetrate in all institutional settings. A theory of that mutual influence is implicit in constructivist methods.

My critique of Habermas emphasizes two extraordinary lacunae in his theory—the failure to include technology and the absence of a theory of the bias of rationality. The role of design is at issue in both but absent from Habermas's theory. The exclusion of technology is indefensible. If the essence of the system is delinguistified action coordination, then technology obviously belongs to the system.[16]

As constructivism has amply shown, Habermas's theory is empirically flawed. Systems have an intrinsic logic, to be sure, but that logic is incapable of fully specifying their actual design. Technologies are underdetermined by their strictly technical basis. They are realized through the intervention of actors who interpret their purpose and nature. These interventions emerge from the lifeworld and determine the design of technical artifacts in conformity with a combination of normative and technical principles. The same sort of analysis can be extended to ad-

ministrations and markets. Design in the case of administration takes the form of organizational structure and operating rules, and in the case of markets various forms of marketing, product and purchaser definition, subsidy, regulation, patents, and zoning.[17] There is quite simply no pure instrumental rationality. That is a reified conception of social life effectively refuted by Lukács and the first generation of the Frankfurt School.

Contributions of Social Constructivism and Actor-Network Theory

Social constructivism argues that technological design depends on how social groups or "actors" interpret technical problems. The early stages of the development of an artifact often involve a multiplicity of actors with conflicting interpretations of the nature of the problem to be solved. Different social groups may assign different purposes to devices that are basically similar from a technical standpoint. Design decisions flow from these assignments. The application of social constructivist methods to particular technologies blocks the ideological recourse to efficiency arguments by showing that social factors intervene in the decisions that lead to "closure"—that is, the phase of the design process in which consensus is achieved or competitors drop by the wayside.

In one of the most cited instances of this approach, Trevor Pinch and Wiebe Bijker offer the example of the early history of the bicycle.[18] Two competing types of bicycles coexisted in the early days: a fast bicycle with a large front wheel and a small rear wheel and a slower bicycle with two wheels the same size, known as the "safety." Today the large front-wheelers appear to be primitive predecessors of the bicycles we ride, but in its own day the design suited a specific group of users. Pinch and Bijker propose a "symmetrical" treatment of the two main designs that takes account of their contemporary social meaning rather than viewing them in terms of an imaginary chronology.

This constructivist "principle of symmetry" was initially introduced to achieve evenhanded treatment of both winners and losers in scientific controversy. The commonplace attribution of superior rationality to the winner of the controversy was to be resisted in favor of an appreciation of the mixed motives and questionable assumptions on all sides. In its

application to technology, the constructivist principle of symmetry requires a balanced view of the various designs competing at the outset, no one of which is obviously superior in the eyes of contemporaries.

Each of the bicycle designs Pinch and Bijker studied appealed to different actors: the high front-wheelers to young men who liked to race and the more stable design to people using a bicycle for transportation. Most of the parts were similar and both versions looked like a bicycle, but they were actually two different technologies understood in different ways by different social groups. Eventually, through innovation, the safer model prevailed. Inflatable tires satisfied both the racers' desire for speed and the ordinary users' transportation needs. This concretizing innovation reconciled all the relevant actors to a single design.

According to Pinch and Bijker, the success of the safety was not due to absolute technical superiority but to contingent developments. The outcome can only be understood by taking into account the long history of actors' competition for control of meaning. The technical underdetermination of artifacts leaves room for social choice between different designs that have overlapping functions but better serve one or another social interest. This "interpretive flexibility" of artifacts concerns a hermeneutic dimension overlooked in standard instrumentalist accounts.

As Pinch and Bijker write, "The different interpretations by social groups of the content of artifacts lead by means of different chains of problems and solutions to different further developments."[19] Their key point is the influence of the social on "the content of the artifact" itself and not merely on such superficial factors as the pace of development, appearances, or usages. This means that context is not external to technology but actually penetrates its rationality, carrying social requirements into the very workings of the device.

This constructivist approach could lend support to the Marxist account of the development of a specifically capitalist technology in opposition to the deterministic arguments of the postwar technocracy. The "rational society" is not the "one best way" but contingent on values and interests. In fact, anticipations of constructivism can be seen in the work of Marxist historians of technology Harry Braverman and David Noble.[20] The Frankfurt School affirmed the capitalist nature of technology on the basis of the same sources in Marx's work that influenced these scholars. Adorno writes, for example, "It is not technology which is calamitous, but its entanglement with societal conditions in which it is fettered. . . . Considerations of the interests of profit and dominance have

channeled technical development: by now it coincides fatally with the needs of control. Not by accident has the invention of means of destruction become the prototype of the new quality of technology. By contrast, those of its potentials which diverge from dominance, centralism and violence against nature, and which might well allow much of the damage done literally and figuratively by technology to be healed, have withered."[21] This argument offers a possible bridge between Marxism and constructivism. Adorno, like the constructivists, attributes the design of technology to the actors who dominate the design process.

However, other scholars, including those influenced by the work of Bruno Latour, object that in relativizing technology this approach absolutizes society. Latour's formulation of actor-network theory attempts to disengage constructivism from what he considers an overemphasis on human intention in order to bring the material layers of the network into focus. ANT therefore extends the constructivist approach to the things incorporated into technical networks. Its argument for a functional "symmetry of humans and nonhumans" differs from the social constructivist version of symmetry.[22] ANT blurs the distinction between the intentional acts of humans and the causal powers of things, signifying both with the neutral term *agency*. People and things link together in networks and have effects on the networks to which they belong. The concept of "program" in ANT does the work of the constructivist notion of interpretation with the proviso that things too may have programs since their agency plays a role in the life of the network.

ANT avoids the subjectivism and relativism sometimes attributed to social constructivism, but it does so in a strange way—not by reintroducing the objective properties of things identified by scientific research but rather by describing their roles in the networks to which they belong. A similar reduction strips human beings of inwardness.[23] People and things are to be understood as *essentially* actors in networks, not as subjects and objects. The division between subject and object, meaning and causality is then explained as a misleading theoretical operation specific to modernity, which Latour calls "purification."[24] This after-the-fact epistemological *coup* obscures the foundational significance of the hybrid sociotechnical realities of the networks.

ANT thus posits the hybrids prior to their components. Its concept of "co-construction," or "co-production," calls attention to the interdependence of the human actors and the technical world in which they find themselves. Societies are not constituted by purely social bonds but

form around the technologies that support the interactions of their members. (The affinities between this approach and that of Simondon are discussed in Chapter 3.) Human agency must not be privileged over the agency of the things that support the sociotechnical networks in which society consists. This argument, like that of social constructivism, is subversive of a naïve confidence in the purely "rational" character of the technical world, which is now shown to be a scene in which many types of agents are active in terms of a variety of programs.

Critical constructivism draws selectively on social constructivism for an alternative to technological determinism and on ANT for an understanding of networks of persons and things. The constructivist approach emphasizes the role of interpretation in the development of technologies. ANT explores the implications of technical networks for identities and worlds. These notions are congruent with the critique of context-free rationality in the early Frankfurt School and give insight into the bias of technology.[25] Critical constructivism thus concretizes the Frankfurt School approach through the application of STS methods.

The Limits of Symmetry

Constructivist STS has introduced new ideas about technological design and the relation of publics to the technical mediations that bind their members together. This is an important advance over standard social and political theories that abstract from technology or fetishize it deterministically. However, the moves beyond case studies to found a relativistic epistemology and a new network ontology are less persuasive. The problems show up in attempts to generalize STS as a full-fledged political theory. As we have seen, the two principles of symmetry require that the same methods and terms be used for participants in controversies and in the descriptions of the relations between humans and nonhumans. These principles have contradictory political implications. On the one hand, they weaken the hegemony of the technocracy and carve out a place for democratic initiatives in the technical sphere. But on the other hand, they make it difficult to understand the nature of social conflict in a heterogeneous environment such as a modern capitalist society.

The constructivist principle of symmetry proves particularly effective in valorizing the technical contributions of ordinary people. Experts bound by interests and traditions sometimes overlook problems and po-

tentials revealed once their products circulate widely.[26] Environmentalism is based in large part on the intolerance of users and victims for levels of pollution deemed acceptable at first by business and experts. With the Internet, users have made an undeniable contribution to the evolution of a major technological system. Symmetry makes for even-handed treatment of public involvement in the redesign of flawed or unnecessarily limited technologies.

Some of these lay interventions involve significant conflict with established institutions. Social conflict was of course a central concern of Marxists such as Lukács and Marcuse. Early social constructivism modeled its discussion of technology on a different type of conflict—scientific controversy. This poses a problem for the generalization of STS methods to society at large. Many later attempts in STS to understand social conflict have broken with this early model, but constructivist symmetry remains an important concept to which reference is often made.

Although there are exceptions, scientists typically act in good faith and on the basis of evidence, even when they disagree over its interpretation or are deluded by their hopes. The social aspect of science is not primarily a matter of motives.[27] The constructivist principle of symmetry was introduced in acknowledgment of this fact. Its application to scientific controversies was intended to ensure that the same methods would be applied to all parties to disputes, avoiding a one-sided treatment. As noted above, the methodological relativism imposed by symmetrical treatment counteracts the tendency to idealize the winner and undervalue the intelligence and rationality of the loser (or, vice versa, to demonize the winner and overvalue the achievements of the loser).

For example, Priestley's rejection of Lavoisier's discovery of the mechanism of combustion cannot be laid to mere dogmatism, self-interest, or stubbornness; his point of view too must be considered as a rational, if unsuccessful, attempt at understanding.[28] Unfortunately, many technical controversies are quite different from this model. One or both sides are often biased by economic interests, dishonest claims, irrational panic, racial or gender prejudice, and the corruption of scientific and public actors. The principle of symmetry can mislead if applied injudiciously in this fraught context. Its application risks providing alibis for the machinations of unscrupulous actors or systematic discrimination. A relativistic method is of no use where dishonesty or prejudice prevails.[29] Not only is symmetry ill-suited to the rough and tumble of technological controversy but it also risks canceling the normal attributions of respon-

sibility on which we rely in public life. An evenhanded treatment of bad decisions can slip over into excuses for those responsible.

Consider the case of the *Challenger* accident as explained by Trevor Pinch and Harry Collins.[30] The common view of the accident attributes blame to NASA managers' impatient refusal to consider all the evidence. This asymmetrical explanation conforms with our usual notions of responsibility, but is it right? The danger of a cold weather launch had not yet been proven experimentally on the fatal day, but there was cause for concern: the informed observations of the engineer assigned to investigate the problem. His observations were ignored, Pinch and Collins write, not because management rejected reasonable caution but because they did not meet "prevailing technical standards."[31] Symmetry prevails, but responsibility is defeated. The question remains of why "technical standards" were preferred in this instance, why expert observations were ignored in favor of more rigorous proof that was unavailable. Could it be that symmetry was broken at the level of epistemology? All too often, scientism trumps all other evidence when it serves the interests of the dominant social actors, but only then. This is a good illustration of Marcuse's notion of "one-dimensional thought," which privileges quantitative precision over experiential knowledge.[32]

ANT has other problems with politics. The network approach led to the widely adopted concept of co-production of society and technology. This concept is well suited to understanding political controversies over technology. It focuses political theory on the technical mediation of politics. But Latour's ambitious theoretical program is not as successful in applying the concept of co-production as the case histories. The principle of symmetry of humans and nonhumans was intended to orient research toward the materiality of the networks uniting them. These networks were said to explain all macro entities such as "state," "ideology," "class," "culture," "nature," and "economic interest." But critics accused Latour of bias in favor of the victors in the struggle to define nature since he argued, in accordance with good STS practice, that nature in the only meaningful sense is established by the network. But what if the nature so defined is discriminatory? To what can the losers in struggles over race or gender discrimination appeal if not to a "natural" equality grounded on a different definition of nature?[33]

Latour responded to his critics in his writings on ecology, arguing that actors can introduce new objects into the taken-into-account world—for example, such objects as toxic wastes and smog. Freedom of

discussion in the constitution of the "collective" would ensure against economic or technocratic domination. This is not a bad start toward understanding environmental issues such as climate change, but it does not explain the actual struggle between affirmers and deniers and the gaps in national uptake of the policy recommendations of the UN panel on climate change.

Latour's rejection of "critique" and of macro concepts in social theory deprives him of the means to address the role of interests and ideologies in determining positions on the issues. Indeed, these good old-fashioned Marxist notions are obviously in play when energy bosses like the Koch brothers mobilize a billion dollars or more to sponsor climate denial and support political candidates whose policies protect their purse.[34] Furthermore, without access to macro concepts, he cannot address the principal insight of the Frankfurt School—namely, the role of capitalism in the cultural generalization of instrumental rationality.

In an early work, Latour introduced the term "anti-program" to signify the conflictual aspect of networks.[35] Critical constructivism introduces a new principle of symmetry based on this notion. I propose the symmetry of program and anti-program in order to avoid any bias in favor of the dominant actor.[36] Programs corresponding to actors' intentions carve out subsets of the interconnected elements brought together in the network. Where actors are in conflict, different programs may highlight different elements. The same factory that appears to its managers as an economic entity may appear to its neighbors as a source of pollution. Both managers and neighbors belong to the network, but their different relations to it are manifested in different programs—for example, a business plan and a lawsuit. Simondon's concept of individuation, explained in the next chapter, shows how to reconcile relativism at the level of programs with realism in the analysis of the network.

Critical constructivism argues for a discriminating application of the two symmetry principles of social constructivism and ANT and rejects methodological individualism. This does not imply a return to preconstructivist realism and humanism, but it does open a bridge to the recovery of key insights of the tradition of social thought, insights that help in understanding the tensions between subordinate social groups and a rationalized society.

As STS has evolved over the years it has engaged increasingly with politically sensitive issues. The problems with symmetry are rarely addressed directly. But the austere exigencies of the early methodological

struggles are left behind by researchers borrowing useful methods and insights from many fields. Critical constructivism offers one possible theoretical framework for such methodological *bricolage*.

Sociotechnical Citizenship

Critical Theory agrees with ANT that individuality cannot be conceived independently of other people and things. The individual emerges from the "network" constituted by the family and its material and cultural environment and is always thereafter conditioned by its roles in the networks to which it belongs. But once constituted the individual retains its identity and agency as it switches from network to network. It cannot be dissolved into its roles. The relative stability of individuality is the basis of the reflective capacities that enable it to distance itself from and criticize the networks in which it participates.[37]

In the tradition of the Frankfurt School individuality is regarded as a historical achievement. Bourgeois culture generalized the capacity for independent thought to an unprecedented degree. This is the basis of personal and political agency, the power to define one's identity and to further one's interests. In principle, socialism would extend this capacity to every human being, but in the mid-twentieth century the Frankfurt School concluded that individuality belonged to an all-too-brief interregnum between societies in which independent thought is overwhelmed, either by custom and religious conformity or by technocratic ideology and mass culture. Reflective rationality is disarmed by the claims of technological rationality and the joys of private consumption. The mass of the population is condemned to passive conformity while a minority preserves its mental independence through theoretical and artistic critique.[38]

Yet in recent years we have seen the sphere of public debate and activity expand to take in technical issues that were formerly considered beyond the bounds of discussion. With the expansion of the public sphere, new forms of agency have emerged. This has given rise to what David Hess calls "object conflicts," conflicts over how to configure technologies so as to serve various interests and conceptions of the good life.[39] The nature of these conflicts lies at the heart of this chapter. Their proliferation raises new questions about technology and democracy. Have we become technical citizens? More precisely, is there political agency

in the technical sphere? And if there is, what is its relation to technical expertise and traditional political agency?[40]

Agency in the sense in which I use it is not a matter of arbitrary preferences but is rooted in the experiences associated with specific social situations. Technical systems enroll individuals in networks which involve them in various roles—for example, as users of the technology or workers building it, or even as victims of its unanticipated side effects. Interests flow from these roles and become politically salient where the individuals have the capacity to recognize them. This is how Marx understood the relation between the class interest of the proletariat and the production technology that formed it into a class. As I argued in the first chapter, Foucault reached similar conclusions in his study of medicine and prisons. In a technified world we can generalize from these examples to a concept of "participant interests" that would apply wherever individuals are engaged with the technosystem. In sum, social struggle *is* technical struggle.

For example, the drivers of automobiles discover an interest in better roads they would have had no reason to feel before joining the automotive network. Similarly, the victims of pollution discover an interest in clean air that would never have occurred to them had they or their children not suffered from respiratory problems caused by those drivers. Drivers, sufferers, and cars co-produce a network to which all belong and it is this which makes certain interests salient that might otherwise have remained dormant or had no occasion to exist at all.

Once enrolled in a network, individuals not only acquire new interests but in some cases they also acquire a situated knowledge of the network and potential power over its development. This knowledge from below and insider power are different from the knowledge and power of individuals who have no connection to the network. Even without expert qualifications, insiders can identify problems and vulnerabilities. They have a platform for changing the design codes that shape the network. This is conscious co-production—the reciprocal interactions of members of the network and the codes that define roles and designs.

In critical constructivism, the actions of citizens involved in conflicts over technology are called "democratic interventions." Most of these are "a posteriori," occurring downstream after the release of technologies into the public world. There are many contemporary examples such as controversies over pollution or medical treatments, leading to hearings, lawsuits, and boycotts. Such controversies often result in changed

regulations, designs, and practices. A second mode of intervention, the creative appropriation of technology, involves hacking or the reinvention of devices by their users to meet unanticipated demands. This mode has played an important role in the evolution of the Internet.[41] A third mode of intervention involves action prior to the release of technologies. This a priori mode takes two main forms, public participation in "citizen juries" or "hybrid forums" to evaluate proposed innovations and collaboration in the design process. In these cases, the individuals are solicited to participate by the authorities in advance of final decisions rather than entering the process in protest after all the decisions have been made.[42]

Differentiation and Translation

The notion of technical citizenship raises questions concerning the role of expertise. Ordinary people intervene in technical decisions on the basis of everyday experience rather than through mastery of a technical discipline. Experts possess such mastery and are qualified to implement technical decisions as most lay people are not. The claims of experience and those of technical disciplines must be reconciled in the design process. The conundrum only seems insoluble from a narrow and dogmatic perspective. In the real world of technology, a largely unacknowledged dialogue between lay and expert is a normal feature of technical decision making and should be further developed.[43]

If we have a different impression and fear both arrogant expertise and irrational experience, that is a function of changes in the regulation of technology that took place in the nineteenth century. Before that time judicial authorities worked with craftsmen and communities to regulate the harmful externalities of production. The case law embodied the accumulated wisdom of experience as it applied to technical activity.[44] In the nineteenth century the path was cleared for rapid technical advance at the expense of workers, communities, and users of technology. Supposedly universal scientific knowledge replaced situated knowledge and central administrative controls buttressed by expert authority replaced the traditional judicial restraints on technology. These changes accompanied a much-enhanced differentiation of society under the impact of industrial capitalism.

The separation of technical work from everyday life is an important aspect of the differentiating process of modernization. Medieval craft

guilds were social as well as professional organizations. In addition to regulating prices, training, and quality, they had many other functions. The crafts were not based on specialized technical disciplines in the modern sense but on traditional knowledge of materials and practices, rules of thumb, and what the French call *tours de main*. Their "secrets" needed to be kept secret precisely because they were communicable to experienced consumers. In fact the final stages of production often required consumers to finish the artifact in a process called "breaking in."

Modern technical work depends on specialized technical disciplines. The language of these disciplines can only be understood by initiates, those trained in the profession. The social and religious concerns of the guilds are stripped away along with the independence of the technical worker. Today, most technical work goes on in business enterprises, which significantly changes its character and goals.

The property system on which business is based is also affected by the process of differentiation. In precapitalist societies ownership involved broad responsibilities. Landowners had political, judicial, and religious functions. Capitalism strips away all these obligations and powers in the interests of profit. Other goals such as providing employment and protecting the community are gradually abandoned.[45] This new form of property explains the destructive logic of the Industrial Revolution. Indifference to nature and human beings shaped modern technology. Throughout the development process, scientific and technical knowledge was applied without regard for the social and natural context of enterprise. Narrow specializations and narrow economic goals complemented each other. The resulting simplifications accelerated technical progress but also led to problems we are only beginning to address today.

For generations the victims of progress were too weak, ignorant, and marginalized to protest effectively. But conditions gradually changed, especially after World War II. The side effects of more powerful technologies became visible and provoked a public response.[46] Unions and social movements gained influence and demanded the regulation of industry. As a result, a new stage of "reflexive modernization" engaged a slow corrective process that still continues.[47]

Where formerly cognitive success required breaking all dependence of technical knowledge on everyday experience, Bacon's famous "idols," experience now measures the consequences of technical knowledge and designs.[48] Those consequences can no longer be ignored and are traced back to their origin in the blind spots of technical disciplines and the

limitations of the business perspective. Users and victims now defend themselves against narrowly conceived technology on the basis of their understanding of their experience.[49] Such democratic interventions constitute the social background that explains the broad success of new interdisciplinary initiatives such as STS.

These postwar trends constitute original forms of de-differentiation that are progressive rather than regressive in nature. On the one hand, the technosciences bring science and technology together in powerful combinations, crossing well-established boundaries between the true and the useful.[50] On the other hand, corresponding to the emergence of technoscience and its increasingly dangerous side effects, public demands for government regulation cross the lines between politics and economics, forcing capitalist enterprise to work under a widening range of constraints. The new relationship must develop its own institutions for translating social knowledge about technology's harmful effects or overlooked potentialities into technical specifications for better designs. Such translation processes will become routine in the long run as public involvement increases, closing the loop in which technology modifies society while itself being modified by society.

Layers and Codes

The emergence of technical citizenship highlights the inherent contingency and complexity of technical artifacts and systems masked by the coherence of technical explanations. Critical constructivism proposes a genealogical approach that treats social "things," such as artifacts, institutions, and laws, as assemblages of functional components held together by their social roles. The components disaggregate and recombine as society changes.

In the case of technology and technical systems, these constructions reflect the relative power of the actors engaged with design. The outcome of their struggles and collaborations is a "design code." The code identifies the larger social meaning of technical designs, the stabilized intersection of social choice with technical specification. Design codes translate the one into the other through what ANT calls "delegation." For example, the social demand for wheelchair-navigable sidewalks became a specification for construction projects. The rights of the disabled were translated into a specific slope. Taken in isolation the slope appears

merely technical, but in its context it has a political significance captured in the code.[51] Such codes are incorporated not only into designs but also shape technical disciplines.

Design codes translate worldviews and interests between the everyday language of social actors and the technical languages of engineers or managers. The translation hides the social significance of the codes behind a veil of technical necessity. Codes that achieve unquestioned authority constitute a technical culture. The task of critique from Marx down to the present is to reverse the process of translation and reveal the code's human significance.

Critical constructivism distinguishes two types of design codes—the codes of particular artifacts and the codes of whole technical domains. The sidewalk example illustrates the artifact code. Codes relevant to whole technical domains are involved in the definition of progress. The domain code under which industrial progress was pursued in the nineteenth century replaced skilled labor by machines. This code is influential to this day. Where it is contested we see the continuing role of public action in determining the technical future.[52] Domain codes in modern capitalist societies are translated into higher-level meanings, such as ideologies and worldviews. For example, the technocratic concept of efficiency translates particular interests into technical arrangements conducive to the exercise of managerial authority.[53] Reification may be considered the ultimate domain code of capitalism, describing the core principles to which all the lesser domains conform.

Critical constructivism expresses these complexities through the analysis of the layers of design corresponding to the various meanings actors attribute to the artifact.[54] Adding layers corresponds to accepting more social inputs. Artifacts are not coherent individuals but rather they are concatenations, assemblages of more or less integrated parts. Like a palimpsest, their parts embody levels of meaning that reflect a variety of social and technical influences. The study of technology must identify the layers and explain their relations. This yields a "concrete" account in Marx's sense, as explained in Chapter 1. It reveals the co-production of the social groups formed around the technology and the design of the technology that forms them.

Often apparently conflicting interests are reconciled to some extent in the final design. The result may involve trade-offs, compromises resulting in a less-than-perfect design for all parties. More interesting are those cases in which elegant innovations make it possible to satisfy all

the different demands without loss in efficiency. Gilbert Simondon calls such innovations "concretizations," that is, the merging of several functions in a single structure.[55] The next chapter will explore this concept in detail and Chapter 4 applies it to the Internet.

Revising Rationality

The early Frankfurt School addressed a cultural environment characterized by an unprecedented faith in instrumental rationality. It attributed the decline of agency to the rational culture of modernity. This is not merely a subjective disposition but is reflected in the multiplication of markets, administrations, and technologies that effectively organize and control most of social life on the basis of technical disciplines. The knowledge of ordinary people is increasingly devalued and their agency reduced to technical manipulations of the given rational systems.

This is still the situation in which democratic interventions challenge the technocracy today. But the original all-encompassing formulations of the Frankfurt School left no room for the return of agency. Anything short of the revolution was dismissed as merely more of the same (*Immergleiche*). To account for struggles over technology, critical constructivism elaborates the critique of rationality in a more empirically oriented form.

Where the Frankfurt School proposed a very general critique of "reified" or "instrumental rationality," critical constructivism looks to a more concrete critique of the bias of social institutions and technologies. Rational culture is shown to depend on methods and concepts modeled on mathematics and natural science generalized as a framework for thought and action in every sphere. For example, market relations rely on quantification in the form of prices. Similarly, administrations subsume specific cases under precisely formulated rules that resemble laws of nature in their formalism and pretention to universality. Technology is implicated in scientific development.

Critical constructivism studies these domains with methods explored in STS and elaborates a cultural and political critique of modern institutions. STS shows that technically rational design is underdetermined by purely technical considerations and thus is biased under the influence of social criteria.[56] As explained in Chapter 1, I call the materialization of interests and ideologies in technical disciplines and designs "formal

bias." The existence of formal bias shows that technically rational artifacts and institutions are value laden like other social realities that frame our everyday existence. But after they are well established, their particular bias seems obvious and inevitable. We cease to conceive it as a bias at all and assume that the technology or institution had to be as we find it for purely technical reasons. Habit institutes ontology.

Formal bias has political implications. Some benefit more than others from the technologies that surround us. I introduced the example of the sidewalk ramp in the introduction. In this case a suppressed interest was incorporated into the system. The outcome is not an unbiased technology but, more precisely, a technology that translates a wider range of interests. In this example a social group excluded from the original design process forces its way in, demanding a revision of the existing design. Its demands are formulated discursively in opposition to an established system or, rather, in the interests of layering that system with additional functions responding to new values. The new actors must struggle to open the "black box" in order to initiate a new iteration of the design process that will translate their values into facts, technical facts.

Technocratic technical codes are called into question in many struggles such as this one. As "rational," technology takes on an apparent inevitability. It is assumed that devices and systems do what they do because of what they "are." This is the dangerous tautology of technology. To create a place for agency, technical citizens must struggle to overcome it and achieve consciousness of the contingency of the technical domain.

Democratic interventions are translated into new regulations, new designs, even in some cases the abandonment of technologies. They give rise to new technical codes both for particular types of artifacts and for whole technological domains, as in the case of energy production and computing. This is a special and irreplaceable form of activism today. It limits the autonomy of experts and forces them to redesign the worlds they create to represent a wider range of interests. Insofar as STS contributes to the understanding of these movements, it plays a progressive political role.

The familiar opposition of irrational society and rational technosystem invoked by technocratic ideology has no place in this context. The design that eventually prevails in the development of each technology and institution is the framework within which it is rational and efficient. Efficiency is not an absolute standard since it cannot be calculated in the abstract but only relative to the specific contingent demands which bias design.

An Exemplary Case

In this section I propose to apply the critical constructivist concepts of bias, technical codes, layers, and sociotechnical rationality to an exemplary case. These key concepts bridge the gap between particular cases and the wider cultural world of modernity. The case I have chosen illustrates a common type of technoscientific controversy in which the same artifact plays very different roles in the different worlds of the actors. In such cases, conflicting interpretations of the artifact resulting from different goals and epistemic tests may eventually lead to design changes or the displacement of one design by another. From the standpoint of critical constructivism, this case illustrates the legitimating role of rational criteria as a basis for decisions defining the responsibilities of the community toward its members. But the definition in this case suppressed subordinate actors, who countered it on the basis of their own epistemic resources, their own "subjugated knowledge."

Medicine is an especially rich field for the application of STS because it lies at the intersection of science, technology, and human lives. Tiago Moreira poses the problem of the relation between supposedly universal "rational" standards and personal experience through the example of the evaluation of an Alzheimer's medication by the British National Health Service (NHS).[57]

The NHS evaluates medications and decides on their cost/benefit ratio in terms of quasi-scientific measures. In the case in question, the evaluation was based on measures of cognition and hospitalization but did not include quality of life. When an existing medication was found not to be cost-effective, it was withdrawn. This represents a reified basis for decision making, aligning scientific and economic regimes but ignoring other aspects of the network in which the treatment is embedded. The occlusion of those aspects is the formal bias of the reified NHS approach.

The program under which the NHS evaluated the treatment had curing as its goal. It did not measure or concern itself with the role of the medication in the network of palliative care constructed around the patient but isolated it as a more or less effective technical device. Patients and caregivers were upset by the agency's decision. Even though the medication did not do much to slow cognitive decline or prevent many hospitalizations, it did have a significant impact on quality of life.

Here we have an alternative program focused on caring, an aspect of the network the scientistic bias of the NHS ignored. A typical clash of interpretations ensued, calling into question the definition of the artifact.[58]

Moreira explains how the victims of the decision made their point through an epistemological shift: telling stories about how the medicine had changed and improved patients' quality of life and their own experience of caring. These stories evoked emotional responses in the form of anger, disappointment, and depression. They operated as allegories, much like human-interest stories in newspapers. Everyone can identify with the subject of a human-interest story through sharing imaginatively the affect it communicates. Similarly, the stories told by the patients' caregivers solicited identification and formed community on a different basis from the quasi-scientific "rational" standards applied by the NHS, with different results for the definition of the medication and indeed of the medical system itself. Eventually the NHS agreed to supply the medication to some patients at a certain stage in the progress of the disease.

In this example, the actors' programs highlight two layers of the medical network constructed around the medication, a curing and a caring layer. The chemistry of the medication was not changed by the caregivers' intervention, but its meaning and usage *qua* medication was decided by the controversy. Meaning and usage, too, are aspects of the reality of technical artifacts. Only a partial alignment between the layers was achieved by the clumsy compromise that settled the controversy.

This example shows the role of democratic interventions in resisting the imposition of a biased rationality representing a dominant actor. The effectiveness of the caregivers' campaign was due in part to the existence of widespread concern about both the NHS and Alzheimer's disease. This is all about politics, but politics in one of several unfamiliar domains troubled by ever more frequent public challenges.

Methodological Suggestions

I call this concluding section "suggestions" because that is the most that a formal methodology can provide. In the end there is no substitute for insight, which cannot be formalized. But methods do suggest perspectives on cases and that can be helpful in pursuing and organizing re-

search. Here then are a few methodological suggestions that follow from the critical constructivist approach. They are not altogether original but it may be useful to describe them in the context of the argument developed here.

A Dialectical Approach. Rational criteria such as efficiency legitimate political and economic power in modern societies, and powerful institutions rely on technical disciplines to satisfy those criteria in practice. This sets the stage for the confrontation of expert and lay actors in many domains, as in the medical example described above. These confrontations are not usually challenges to rationality as such but to the particular form it takes in specific cases. Critical constructivism argues that such events are a unifying theme in the study of the politics of the technosystem.

The different concerns of expert and lay actors often place conflicting demands on design. This is illustrated in the example, where an object conflict arose over a medication. Such conflicts reflect programs that carve out different subsystems from the total network. In the example, the network extended to pharmaceutical companies, the NHS, hospitals, doctors, patients, caregivers, and all the relevant artifacts they employ, including the medication in question. The curing and caring programs foregrounded different aspects of the network—the one emphasizing economic costs of treatment, the other the quality of life of patients and their caregivers. Similar conflicts are found in relation to environmental issues, transportation, urban design, worker health and safety, food and water safety, and many other issues. Research can be structured around such conflicts.

Symmetry and Asymmetry. Any method which fails to recognize the widespread existence of deception and corruption is fatally naïve. (Volkswagen has a car for those who dismiss the critique of hidden motives as outdated.) STS must be able to distinguish these cases from authentic disagreements and employ appropriate methods to study each. Asymmetrical methods such as old-fashioned muckraking and ideology critique are useful in cases such as energy industry–financed climate change denial and cigarette companies' tobacco research. There is no symmetry between the painstaking work of real science and the manufacture of propaganda.

Symmetrical methods are appropriate for other cases where the actors are engaged in a real controversy. In such cases actual knowledge is invoked with reason and conviction on all sides, other motives notwithstanding. Claims are not offered simply to create artificial controversy or to hide costly failures from public view. The real problem of symmetry arises where one side in the argument can stand on material achievements while the other is able to mobilize only words as is typically the case where dominant actors with their established technologies and systems meet subordinate challengers with a discursively formulated anti-program. This is where the symmetry of program and anti-program plays an essential methodological role. It overcomes the apparent asymmetry between dominant actors and protesters.

Layers. The multiple demands on design are reflected in discursive forms, practices, and specifications. Technologies can thus be analyzed as layered phenomena, reaching from the heights of full-blown ideology down to the details of technical design. At each level, further layers appear, reflecting different degrees of abstraction. For example, the neoliberal ideology of the British state inspired the quantitative evaluation methods of the NHS, which in turn reflected the institutional preference for curing typical of modern medical practice. The program of the NHS achieved congruence at all levels except the crucial one, the level of the medication itself, which did not perform effectively by its standards.

The caregivers' anti-program introduced a different epistemology, one appropriate to an ethic of care and oriented toward the needs of the chronically ill. An appeal to empathy through personal case narratives corresponded in their program to the quantitative methods of the NHS. On these terms, the medication performed effectively. Case studies of issues such as this can be organized from top to bottom, from ideological formulations of the desiderata to their realization in usages, technical features, and functions.[59]

Double Aspects of Rationality. Critical constructivism argues that modernity is characterized by a dominant rational culture. Rationality in this sense is not universal but is context-bound like other aspects of culture. Critical constructivism claims further that the rationality of actors' positions in authentic public debate has both strictly technical and intrinsic normative aspects. It is not necessary to invoke extrinsic values to

get at the normative aspect because it is implied in the nature of the technology or system as understood by the actors. Public argument rests on rational principles of technical construction, which are also the basis of normative claims. The double aspects of sociotechnical rationality thus transcend the supposed gap between "ought" and "is." Furthermore, different forms of sociotechnical rationality are available to expert and lay actors. Basic technical categories such as "efficiency" and "compatibility" are refined versions of categories familiar in everyday experience and so communicate across the boundary between expert and lay. The methodological suggestion that follows from this approach is "Follow the actors' *reasons*."[60] Here I will again use the medical example to illustrate this approach.

Technologies depend most fundamentally on an interpretative act of abstraction in which the useful aspects of an entity are isolated and privileged for incorporation into a device. Abstraction supplies technical elements that combined constitute a thing with a purpose served by specific practices. The chemists who devised the Alzheimer's medication were not simply abstracting aspects from nature; they were also creating a meaningful object from which specific practical obligations would flow. Those obligations were interpreted differently by other actors who understood the product differently. For the NHS, the medication had to "work" by curing or at least slowing the progress of the disease. For the caregivers, "working" had a different meaning: the medication had to relieve the burden of care. These normative aspects of the medication flow directly from its nature as interpreted by the actors.

This example shows the role of rationality not only in the dominant program but also in the anti-program of the lay members of the network. Of course there is an important difference between program and anti-program: experts must translate the lay position into technically rational specifications for it to achieve success on a par with the already realized program of the dominant actors. In the case in point, physicians would understand the nature of the medication differently depending on which program prevailed. While this does not change its chemical composition, it does define it differently within the medical system. In other cases the actual design of the technology might have to be changed to adapt it to lay demands. Interpretative flexibility, understood as a conflict of rationalities, reflects the claims of differently situated actors.

Many more methodological suggestions flow from the focus on the

role of biased realizations of rationality. Critical constructivism examines these realizations in particular cases in the context of a theory of modernity. In so doing, it aims to create a bridge between the two "layers" I have been discussing throughout this chapter—empirical research and general social theory.

■ CHAPTER THREE ■

Concretizing Simondon and Constructivism

Introduction

The understanding of science and technology has changed in the last fifty years. Formerly standard notions of truth and progress have been overthrown by empirical research in science and technology studies (STS). Accompanying these changes in scholarship, social movements around medical and environmental issues have challenged the autonomy of the experts who invent and manage the technical systems on which modern societies are based. And hackers and amateur innovators have transformed the Internet. Nevertheless, despite these changes, discourse in the realm of public policy remains much the same. Conservatives still refer to truth and progress on terms that recall the nineteenth century. Social movements such as the environmental movement are routinely charged with Luddism. But despite certain affinities with STS, those movements have not seized on its approach to refute conservative criticism. What explains this paradoxical split between theory and practice? This chapter finds elements of a solution to the conundrum in an interpretation of Gilbert Simondon's classic writings on philosophy of technology.

These writings have become a point of reference in recent years, influential for the work of Bruno Latour, Gilles Deleuze, and Bernard Stiegler. However, Simondon is little known in the English-speaking world. *Du Mode d'Existence des Objets Techniques* (hereafter MEOT) is still not available in an English book publication as I write this.[1]

I first encountered Simondon's thought as a graduate student of Herbert Marcuse, who cited him in *One-Dimensional Man*.[2] This little-

noticed connection between the radical Marxist social critic and the French philosopher of technology was motivated by Marcuse's search for an emancipatory theory of scientific-technical progress. Despite his fierce criticism of what he called "technological rationality," Marcuse was not hostile to science and technology. In Simondon he found a reflection on technology that promised an escape from the familiar dilemma of uncritical celebration and purely negative critique.

Progress is usually defined in terms of efficiency or productivity, economic measures of technology's contribution to human well-being. It is true that these economic criteria describe many technical developments, but progress has a dark side, too often ignored by those who celebrate it. That dark side is highlighted in theories of technification, of which Heidegger's is the most famous. The usual formulations hold that human values are sacrificed to efficiency and unrestrained technological development. This view is often associated with a call for spiritual redemption in opposition to a technology-based lifestyle.

Simondon was unusual in defining technical progress not in terms of economic criteria but on purely technical terms. He identified a principle of technical progress in the nature of technology itself rather than in its relation to society. This would seem to distance him from Marcuse's project, but in fact Marcuse needed just such a concept of progress to escape from the radical pessimism of Heidegger and his Frankfurt School colleagues. Unlike them, his political conception of technological rationality left room for a higher stage of technical development.

Simondon rejects the notion of spiritual redemption and argues that the way forward is to better integrate technology with human beings and nature. He writes, "The relation of individual being to the community is mediated by the machine in a highly industrialized civilization." And he goes on to define an ideal relation: "In the authentic complementary relationship, man must be a being completed by the machine, and the machine a being which finds in man its unity, its finality, and its connection with the totality of the technical world. . . . *There is a chiasmus between two universes which would otherwise remain separated*."[3]

This is roughly similar to Marcuse's hope for a new technology that would respect human beings and nature. He cites a passage in MEOT that calls for a culture that "treat[s] as technical problems, questions of finality considered wrongly as ethical and sometimes religious."[4] Marcuse understood this to mean that values must be realized in technology itself, in its design and functioning, rather than posited as ideals opposed to technological reality. He thus followed Simondon in argu-

ing that emancipation would require deep changes in both culture and scientific-technical rationality. In the process, he revealed Simondon's underlying radicalism.

Unfortunately, neither Marcuse nor Simondon developed the argument convincingly for their time. Marcuse lacked an understanding of science and technology that would have enabled him to present a plausible account of the alternative he sensed in Simondon. Simondon himself remained vague on the political implications of his argument, as Gilbert Hottois notes.[5] This is understandable given the epoch in which they formed their approach, before the emergence of multiple social movements in the technical sphere. Thus the surprising convergence of these philosophers around a call for the transformation of technology has gone largely unnoticed.

A better understanding of their project is possible in the light of STS. Many of the conceptual innovations of this empirical discipline were anticipated, in speculative form, by philosophers of technology such as Simondon. In turn, Bruno Latour's version of actor-network theory (ANT) clarifies certain of Simondon's ideas. The concepts of *networks* and *actors* complement Simondon's argument by conveying the inseparable connection between the technical and the social. STS forms the background against which Simondon's contribution must be evaluated today.

The next section of this chapter discusses limitations of constructivism, broadly defined, as it relates to the politics of technology. The following sections focus on Simondon's key ideas, the concepts of concretization, associated milieu, and individuation. I then consider his ambiguous relation to technological determinism. In the concluding sections, political struggles around technical issues are reconceptualized in terms of a combination of ideas from all three sources—STS, Marcuse, and Simondon. As the reader will discover, this is not a strictly interpretive project but involves the creative use—some will no doubt say abuse—of Simondon's ideas.

Constructivism and the Question of Progress

In this section I intend to set up the problem for which Simondon offers elements of a solution. As noted above, there is a new politics of technology. Examples include movements around women's health and AIDS

and environmental struggles for clean air and water and for renewable energy. Human communication on the Internet is due to user innovation rather than government or corporate sponsorship. Technical citizenship has become a reality. These developments have implications for the philosophy and sociology of technology.

Technical citizenship reveals the limitations of theories of technification such as Heidegger's that focus on the imposition of rational form on modern society. These theories identify a general social transformation—Weber called it "rationalization"—which extends the application of technical rationality beyond its usual boundaries in premodern societies. Opposition to technification appears doomed in most such theories, but not in Marcuse's. His version focuses on the contrast between "technological rationality," which treats everything as an object of control and manipulation, and a different form of rationality and practice that realizes the potentialities of the objects themselves.

Marcuse's notion of potentiality refers to the internal dynamics of objects. Human beings and natural systems grow and develop. These are teleological properties that technological rationality ignores. Marcuse imagined a specific type of progressive technical change that would work with rather than against these dynamics. His argument is speculative and abstract but converges with the environmental movement as he himself recognized toward the end of his life. In the late 1970s he was an early Marxist advocate of environmentalism.[6]

In principle one would expect similar sympathies from STS but for very different reasons. The constructivist literature does not contain references to anything like Marcuse's notion of a new form of technical practice. I imagine constructivists would consider his concept of potentiality metaphysical were it considered at all. Perhaps Latour intended such a critique in dismissing the very idea that people and things have an essence.[7] I will argue in the concluding sections of this chapter that Marcuse's aspiration for harmony between human beings and nature can be reformulated in a more empirically concrete form with the help of Simondon's theory of concretization.

Given its rejection of determinism, constructivism ought to be in the forefront of explaining and inspiring resistance to conservative arguments based on "technological rationality." But there is a theoretical obstacle to joining a constructivist approach to the social movements. The rejection of determinism has taken constructivism so far in the opposite direction that it no longer has an account of the distinctiveness of

modernity. In some cases the suspension of the notion of rationalization shows up in a rejection of the specificity of rationality.[8] Many STS scholars dismiss the "great divide" between premodern and modern society as an artifact of a naïve notion of progress or an equally naïve notion of "pure" rationality. This makes it difficult both to criticize the existing society, based as it is on technologies and technical disciplines, and to imagine its transformation on the basis of critical norms.

Despite these problems, the social movements could counter conservative arguments by reference to the constructivist critique of technological determinism. The temptation to depict technical progress as a deterministic sequence of necessary stages based on scientific knowledge is effectively eliminated. Social constructivist technology studies shows that not pure reason but social actors stand behind design features. This has both cultural and causal aspects. Technical development is conceptualized as relative to the social interpretation of the problems it addresses. Standard technical categories such as "working" and "not working," "efficient" and "inefficient," are understood in terms of social demands and perceptions. Not only is actors' understanding of the artifacts they use contingent; their contingent views shape the technological future.

From this standpoint feminists demanding changes in medical care or environmentalists arguing for renewable energy appear as new actors taking advantage of the inherent contingency of technical development to introduce new interpretations of efficient functioning and corresponding designs. However, the constructivist approach has a high theoretical cost activists cannot accept. Because it is relativistic, it is incompatible with the idea of progress. Yet environmentalists and others who struggle in the technical domain consider their movements to be essentially progressive. They are engaged in that alternative rationalization Marcuse imagined.

Does actor-network theory have a solution? It attempts to correct what it takes to be the exaggerations of the original social constructivist program. It continues to argue for an analysis based on actors and in that sense it continues the constructivist approach. But it innovates by attributing the status of actor to natural and technical objects. Something like the constructivist "society" is now redefined to include its natural and technical as well as its human members. Indeed, the theorist now avoids the term "society" and substitutes the notion of a "collective" or "assemblage" of humans and nonhumans. This approach makes it possible to take account of the independent contribution of natural

phenomena and technical artifacts without regressing to common sense naturalism. But ANT still excludes recognition of an alternative progressive rationalization process.

Avoiding the usual deterministic account of modernity is commendable but it only sets the stage. The challenge is to come up with a recognizable picture of modernity and a corresponding politics. Latour offered the most inventive solution, substituting notions such as "laboratorization," "scaling up," and "long networks" for the Marxist "capital accumulation," the Weberian "rationalization," and Marcuse's "technological rationality." But all this is somehow supposed to obviate the need for social critique at a time when the Koch brothers mobilize their network of billionaires to subvert public discussion of climate change and Professor Piketty reveals anew the biased logic of capital. The theory culminates in what seems a plea for tolerance and pluralism in the understanding of nature in the face of the overweening claims to authority of Marxists and scientists. "Composition" rather than "critique" is the new order of the day. The resulting politics is disappointingly abstract.[9]

Theories of co-production have inspired more concrete research on the politics of technology. These theories draw on both social constructivism and ANT. They recognize the mutual dependence of artifacts and individuals. The emphasis on democratization responds to the conflicts of interest that arise in this context.[10] This seems to justify the enlarged democracy demanded by social movements to reform technology.

But the role of sociotechnical rationality is downplayed in these theories too. Struggles between lay and expert actors cannot be fully understood without explaining the rational form of their encounter. In the next sections I will explain how Simondon's theory builds a bridge between the older tradition of technology critique and the constructivist understanding of social influences on technological design.

The Theory of Concretization

Simondon distinguishes between technicity—that is, what makes technology technical—and utility, its relation to human needs. Technicity refers to the essential nature of technique, to which corresponds a "technical mentality" engaged with the intrinsic logic of technique. Technicity is manifest in every technical device and system and has shaped modern

culture. Simondon believes that the full development of technicity will reconcile human beings and machines.

While we normally view technologies as useful, Simondon demands what I will call an épochè, a suspension of judgment about usefulness.[11] The explanation of technology must not be confounded with human purposes but must be based on the laws of its independent "mode of existence." These laws preside over a progressive development culminating in "technical individuals," the machines of the industrial era.

Simondon calls the fundamental law of development "concretization." By this, he means something like what technologists themselves call "elegance." In contrast to a design in which each structure is restricted to a single function, an elegant structure serves many functions at once. Simondon introduced the concept of concretization to describe multifunctional designs such as the air-cooled engine that combines cooling with containment in the engine case.[12] Concrete designs contrast with "abstract" designs that add structures for each function, complicating the device and reducing its efficiency.[13] For Simondon technologies are characterized as more or less abstract or concrete depending on their degree of structural integration. Concretizing innovations adapt technologies to a variety of demands that may at first appear unrelated or even incompatible. What started out as a collection of externally related components ends up as a tightly integrated system. A single structure with several functions replaces separate structures, each fulfilling a single function.[14]

Is Simondon's claim to have discovered a fundamental law of development plausible? Indeed one could point to other trends, such as standardization, economies of scale, and product differentiation, but Simondon's proposal cuts deeper. It supplies critical constructivism with a new idea of technical progress.

Concretizations affect not only the internal structure of technologies but also their relation to their "associated milieu." The associated milieu is the "niche" within which the technology functions and which it requires for its functioning. The voltage requirements of electrical appliances offer a simple example of the essential relation between technology and milieu. The most sophisticated technologies employ synergies with their milieux to create a semiartificial environment that contributes to their functioning. For example, a hydroelectric dam creates a lake from which it draws the water that turns its turbines.

Simondon argues that technologies evolve through such elegant con-

densations aimed at achieving internal and external functional compatibilities. As devices develop in the course of technical progress, they are continually redesigned to multiply the functions served by their components. They thus achieve higher and higher levels of concretization. In so doing they resolve tensions arising from the initial relations between their components and their environment. Their internal coherence increases to the point where they can be compared to organisms. However, we will see that unlike true organisms, the components of technical artifacts are never completely integrated.

Although Simondon does not develop the political implications of concretization, his theory clarifies the distinction between simple technical advance and a form of progress that is both social and technical. The distinction is evident in applications of concretization to environmentally compatible technologies. Energy-efficient housing combines the functions of shelter, warmth, and lighting through orientation toward the sun. In most homes, the relation to the sun is accidental, and these three functions are served by separate structures, but in this case the sun forms an essential aspect of a design that brings them into relation around a single structural feature. This technical system is not simply compatible with environmental constraints but integrates them structurally. The niche in which the house is situated is constituted by its angle with respect to the sun. Similar applications are possible in every domain where social progress is mediated by technology. Concretizing innovations are increasingly sought in response to environmental problems. They make it possible to satisfy a range of demands that were formerly ignored.

The concept of concretization introduces a normative aspect lacking in STS but essential to the tradition of Critical Theory. Beyond conflicts of interest and questions of efficiency, Simondon recognizes an inherent tension in the existing stage of technological development that, he contends, must be overcome through the integration of humanity, nature, and the machine.

Individuation

The heart of Simondon's philosophy is his theory of individuation. It appears to derive from Jacob von Uexküll's influential theory of the *Umwelt*.[15] Uexküll argues that the organism does not relate to nature

as such but instead to a specific segment of it to which it is adapted—its niche. There is a sense in which the whole is prior to the parts; the animal subject and the natural objects that form its environment must be analyzed together. This theory influenced Heidegger's concept of Being-in-the-World, as well as the general outlook of Simondon's teachers, Georges Canguilhem and Maurice Merleau-Ponty. Simondon's theory repeats its structure.

According to Simondon, the individual is not independent of the world but arises from a process of differentiation in a "pre-individual" medium that splits into individual and milieu. Simondon illustrates this process with the formation of crystals through the disturbance of a supersaturated solution. A single speck of dust can initiate the process, which is then transmitted throughout the "meta-stable" liquid until the entire solute precipitates out. This process, which Simondon calls "transduction," depends on the introduction of an external element, which he calls "information."[16]

Crystallization is useful for presenting the notion of individuation but it gives the impression that the pre-individual exists prior to its division into subjective and objective phases. But if the pre-individual were an existing thing, it too would have a pre-individual basis. The solution in which the precipitate forms is itself an individual in a lab, and so the solution and the lab must have an origin in a still deeper level of pre-individuality. Infinite regress threatens. The real content of the concept of the pre-individual is analytic. It is a way of explaining the dynamics of development—potentiality. Simondon argues that individuals conserve a charge of "pre-individual" energy or potential that can be actualized as they develop.

The theory of individuation is intended to replace Aristotle's "hylomorphic" scheme.[17] The Aristotelian "substance" or thing is constituted by the relation of matter and form. For example, the architect's plan, the form, is realized in the building materials, the matter. Each substance has its foundation in itself and relates only accidentally to its environment. Wind and rain affect the house superficially but its essence remains untouched.

The developmental dynamic of substance comes from within. It is inherent in the thing itself: the oak slumbers as potential in the acorn. Aristotle accounts for development by positing a metaphysical essence within the substance. By contrast, Simondon's pre-individual offers a more plausible notion of potential arising from internal tensions within

the individual and between it and its milieu. What remains of Aristotelian teleology is the notion of a progressive direction of change but not the metaphysical idea of essence.

Interpreted in this way Simondon's theory has wide application. For the most part we do not witness a process in which a unified medium actually splits into two phases. Instead we are confronted with a subject or thing and its environmental niche. The two phases form a system fraught with tension. It is that tension which testifies to the system's sustained potential, which provides the basis for its evolution toward higher levels of integration. This is the progressive tendency implied in Simondon's theory of concretization.

Certain aspects of the theory of individuation have a suggestive similarity to ANT. The comparison makes it much clearer what is at stake in Simondon's argument with Aristotle. In Bruno Latour's version, ANT is based on what Simondon would have called an "ontogenetic" theory of the social. ANT argues that the social originates in the structure of the network of humans and nonhumans. Social groups exist only through their connections, which are sustained by technical artifacts. The human and the nonhuman are tied together, each serving as the milieu of the other in a reciprocal process of individuation. This notion of "co-production" postulates an essential connection between technology and society.

Co-production is obvious in the case of labor: workers are assembled as a social group around the tools they use. Once so assembled they may in turn change the tools that tie them together, forming a "strange loop" as discussed in the introduction to this book. The ubiquity of technology in advanced societies has generalized such relationships. We and our tools have become "hybrids"—"cyborgs" in Donna Haraway's version of the co-production thesis.[18] This view contrasts with the notion that human beings exist independent of the tools they create or use. Instead the human cannot be separated from the technical; human beings are *essentially* tool creators and users—not just generally, anthropologically, but in their specific sociotechnical involvements. But then the question arises of the origin of this apparently circular relationship in which humans depend on the tools that in turn depend on them.

It is here that ANT and Simondon appear to be on the same track. ANT's notion of hybrids posits a prior unity of the human and the technical. This unity is the experiential basis of all subsequent dichotomies between man and nature, subject and object. It is broken and differen-

tiated theoretically in a process of "purification" that masks the hybrid reality that is its true basis. In reality, Latour argues, we cannot separate the human from its artifacts.

Latour argues that each technology draws together a "sociogram" of social groups around a specific configuration of technical elements, which he calls the "technogram." He concludes, "Every piece of information you obtain on one system is also information on the other."[19] Sociogram and technogram are essentially correlated, the technical configuration reflecting the influence of a network of human actors and vice versa. The specification of a technology and the sociology of the actors are abstractions from the unified whole of the network. The distinction between the social and the technical depends on the point of view; it is not a substantial reality dividing different types of things in external relations. Latour cites Simondon in defense of this argument.[20]

Here is how Simondon explains something quite similar. He writes, "This intermediary reality [the pre-individual], which is subsequently considered as a mixture based on a relation, is perhaps the bearer of the extremes, which it engenders and pushes out of itself as the extreme boundary markers of its existence. Perhaps the relational appearance presupposes a pre-relational being. The opposition of the inert and the living is perhaps the product of the application of the dualistic schema derived from hylomorphism, with its characteristic shadowy center which gives the impression of the existence of a relation where in reality there is the substantial center of being."[21]

Could we substitute for "the inert and the living" the nonhuman and the human, joined together in a network in what Latour calls "the middle kingdom?"[22] Then we could explain Simondon's comments in terms of actor-network theory. The technological assemblage is the basic reality and the natural and social components of which it is apparently composed are actually abstractions from the unity of the underlying hybrid. The social and natural are not "related" in the technological hybrid as though two essentially distinct entities were artificially combined. Rather, the social and natural emerge together as differentiations of an original unity which Simondon calls the pre-individual. The "hylomorphic" split between matter (nature) and form (society) is overcome.

But Latour's sociotechnical version of individuation differs significantly from Simondon's. The specificity of what Simondon calls "technicity" is obscured, as is his notion of progress through concretization. Where Latour dismisses the notion of essence, Simondon reconstructs

something similar by shifting the level of potentiality from the Aristotelian substance to the hybrid of individual and its associated milieu. Simondon constructs a theory of progress motivated by the internal tensions and potentials of technical systems. ANT does not posit an internal force driving its networks forward to "higher" stages of integration or development.

If this aspect of Simondon's theory has no counterpart in ANT and indeed in STS generally, it does resonate with Marcuse's version of Critical Theory. Like Simondon, Marcuse needs a concept of potentiality to theorize the transcendence of the current stage of civilization. And like Simondon he cannot rely on metaphysics for that purpose. He too finds potentiality in the relational nature of society and technology rather than in an inherent *telos*. Marcuse refers to Hegel's concept of essence which "denotes the unity of being, its identity throughout change. Precisely what is this unity or identity? It is not a permanent and fixed substratum, but a process wherein everything copes with its inherent contradictions and unfolds itself as a result. Conceived in this way, identity contains its opposite, difference, and involves a self-differentiation and an ensuing unification."[23]

Marcuse's Hegelian interpretation of the concept of essence resembles Simondon's theory of individuation in emphasizing the tensions that arise in the relations of the thing and its circumstances. This is the new meaning of "essence" as a historical rather than a metaphysical category.

The Question of Determinism

The promise of Simondon is compromised by what appears to be an old-fashioned deterministic philosophy of technology. Most STS scholars no longer consider determinism a viable approach. There are some interesting recent attempts to reevaluate determinism, but none have the extreme form it sometimes takes in Simondon. He often seems to presuppose what Sally Wyatt terms a "normative technological determinism" that allows for no social influences at all.[24]

Determinists usually argue that technology develops along a single track and in so doing shapes society. This view contrasts with a constructivist position according to which there are multiple possible lines of development between which social forces choose. In fact, numerous case histories show the influence of social demands on the design pro-

cess. This would seem to disqualify Simondon's contribution, but we will see that his position is more interesting than his reputation as a determinist would suggest.

In MEOT Simondon illustrates his theory with politically neutral examples from such domains as automobile and vacuum tube design. He distinguishes between "extrinsic" and "intrinsic" causes of development.[25] This is what gives a deterministic cast to his argument. His distinction between technicity and utility is often so sharp that technology appears to be an autonomous domain to which society must adapt.[26] His hope for reconciliation between technology and society does not rest on social and political action but on cultural and technological change.

Simondon's book on individuation carries this approach to an extreme. He argues that society imposes conformity and a purely utilitarian relation to the world.[27] The technician can achieve authenticity in his technical activity, but on condition of ignoring the social and its utilitarian perspective. Pascal Chabot finds the origin of this romantic conception in Simondon's admiration for Jules Verne.[28] In the concluding pages, Simondon argues for the absolute autonomy of the technical with respect to society and claims that its norms of development are purely intrinsic.

To illustrate Simondon's argument, Chabot offers the example of size. The ideal size toward which development tends is intrinsic to each specific technology.[29] No doubt there is something to the notion that power plants are big because they achieve economies of scale while electronics is suited to miniaturization. But this does not explain why bigness is associated with American culture and miniaturization with Japanese culture. Society does not cancel out simply because a technical account is available. Rather, a social account explains the remaining contingencies, such as specific design choices and the time, place, and manner of innovation. In so doing, it reveals the social meaning of what appear to be purely technical considerations.

Jean-Hugues Barthélémy contests the interpretation of Simondon as a determinist. Simondon distinguished the history of technologies from their "genesis," understood as an internal technical logic. While the stages of development follow this logic, it is not inevitable and does not determine the shape of social life.[30] Simondon writes that "the invention intervenes when the *social filter* lets it through."[31] The path of technical progress can either be inhibited or permitted by society, rather than itself determining society. Nevertheless, one of the main objections to Simon-

don seems to apply. At least in most of his texts the motor of technical development is to be found within technology and not in society.

The limitations of Simondon's approach show up clearly in his discussion of photography in his 1965–1966 course on "Imagination et Invention." He argues there that extrinsic factors reflect changing fashions materialized in superficial features of technical objects. Such materializations belong to an intermediary layer between purely visual effects and the internal technicity of the object. The elaborate designs of automobile bodies can serve as an example. Such external layers are mere "parasites" on the intrinsic nature of the technical object.[32]

With this distinction in mind, Simondon interpreted what we now know to be the actual progress of photographic technology as a regression due to the influence of the external layers. The loss of control and refinement characteristic of mass-produced cameras in everyday use testifies to this backward movement. Simondon did not foresee the new wave of invention that transformed these popular devices into highly effective photographic instruments. The game-changer was the introduction of a practical autoexposure single-lens reflex camera (SLR) in 1965, precisely when Simondon delivered his course.[33]

The SLR reconfigured features of the various existing types of cameras around several key innovations: the focal plane shutter (which makes it possible to view through the lens with a pentaprism rather than through a separate viewfinder) and exposure metering coupled with shutter speed and, later, with aperture. Instead, he looked to the Polaroid Land camera which had the unique characteristic of allowing photographers to view each shot before taking the next. The Polaroid concretized the camera by combining shooting and developing. This technical advance has only recently come into its own with digital photography. It was not on the path of photographic progress in the 1960s and the following decades.[34]

What Simondon missed was the concretization in the SLR of the main functionalities required by both everyday and professional photographers. The combination of manual adjustment, autoexposure, and eventually autofocus in cameras able to accept either cheap consumer lenses or expensive professional lenses was a far more important advance than the Polaroid. The digital SLR is still the most advanced type of camera in wide use. Simondon mistakenly took the distinction between optical and chemical processes to be the essential technical issue in photography. Why this was supposed to be more important than the distinction between manual and automatic functioning is not clear, but

the latter proved to be the key to the future. This example illustrates the arbitrariness that vitiates a "pure" technical approach, given the wide variety of features and the lack of any purely technical reason to focus on some rather than others in projecting the future.

But there is another side to Simondon's work. Less developed aspects of his thought support something like the notion of underdetermination. The concept of individuation depends on a notion of meta-stability that is incompatible with a deterministic theory of progress. Simondon writes that "being can possess several successive entelechies."[35] This implies that the norms under which objects individualize are not fixed once and for all but can vary, presumably, with the changing conditions of the milieu in which different stimuli actualize different potentials.

Simondon argues that the usual understanding of technology mistakenly substantializes the machine, as though it were a kind of mechanical organism. In fact it is a concatenation rather than a unified totality: "The machine does not relate to man as a block, but in the free plurality of its elements, or in the open series of its possible relations with other machines within a technical assemblage."[36] This exactly describes the evolution of the SLR, which freely borrowed elements from previous designs.

As we have seen, Simondon argues that technologies must achieve both internal coherence and external acceptability in their milieux.[37] Although he usually defines the milieu in strictly technical terms, it is unclear why it would not also include human, social, and ecological conditions. In that case why not consider social stimuli among them? They surely qualify as "information" in Simondon's sense. For example, the technologies of the fax machine and the calculator were "transduced" by an already existing culture of miniaturization in Japan (think of *bonsai*), initiating a new path of development. Society and the functions it privileges inflect the evolution of technology as happened in the case of photography.[38]

Indeed, a passage in his 1965–1966 course seems to contradict the distinction between extrinsic society and intrinsic technicity. Simondon argues that "multi-functional usage corresponds to one of the essential functions of invention as a creator of compatibilities." And he goes on to say, "The object can totalize and condense information expressing needs, desires, expectations; the recursive circulation of information between production and virtual use brings the image and the created ob-

ject into direct communication, which in turn makes possible an invention that establishes compatibilities."[39] Here Simondon is critical only of restricting invention to a single purpose, rather than allowing it to flow from an unpredictable combination of technical logic and social demands.

These remarks can be read in a constructivist vein to say that technical considerations alone do not determine design; there are alternatives, and social choice decides between them. The flexibility of technology so understood creates a space for social intervention.

In the conclusion of MEOT Simondon envisages an evolution of technology and culture that would end the alienation of human beings from the machine. Marcuse took this to imply a radically new path of technical progress. The task for us who encounter these authors in a very different intellectual and political climate is to show the fruitfulness of such a reading. This requires overcoming the antinomy of function and usage that gives Simondon's argument the appearance of a technological determinism.

The Politics of Concretization

In this concluding section I will sketch some implications of this attempt to find resources for the politics of technology in Simondon, Marcuse, and constructivism.[40] Contemporary struggles over technology are profoundly political. They result from new actors intervening in the design process, actors excluded from the original networks of influence. Where codes regulating whole domains of technology are successfully challenged, the interventions redefine the meaning of progress. As Simondon argues, the internal dynamics of technical change play a role in this process. The outcome of these interventions reflects and realizes a social world even as they achieve technical coherence.[41] Let me now explain these points at greater length.

Constructivism views technology through the lens of its social relevance and involvements. Simondon's concept of technicity plays no role, either as an intrinsic logic of the technical or as a cultural phenomenon. Constructivism thus depends on an épochè complementary to that of Simondon, in this case suspending judgment on technicity rather than on utilitarian aspects of technology. This does not mean constructivists

ignore the technical. Rather they are skeptical of theories such as Simondon's that posit a specifically technical form of rationality, or related theories such as Marcuse's that deplore the imposition of that rationality on all aspects of modern life.

The solution to the conundrum constituted by Simondon and constructivism lies in revoking the two épochès and combining the technical and the social in a new way. We must find the link between the two objects focused independently by these two approaches. This calls for a (metaphorical) concretization of apparently incompatible theoretical functions—hence the recursive character of my argument signaled by the title of this chapter. My aim is to "concretize" in a single conceptual framework the functionally distinct notions of concretization in Simondon and actors in STS. Combining the concept of actors with the theory of concretization yields a new and more powerful theory that takes into account both the internal technical dimension of development and the role of influential actors in shaping design.

The idea that actors stand behind designs implies an underdetermined course of technical development. This is compatible with Simondon's theory if multiple possible concretizations can respond to a variety of social demands. Then technical design would be contingent on the outcome of conflicts between actors, and concretization might be achieved whichever ultimately prevails. In this constructivist formulation, the potential variety of concretizations corresponds to the diversity of the social. It refers not merely to technical improvement but also to the positioning of technologies at the point of intersection of multiple standpoints and aspirations. In uniting many functions in a single structure, concretizing innovations offer much more than technical improvements; they gather conflicting social groups around artifacts or systems of artifacts.

Concretizations construct alliances among the actors whose various demands are materialized in a single object. That object operates across the boundaries of different social groups, each interpreting it in accordance with its own conception of its needs, each incorporating it into its own world. Such materialized "boundary objects" are increasingly sought in the struggle between environmentalists and the representatives of industry.[42] They make it possible for industry to find a new trajectory of development that satisfies environmentalists' demands. Concretizing advances refute in practice the supposed opposition of facts and val-

ues—rational achievements and ideological opposition—that justifies the technocracy in its resistance to change. Identifying such advances validates a democratic politics of technology.

The constant reference in official policy discourse to cost-benefit analysis and trade-offs tends to discourage that politics. Because our technology was designed without regard for the values supported by weaker actors, their newly formulated demands appear as ethical or ideological imperatives that are costly to implement rather than as potentials awaiting realization. The recurring argument against reform holds that designs will be made more complicated and expensive by technical add-ons. On Simondon's terms they will become more abstract. Rational individuals are expected to choose prosperity over ideology.[43]

For example, considerable costs were associated with the addition of a catalytic converter to the automotive exhaust system to satisfy new environmental requirements. Each function—transportation and preservation of air quality—was served by its own separate structure; the automobile became more "abstract." This appeared to represent an essential trade-off inscribed in the very nature of automotive technology when in reality the increasing abstraction and its associated costs were side effects of a specific design process that had ignored the environment for generations. A concrete solution was eventually found through new fuel injection systems and this had other benefits besides reducing pollution, such as improved performance and gas mileage.

Concretization cancels the false dilemma of rationality versus ideology. It supports a concept of critique that validates social demands for technical change. In such cases what appears at first to be a necessary trade-off, in which some groups' interests are sacrificed to others' advantage, turns out to be the site of new alliances. Concretization thus has political implications. Progress is not determined exclusively by technical considerations but responds to social constraints with concretizing advances serving multiple actors.

The theory of concretization explains how human and environmental contexts understood as associated milieux can be incorporated into design without loss of efficiency. This is not an outcome dictated by technological imperatives, but concretizing designs can in principle take account of these contexts as they do many others. Technology can thus be integrated to nature and to human nature. Struggles for environmentally sound technology, free expression on the Internet, and work that

is humane, democratic, and safe are not extrinsic impositions on a pure technical essence but respond to the tendency of technical development to innovate synergisms of natural, human, and technical dimensions. They reveal the potentials awaiting realization.

So reconceptualized concretization holds promise for a theory of the politics of technology. However, Simondon does not analyze the role of conflicts of interest and power in the technical realm. Constructivism loses the other aspect of the problem, the political impact of technification as a dominant cultural paradigm.

Marcuse comes close to a synthesis but his concept of technological rationality is still remote from the empirical world constructivism describes in such detail. Despite its limitations, his theory introduces a concept of potentiality that gives an orientation to development. Simondon brings technical specificity to the idea of potentiality through his theories of concretization and individuation. Simondon's approach is thus a necessary complement to the Frankfurt School's "rational critique of reason" which culminates in Marcuse's speculations on a new concept of reason.[44]

These observations suggest a way of incorporating a critical perspective into a progressive theory of technological development. While Simondon agrees with actor-network theory that the human and the technical cannot be separated, he recognizes the alienation of human beings from technology in modern society. And he also promises reconciliation around technical advance rather than fixed and frozen opposition between technology, humanity, and nature. Simondon introduces a normative aspect lacking in STS but essential to critical theory.

Marcuse's argument for a new concept of reason is based on recognition of potentiality. This has methodological implications for the understanding of technical controversies opposing democratic interventions to expert claims. When technical understanding, efficiency, and control are identified with rationality as such, the potential for radical transformation is effectively suppressed. Eliminating the idea of potentiality opens wide the space of manipulation. Today potentiality is no longer defined by custom and religion as in premodern societies but rather by resistances, hacking, artistic experimentation, and imaginative solutions that signal the existence of unmet needs and suppressed capacities. In this new form, the notion of potentiality is still an essential basis of any radical theory of politics. It finds support in Simondon's analysis of technological development in my constructivist interpretation.

This interpretation identifies a type of development that is both technically and normatively progressive. The normative standards of that development are immanently derived from the resistances evoked by technology. The continuing "individuation" of society occurs through the tensions between its members and the technical mediations of their relations. Reified forms reflecting a narrow spectrum of interests are embodied in devices and systems that encounter resistance from beyond their horizon as irrationalities, inefficiencies. In reality, those resistances are reactions to technical designs that suppress features of nature and social life the affected individuals mobilize to defend or to incorporate into improved designs.

APPLICATION

The Internet as a public information utility is a technology in flux. It supports a wide variety of activities but it has not been perfectly adapted to any of them. As a result, its development is marked by tensions and uncertainties. Lobbyists and occasional online protests vie for control of its future. That future will be dominated either by business or by communicative usages. Its "rationalization" can take very different forms. The Internet is thus an ideal candidate for the application of critical constructivism.

This chapter argues that the future of the Internet will be shaped by struggles between certain business groups and the public over the design of the system. Eliminating network neutrality and protecting intellectual property while exposing user data to exploitation are issues of concern to many businesses that would like better access and control. Communication, social networking, and political discussion and mobilization constitute another pole of development with different priorities: not control but freedom. Can market rationality coexist peacefully on the Internet with communicative rationality?

This question is approached here in terms of constructivist methods supplemented by Simondon's concept of concretization. Many features of the Internet today are useful to both business and the ordinary users who privilege communicative usages. These are concretizations in which a single feature serves multiple functions corresponding to the demands of different actors.

This approach contradicts both the hype and counterhype that dom-

inate discussion of the Internet today. Generalized praise for the "new spirit" of capitalism, like dystopian critique, gives an unrealistic picture of an ambiguous phenomenon. The overlapping features and functions of the Internet support opposing visions of its future. There are many other examples of similar ambiguities in struggles over the technosystem. Explaining such ambiguities is an important innovation of critical constructivism.

■ CHAPTER FOUR ■

The Internet in Question

Two Critiques

In the context of contemporary critical theory the Internet figures increasingly as the problem rather than the solution to the crisis of democracy. This marks a change from early optimistic assessments that still inspire a diminishing band of commentators. But mainstream academic opinion has turned against what is now considered "hype," the exaggerated expectation that the Internet would contribute to the democratization of society. The purpose of this chapter is to reaffirm the democratic potential of the Internet.

In this introductory section I will consider critiques of the Internet from the standpoint of political economy and cultural theory. I have chosen to respond here to Christian Fuchs and Jodi Dean, articulate champions of counterhype who skillfully deflate the myth of the Internet. I will argue that their critiques are one-sided.

Let me begin with Christian Fuchs's Marxist analysis of the Internet, which combines the theories of free immaterial labor and the "multitude" with audience commodity theory. Marx claimed that the productive power of knowledge increases with economic development. Fuchs argues that advanced capitalism is an information society in which knowledge is essential to the reproduction of capital. As a collective product, knowledge is social but under capitalism it is privately appropriated. Like the common lands divided up and expropriated at the origins of capitalism, knowledge belongs to an ideal commons exploited by

advanced capital. Fuchs concludes, "With the rise of informational capitalism, the exploitation of the commons has become a central process of capital accumulation."[1]

If capitalism is an information society, the knowledge producers constitute an exploited class. They include many workers in industry and government, students and researchers in universities, and also those whose "immaterial labor" contributes to social reproduction such as household and service workers. Since goods are produced in the commons through communication and sharing, their appropriation by capital "colonizes" an increasingly important sector of society.

The commons includes those Internet sites where individuals communicate and thereby contribute to the sum of knowledge. The production of user-generated content becomes the occasion for profit-making activity on the part of the companies that provide the popular web platforms, but the users are paid nothing for their efforts. The unique structure of the Internet enables this new form of knowledge production and also supports the exploitation of the free labor of the producers. Since exploitation is measured as a ratio between wages and the value of the products produced, the rate of exploitation is virtually infinite!

Fuchs draws on Dallas Smythe's audience commodity theory to explain how companies realize profits from free labor on the Internet. Smythe studied television, the dominant medium at the time he wrote. He claimed that in selling advertising time, media companies were in effect marketing commodified audiences. Social networking platforms such as Facebook operate in a similar way, accumulating users and selling them as an audience to advertisers. Just as television disappointed early hopes that it would contribute to education and political enlightenment, so the Internet has failed to live up to the hopes placed in it. In the texts under consideration here Fuchs concludes that the activity of Internet users "does not signify a democratization of the media toward a participatory or democratic system, but the total commodification of human creativity."[2] And further, "User-generated content on web 2.0 platforms has not brought about a participatory Internet but the total commodification and exploitation of human creativity on the Internet."[3] And yet again, "Commercial social media do not constitute a public sphere and a participatory web. . . . Social media are mainly commercial and mundane spaces—politics are the exception to the rule."[4]

Fuchs relies on the broad redefinition of exploited class suggested by Hardt and Negri to conceive a possible counterhegemony. Whatever the

nature of the exploited group, it contributes to the production of alien wealth. The exploited "multitude" can potentially come together around resistance to the colonization of the commons. Its members can resist capitalism as did the proletariat at an earlier stage.

Although I agree that Fuchs has identified important aspects of the Internet, in what follows I will criticize the excessively wide scope of his argument. The Internet is truly the site of new forms of production and exploitation, as he shows, but his evaluation of the Internet is surprisingly reductive. In these texts he *defines* the Internet by the exploitation of free labor and the commodification of its products. Whatever the content of the communications, the simple fact that corporations profit from them determines their essence. It is obvious that user activity is profitable for corporations, but it is less obvious that this is the most important thing one can say about it. What is more, qualifying this activity as labor in the strict Marxian sense is questionable.

Indeed, Fuchs himself appears to recognize this in articles and books that argue for what he calls a "dialectical" understanding of the Internet as a class-conflicted and not merely a class-structured space.[5] He claims that he held this dialectical view even in his writings on the political economy of the Internet, although focusing there on the corporate aspect. But his condemnation of the Internet in these writings is unequivocal. As a result he appears to hold a reductive interpretation of the Internet. In any case, Fuchs dialectical interpretation is useful. Later in this chapter I will analyze the technological basis of the dialectic of the Internet.

In these writings on political economy, Fuchs's comparison of capitalism and user production on the Internet is greatly simplified. Capitalist development involves more than extracting profit; it also creates new conditions for doing so. The labor process was reorganized around new forms that could be quantified and controlled. The products changed too as their production changed. Marx called this "real subsumption."[6] Capitalist appropriation thus involves not only commodification but also the transformation of labor and the commodified products. The capitalist form penetrates the actual content of production.

The audience commodity theory of the mass media is roughly compatible with Marx's theory of commodification since not only is audience attention sold, the "content," the object toward which it is directed, is controlled and rationalized by capital. But with Facebook or Google only sale occurs. Corporations commodify the knowledge commons, but

they do not transform its content as thoroughly as were land and labor at an earlier stage. The standardizations imposed do not add up to real subsumption. Unlike land cleared and fenced for raising sheep, or labor stripped of skills, online communications remain essentially what they were even after their commodification. Of course the content is shaped to some extent by the design of the interface and worked up by such procedures as data mining, but the original flow of data is not much altered in the process. This is an important distinction. Although Fuchs claims that users' communications suffer "total commodification," in fact the commodification is quite restricted and leaves the users relatively free.

Capitalism is a parasite on an independent content that has two quite different destinies: on the one hand, the untransformed content is exchanged between users; on the other hand, the content is transformed by the imposition of the commodity form through such procedures as data mining. This double character of content suggests a different analogy than labor. Social networking actually resembles the telephone more than the factory. The transmission of user content by Internet companies is similar to the transmission of telephone conversations by telephone companies. Neither telephone companies nor social networking sites control users' conversations as labor is controlled by factory owners. Telephone companies commodify the conversations by simply measuring their duration. Commodifying social networking content is more complicated, but like the measurement of duration, it leaves the communication itself to go forward free of interference. The analogy between factory labor and social networking "labor" is misleading. A better analogy would be a common carrier.

This has a further consequence brought out by Adam Arvidsson and Elanor Colleoni in their critique of Fuchs.[7] The capitalist transformation of the labor process has the effect of reducing labor to the expenditure of uniform effort over time. This abstract labor is measured by its duration—hence the discussion of the struggle over the length of the workday in *Capital*. Marx's concept of exploitation depends on the assumption that under capitalism goods are valued at their cost of production. The cost of production of the labor power the worker sells to the capitalist is the value of the necessities of life required to reproduce it from day to day. That cost bears no relation to the amount of product the worker can produce in the course of the workday. The difference constitutes surplus value and its appropriation by the capitalist is exploitation. This does not describe how profits are generated from users' communications.

Although production undoubtedly goes on in social networking sites, the economics are not those of labor under capitalism. The users and their contributions are exploited only in the usual common sense meaning of the term, not in accordance with Marxist value theory. The "labor" of users is not abstract but totally concrete in the sense that it depends on personality and style. It is not uniform, is not measured by the time expended on the effort, and it cannot be divided into a portion devoted to reproduction and another portion expropriated as surplus value. Its quantification simply records a by-product of user activity. The sophistication and complexity of its commodification through big data and advertising is necessary precisely because user activity has not been reduced to the simple expenditure of effort over time as in the real subsumption of labor in the factory.

It is simply wrong to qualify every activity from which capitalists draw a profit as labor and reduce it to its economic function. Capitalism profits from many activities that are not labor and are not exploited in the precise sense Marx intended. As noted, telephone companies profit from conversations on their lines but though the callers are active and sometimes even creative, their conversations cannot be described as labor. Restaurants profit from the proximity of tourist venues, but the tourists sunbathing on the beach do not work for the restaurant owners. Gentrification follows artists into dilapidated neighbourhoods, but the artists painting in their lofts are not working for developers. Babies offer a business opportunity for diaper makers without performing free labor for the diaper company. The incidental character of the profitable activity associated with each of these situations belies their reduction to their economic function. Similarly, information provided by users is not work producing surplus value. In a very broad usage we can call all these examples "exploitation," but they do not do the harms nor have the political implications of the expropriation of surplus value in capitalist production.

A more relevant analogy to the exploitation of social networking is not television but the sidewalk. Like the sidewalk social networking sites form a public space on which all sorts of interactions take place. And just as the activity on the sidewalk creates business opportunities for the owners of stores along the way, so the Internet creates opportunities for the owners of the sites on which individuals meet and converse. Advertisers on Facebook resemble store owners who rent a good location in a mall. Data mining user contributions to target advertising enhances the

value of the "rental property." What is commodified thereby is what is effectively rented—space on web pages. As in a mall the commodification that takes place on these sites concerns access to audience attention, not ownership and sale of the conversations and their by-products such as photographs and videos. Although sidewalks and malls are not typically associated with public discussion, it does occur there occasionally. And when it does, that is a significant expression of freedom of assembly in a democratic society.

In sum, while it is clear that many users of Facebook and similar sites work hard to generate content, and while it is also clear that commodification and exploitation occur on these sites, the specifically Marxist concept of labor under capitalism does not apply. That concept has a systematic significance and connotations in Marxist theory that follow it in Fuchs's argument. But the Marxist concept is actually quite narrow and is tied to the production of commodities by deskilled labor under the control of capitalists or their managerial representatives. It implies a notion of rationalization inapplicable to social networking sites.

Fuchs dismisses the democratic implications of the Internet because of its economic function, but the human significance of online interaction persists despite its place in the capitalist economy. The contributions of Internet users cannot be reduced to their economic function any more than can conversations on the sidewalk. Whether those contributions have a democratic value requires further analysis of their actual content in their context.

This is what Jodi Dean attempts in her cultural critique of the Internet.[8] Let's consider her argument against Guy Debord's claim that reciprocal communication has an emancipatory potential mass communication lacks.[9] Debord's dystopian view of advanced capitalism is similar to the position of such Frankfurt School theorists as Adorno and Marcuse. Roughly summarized, they argue that a technocratic-capitalist elite dominates a subordinated population held in thrall by the mass media and consumerism. The introjection of system requirements makes coercive suppression unnecessary because the manipulated individuals reproduce the system spontaneously.

According to Debord, breaking out of this syndrome requires dramatic exemplary acts by a small minority of dissenters able to deconstruct the virtual chains binding the mass. He introduces a strategy he called "*détournement*," modifying typical mass cultural products to reveal their fetishistic character. He hoped that provocation from the

margins would become a catalyst for the breakdown of the system. The French May Events of 1968 could be interpreted as a confirmation of this approach and in fact the Situationist critique of mass society did play an inspirational role in the movement.

Dean complains that in emphasizing the top-down nature of advanced capitalism, exemplified in the mass media, Debord idealizes the potential of bottom-up activity to disrupt the system. But in fact, she argues, we now have the bottom-up alternative to the mass media Debord dreamed of. It is called the Internet and far from disrupting advanced capitalism, it reproduces it ever more effectively. Free communication on the Internet has not had the emancipatory effects foreseen by those like Debord who criticized the centralized, one-way structure of the mass media. She argues that we have entered a new stage of "communicative capitalism" that renders theories such as Debord's obsolete.

Dean argues that the distinction between symbol and thing, fantasy and fact, is essential to the possibility of both truth and resistance, but on the Internet it disappears and with it the authority of meaning collapses. The disruptive feature of the Internet is the ease with which users externalize their own discourse and multiply alternative sources of information. No longer committed to anything, they are unreal to themselves. No longer persuaded by anything, they cannot leave the cocoon of the derealized self. Reflexivity, which the Enlightenment identified with individual autonomy, here renders the individuals helpless before the power of the system. This is in fact the hysteria of reflexivity, a bottomless pit of second thoughts, which destroys the "symbolic efficiency" essential to belief and action.

Dean relates these aspects of life in cyberspace to a strange phenomenon unforeseen by the early prophets of the network society. This is the enormous flood of useless contributions sent out by Internet users who neither expect nor receive any meaningful response from the imaginary public they address. This is indeed puzzling. The systematic lack of serious content and responsiveness contradicts the emancipatory promise of communicative freedom.

To explain this phenomenon, Dean deploys the categories of Slavoj Žižek's Lacanian psychoanalysis. The explanation turns on the difference between desiring what one lacks and desiring the lack itself. This latter form of desire involves obsessive repetition in the pursuit of something elusive which is attained so far as possible in the very pursuit of it. The pursuit itself becomes its own object and yields a kind of enjoyment

which draws the subject in again and again. Anyone who has played a video game will recognize the syndrome. In sum, Dean describes communication on the Internet on the model of obsessive-compulsive neurosis.

But the effects are not merely individual. Participation in the network shapes a type of subject unable to contend with the political realities of capitalist society. Caught in a web of communication without content, subjects substitute debate for action and mistake participation for power. They have the illusion of political effectiveness whenever they express an opinion or sign an online petition, but in reality they are victims of technological fetishism. The Internet does not automatically amplify opinions into significance but simply registers them as empty placeholders for real political action. Dean writes, "Our participation does not subvert communicative capitalism. It drives it."[10] The circulation of messages on the Internet thus depoliticizes the population and integrates it to communicative capitalism. Dean admits that there can be effective political uses of the Internet, but she considers these to be relatively insignificant compared to its overall depoliticizing effect.

I find much of Dean's analysis of the failure of communication on the Internet persuasive up to the point where she draws these political conclusions. On what grounds does she consider the activities on which she focuses to be the Internet's most significant effect, able to actually reshape users' subjectivity? This is reductive. She assumes that with her explanation of Facebook, she has grasped the Internet's essence and the mechanism of political control. But she ignores other types of online interactions. There are many serious discussions on the Internet, including politically significant ones.

The notion that the Internet replaces real political action inspires Malcolm Gladwell as well as Dean. In an article in *The New Yorker* he contrasts the courage of the black activists who sat in at lunch counters in the South with the trivial engagement of those who sign online petitions.[11] His argument can serve as a reductio of Dean's. Gladwell both confuses a means of communication which assists political action with the action it assists and also claims that users of the Internet generally make such a confusion. But where is the evidence that the people who sign Internet petitions would have gone out into the streets in the absence of an easy alibi for staying home? I am unconvinced both by the inappropriate contrast of online communication with "real" action and by the notion that anyone is actually dumb enough to confuse the two.

Here is an alternative explanation. The Internet does not depoliticize its users but it does reduce the testimonial value of their free expression. Those who sign online petitions are perfectly aware that their views will not have as much impact as if they were expressed in a context that shows the full extent of their commitment. Hence they can hardly expect radical change in response to online petitions as they might from demonstrations in the street. But by the same token there is also no reason to suspect that the one is substituted for the other. If anything the ability of dissenting views to reach a public, however imaginary, may encourage others to come forward. What is involved is play with isolation and popularity rather than illusions about political action. The Internet reduces the loneliness of the dissenter.

Dean's critique depends on the notion that we have moved on from the type of capitalist society criticized by Debord and the Frankfurt School to a new type based not on top-down hierarchical control and psychological introjection but, paradoxically, on free communication and participation structured in such a way as to reproduce the system. Her approach is the culmination of a trend that begins with Foucault's rejection of Marxist explanations of capitalism in terms of class power, for which he substituted his own notion of power as a play of discipline and resistance within a rule-governed system.

The transition to this new paradigm has inspired a great deal of recent discussion such as Deleuze's concept of the "control society," and more recently Boltanski and Chiapello's "new spirit" of capitalism.[12] Whereas the antidystopian theories of earlier critics focused on technocracy and the seductive power of consumer goods, these new critics argue that we are now faced with the self-subjugation of the population through communicative interaction and participation.

Such theories, like Dean's, are based on transformations taking place in the advanced sectors of the economy where flexible career paths, personal branding, post-Fordist participatory management, and now also blogging and social networking play an important role. But the older theories of technocratic control and consumerism are still convincing. Most of the population lives in the world they describe, ruled not by invisible protocols but by visible hierarchical superiors legitimated by claims of ownership and technical competence. People are attached to the system primarily through material rewards rather than network protocols. Dean may be right in claiming that today some of those rewards take the form of enjoyment of communication as such, without hope of

significance or reciprocation. But this hardly replaces automobiles and home appliances, houses and sports, as basic integrative mechanisms. Furthermore, despite the cognitive chaos of the Internet, most people still accept the authority of doctors and scientists, teachers and preachers, and many people still follow political leaders and molders of opinion in the mass media.

The discovery that much communication can be absorbed into the rituals of consumer society is an important insight, but it is still the case that truly free, reciprocal, bottom-up communication has emancipatory potential and such communication does occur on the Internet. Indeed, every radical movement today builds on it. Politically significant communication may be less common than the sort of thing Dean criticizes, but it nevertheless plays an important role. Serious discussion and debate have not disappeared from the Internet.[13]

Dean's critique depends on an illusion specific to the technology of the Internet—its ability to record everything that happens on the screen. Once again, I can best explain why this is important through the metaphor of the sidewalk. Since we don't have transcripts of sidewalk talk, as we do for the Internet, we cannot compare the various conversations as to their radical political or integrative effects. Everything is discussed on the sidewalk, but surely most of it is as boring and pointless as the chatter Dean analyzes. Because it is ephemeral, no one criticizes the sidewalk as a medium. The democratic significance of free speech there cannot be reduced to a question of proportions.

Despite the exorbitant influence of a small number of popular websites, there is still a great deal of variety and room for nonconformity.[14] Debord's hope that an alternative to the mass media would make a difference is not wholly disappointed. It is true, to be sure, that there is little effective political resistance, but I see no evidence that the Internet is responsible for that. It cannot simply be dismissed because it has not solved the difficult conundrum of getting Americans to join radical political organizations. Surely the weakening of the American labor movement and the rise of the extreme right and right-wing media are a more plausible explanation.

I believe critics like Fuchs and Dean are caught up in an internecine struggle within the contemporary intelligentsia that distracts them from important aspects of the problem. The Internet was hailed at first in such expansive terms that a critical reaction was inevitable. It has not had the promised revolutionary impact, but the expectation that it would was

always unrealistic. A critique based on disappointment with a fantasy is distorted by its dependence on its object.

It is useful to criticize exaggerated claims, but at this point in time we should have gotten beyond the exclusive focus on them. The Internet as we know it is under attack from serious enemies. Its important, if limited, contribution to democratic politics may well be extinguished in the coming years by changes in regulation and technology.

The Layers of the Internet

In this section I will propose an alternative interpretation of the Internet. Fuchs and Dean offer critiques based on political economy and cultural theory. They pay little attention to the technology of the Internet. To the extent that technology figures in their accounts at all, it appears as finished and complete, with a single dominant social impact.

The Internet is a technical system first and foremost. Its social meaning is inextricably intertwined with its technical character. In arguing for attention to technology I am not returning to an outmoded technological determinism. We need a method that recognizes the essentially technical character of society and the social character of technology. Just as there are divisions in society, so there are divisions in the technical sphere, reflected in the ambivalence of technical systems; potentials foreclosed by the dominant social powers give rise to resistance.

Critical constructivism differs from the generalized impact or "powerful-effects" studies we are familiar with in the writings of Adorno and McLuhan down to Castells and much recent postmodern theory.[15] While undoubtedly useful, impact studies, like political economy, tempt some commentators to overgeneralize. They then draw utopian or dystopian conclusions: either we are headed toward a universal mind or a corporate matrix. I cannot engage in debate with these alternatives here beyond noting that they are associated with the sort of technological determinism of which Marx is often accused. In earlier chapters I drew on other aspects of Marx's work and STS to reconceptualize social struggle as struggle over technology and, specifically as I will now show, struggle over the Internet.

Technologies realize in technical form various layers of function and meaning corresponding to the demands of the actors who shape them. The transformations technologies undergo as their technical codes are

contested take different forms. Some technical controversies are zero-sum games in which the winner takes all, but often the inherent flexibility of technology makes compromise possible. Conflicting interests may find a modus vivendi or be reconciled in the final design through concretizing innovations. Designs are thus often composed of multiple layers of functionality representing several relevant actors rather than forming an unambiguous and tightly unified whole with a single purpose.

Can we apply this approach to the Internet? Because Fuchs and Dean define the Internet in terms of economics and the mainstream culture of social networking, its political usages appear as anomalies. Their analyses privilege a single layer of functionality. Judgments such as theirs assume that business has been far more successful in corralling the Internet for its purposes than is plausible given the enormous variety of content and initiatives. But the counterargument can go deeper than such quantitative comparisons. A serious study of the Internet must take into account its technical evolution, which is still incomplete. Many contending forces act on its design for sometimes conflicting, sometimes complementary purposes. Dean cites Galloway and Thacker, who criticize "the uncanny, unhuman intentionality of the network as an abstract whole."[16] This is what she tries to explain, but the assumption that the Internet forms a "whole" is questionable. A more comprehensive understanding of the Internet would find a place for its political aspect within a complex matrix of multiple "intentionalities" and functions. The constructivist approach allows for such complexity.[17]

Since many actors objectify their needs in the features of the technology, no simple definition can explain it. The Internet is not unified but is intrinsically divided and conflicted. The analytic problem consists in disentangling this complexity and assigning each aspect of the technology to the social forces underlying it. I will focus here on two of these forces, the business interests such as the major service providers that are attempting to transform the Internet into an entertainment medium and the public actors who employ the Internet to participate in the life of society. I call their goals for the Internet the "consumption model" and the "community model," respectively. They both draw on resources available on the Internet in its current multistable condition, but they emphasize different features in different combinations.

Each of these two main alternatives in contention for control of the network represents a technical code that may someday determine its overall design and evolution. The consumption model follows the logic

of consumer society in objectifying human capacities in commodities. It privileges features that support entertainment, commercial transactions, and advertising while the community model relies on other features that support online group activity and public life. The community model supports new forms of sociability through which individuals communicate and appropriate alienated aspects of their lives. The coexistence of the older community model with the new consumption model creates a hybrid system of uncertain character and future. Collaboration and struggle between the actors play out in many venues that are not normally considered "political" but which do indeed have political significance. Both the meaning of the Internet and what it is to be an individual in an Internet-enabled society are at stake.

At the ideological level, each model appeals to widely recognized values—the consumption model to market freedom and its role in fulfilling human needs, the community model to freedom of expression and the role of community in public life and personal growth. At the technical level, specific features underlie the two models. The Internet protocol was intended for point-to-point communication. As Christian Sandvig argues, the Internet was originally conceived as an "anti-television," well adapted to the community model but unable to support large-scale broadcasting.[18] Innovations such as the "edge cache" system invented by Akamai led to the generalization of "content delivery networks" which render the network a much more efficient distributor of media content. These special networks are a paid overlay on the Internet. Without directly violating the principle of network neutrality, they privilege mass broadcasting by media companies over the original peer-to-peer relationships envisaged by the creators of the Internet.[19]

The future of the Internet depends on which actors determine its technical code. The two models coexist today on a system without clear definition. The actors behind the models each vie for control of the future of the Internet, its ultimate technical code, but so far neither has been able to prevail.[20] The Internet is thus a terrain of struggle rather than a definite "thing" with a singular essence. In the critical texts considered above, Fuchs highlights important features of the consumption model while ignoring the competing community model which does not fit his schema. But incoherence is characteristic of a technology that is still in its early stages of development, before it reaches closure around a univocal definition of purpose. The critique of the Internet should focus on the struggle rather than assuming it is already over and done with

to the exclusive advantage of business. In what follows I will attempt to unravel the complexity into the two distinct strands that describe much of the contention over the Internet today.

The Internet has a number of features such as searching, copying, and linking, used by all actors in similar ways. Here I will focus on features that have been appropriated by these actors for their different purposes through distinctive practices or software. Each of these features supports multiple functional layers. Closure around one or another technical code can occur in two different ways, through simplification of the features or a new configuration that recombines and reconfigures the functions to the satisfaction or at least the passive acceptance of all influential actors. In many cases actors share features, allowing different uses of the same resource. In such cases, a single structure may serve a variety of functions, as Simondon explains with his theory of concretization.[21] The critical constructivist version of this theory shows how technologies assemble various influential actors around structures that concretize the functions they each require. The Internet is a spectacular illustration of this concept. I will show how each of the features concretizes the layers of function privileged by the two models.

The resulting hybrid seems to work well for now. But pressures to change or combine features and functions in new ways to accommodate business interests threaten to alter the character of the Internet. This is the scene of struggle which must be analyzed in detail to understand the state of the technology. I contend that we do not and indeed cannot know how the ambiguity will be resolved at this time. The best we can do is to chart the conflicting and converging layers and identify the actors behind them. In what follows I will list five features and show how the functions they support are distributed between the two models.

1. *Nonhierarchical Structure*. The Internet protocol creates a disseminated network rather than a centralized system like a broadcasting network. Its nonhierarchical structure, derived directly from the transmission protocol TCP/IP, complicates business applications while favoring public usages. There is no one at the helm, no Rupert Murdoch who can kill a story he does not like, no ABC or NBC that can dominate the news, no company that can dictate taste and trends. This is not to deny obvious asymmetries of influence, but that is a far cry from the kind of predictable, well-managed, central control business prefers.

The Internet was not conceived with business in mind and is still not

perfectly adapted to its needs. The military created the Internet protocol for a system of trusted computing centers. It is still marked by this origin today. Advertising as a revenue source came rather late to the Internet and is a work-around. It is by no means certain that the advantages of targeting, made possible by data-mining social networks, compensate for the limitations imposed by the protocol.

The issue is clear from a consideration of the alternatives. A business-controlled medium such as television protects intellectual property and focuses users' attention on a restricted set of offerings and advertising. The Internet in its present form cannot come close to this ideal. The French Minitel system resembled the Internet as a domestic computer network, but it was based on a different protocol that supported a more efficient business model.[22] That system tracked the usage of specific services and charged users by the minute on their phone bills. ISPs can only dream of such control over their clients.

The Internet has had massive impacts on the entertainment industry, some positive, others negative. Ideally, entertainment companies would like to impose greater security and better control over distribution to protect intellectual property. Powerful business interests have called for an end to network neutrality to insure that commercial services get greater bandwidth at the expense of public usages and personal communication. If the solutions they prefer prevail, the Internet will be transformed into something resembling a personalized television, a broadcast system controlled by a few networks and cable companies rather than the decentralized, nonhierarchical configuration we currently enjoy.

2. *Anonymity.* Apart from these business-related inconveniences of nonhierarchical structure, the Internet supports anonymity. Anonymity protects any form of stigmatized or antisocial activity. Much of this activity has a commercial character—for example, the paid distribution of pornography. But anonymity also serves community. Individuals who would otherwise be fearful of the consequences of expressing unpopular views are free to do so in forums where they debate the issues of the day or gather with others to clarify their ideas and organize. Although it is possible at some expense to break through the veil of anonymity, it has been used effectively to build political opposition. Anonymity has had explosive consequences in countries under dictatorial rule.[23] Since both commercial actors and online activists in democratic societies benefit from anonymity, only a few major sites demand real-name identities.

Penetrating the veil of anonymity is primarily a concern of governments, a third relevant social group. But so far, at least in democratic societies, government surveillance has not inhibited public debate. Whether the struggle against terrorism will change that remains to be seen.

3. *Broadcasting*. Broadcasting is an important feature of the Internet. It can reach millions with the same content at times chosen by recipients rather than senders. This marks progress in convenience over television. In the consumption model the Internet functions as a replacement for television, CDs, and DVDs. Since we are only at the beginning of this development, it is impossible to say how drastically it will reshape the Internet as media companies struggle to ensure the best possible delivery of their products and to protect their intellectual property. The community model also relies on broadcasting for public interventions, protests, fund-raising, and other political tasks. Combined with anonymity, broadcasting is a powerful political tool. It has been used to mobilize citizens on a large scale for demonstrations and elections. So long as communication on the Internet is free and anonymous, broadcasting will serve both commerce and community.

4. *Data Storage*. Stored data on the Internet has a variety of functions. The consumption model privileges commercial purposes. Data is collected by the owners of social networking sites, analyzed, and sold to improve the performance of advertising. Users search the Internet for goods, which has created huge new markets linking buyers and sellers globally. Stored data is also available to governments for surveillance. Occasionally dissenters get hold of data embarrassing to governments and corporations and publish it on the Internet for all to see. In the community model certain kinds of data access are restricted to protect privacy. This has influenced the use of data by business. Companies such as Facebook and Google promise to limit their intrusions to data mining. The data is only fully available to members of each online community (and government spies). It can then be used by individuals to reconstruct their past statements and commitments, much like a collective diary or agenda.

Data storage would be confined to community usages if online communities moved away from proprietary platforms, for example through a peer-to-peer alternative, or if privacy rights were interpreted to prohibit data mining. By the same token, proprietary networks threaten

online community when they go too far in violating privacy. A rough equilibrium has been achieved in which data storage is useful to both business and ordinary users.

5. *Many-to-Many Communication*. The Internet supports online community, gatherings of like-minded individuals, through a unique feature, the ability of users to share a common file. Messages sent to the file are seen by all in contrast with mail and email which are addressed to individuals rather than to a group.[24] Access to the file is access to all those with similar access. Many-to-many communication is a typical concretization. The two seperate structures which it models digitally, transmission and filing, are here brought together in a single structure. This is the technical basis of social networking.

Online community is an important innovation. It offers the first electronic mediation of small-group activity. Most social life goes on in small groups, as well as education, business meetings, and political discussion. Since online communities assemble groups without regard for geographic distance, scattered individuals can come together around a theme of discussion or struggle that would otherwise be unrepresented in public life. The fact that individuals reveal their tastes and preferences in these group activities has made possible the exploitation of many-to-many communication for commercial purposes. Social networking sites thus serve commerce in serving community: targeted advertising based on data mining is Facebook's major source of revenue.[25]

In the early days of commercial computer networking and the Internet, many-to-many communication supported the invention of exciting new forms of sociability. This is the background to the expectation that computer networking would bring about revolutionary social change. No doubt the prophets of networking exaggerated its transformative power, but the critics exaggerate its failure to support democratic initiatives.

An Ambiguous System

The ambiguity of these five features explains how they can serve in the different strategies of very different actors. The dissemination of popular films, pornography, and calls to revolution all employ broadcasting. Anonymity protects criminals as well as dissenters. Online communities gather rock fans as well as revolutionaries. And so on. Different combi-

nations of the functional layers favor consumption or community. In its present form the Internet is compatible with both but it will only remain hospitable to online community and public political participation so long as something approaching the free flow of information is preserved.

The essence of the community model is reciprocity. Each participant is both reader or viewer and publisher. To maintain this structure, the community model requires the continued neutrality of the network so that nonprofessional, unprofitable, and politically controversial communication will not be marginalized. It must be possible to introduce innovative designs for new forms of association without passing through bureaucratic or commercial gatekeepers. The involvement of open source developers and other unpaid volunteers is essential and would not survive a commercial takeover of cyberspace. Embedding a strict regime of intellectual property in the technology of the system would be incompatible with free communicative interaction.

The conditions of community are both social and technical. These conditions, which are accidental consequences of the Internet's military origins, are incompatible with the most ambitious plans of business, but they must be protected for the Internet as we know it to survive. Should the community model prevail, commercial, entertainment, and informational applications would certainly find their place, but they could not dominate the evolution of the system with their special technical and legal requirements. Indeed, so far business seems to be adapting to the requirements of community: the commercial operation of community sites turns them into advertising platforms without interfering with their communicative content. This is why the Internet continues to have political significance even as business encroaches on it more and more.

The consumption model has enormous potential for growth because the Internet has not yet been fully adapted for broadcasting. We can expect a huge boost in consumption usages when every sort of recorded entertainment is readily available. But to most effectively serve as an entertainment medium, the Internet would need to be "rationalized." As Andrew Ure wrote with respect to production, "self-willed and intractable" users of the Internet must be prevented from "doing damage to the whole."[26] Predictably if entertainment takes over the Internet it will squeeze out or marginalize most communicative usages. So in this version the word *Internet* comes to mean a mass medium like television.

Fortunately, the Internet is not yet completely dominated by business. There is still a free space for community in cyberspace.

The Internet as a Public Space

The democratic public sphere is an essential aspect of democracy. Elections would have little meaning if citizens did not engage in widespread and continuous discussion of policies and government. The public sphere is the "space" of those discussions. It is occupied by a more or less significant portion of the population at any given time. In periods of crisis or uncertainty, it swells. When all is going well, it may contract. But in any case democracy involves public participation in the creation and the criticism of ideas, policies, and representatives.[27]

The Internet is an important site of public discussion. The list of progressive political activities it supports gets longer and more impressive every year—from the Zapatista movement in Mexico to the protests against the WTO and the IMF or the worldwide demonstrations against the War in Iraq. Facebook and Twitter supplemented more traditional means of discussion and mobilization in the unprecedented protests that gave rise to the Arab Spring and the Occupy Wall Street Movement. The Internet also impacts electoral politics, first coming to attention with Howard Dean's campaign and playing a major role in the elections of Barack Obama and Donald Trump. In all these cases the Internet has broken the near monopoly of the business- and government-dominated official press and television networks by enabling activists to speak directly to millions of online correspondents.

The results of the recent elections in the United States confirm the political significance of the Internet, if not its progressive contribution. Yes, the right too can use the Internet for its simulacrum of revolt. It too can spread its own view of events. But the claim that the Internet polarizes public life by creating echo chambers in which the individuals never contact anyone with dissenting views is refuted by the contentiousness of comments on newspaper articles, among other venues for political argument. The Internet may have some responsibility for enabling incivility to go public and it contributes to partisan divide by diminishing the authority of the "official" media. But these impacts pale into insignificance compared to the political strategy of the powerful Republican party and its billionaire

supporters. The effects of free trade on the working class, the weakening of the labor movement, gerrymandering and conservative mass media are the obvious places to look for an explanation for polarization. However, the election did reveal an ominous trend the significance of which is still difficult to measure: new techniques of propaganda employing socialbots present a new version of an old threat to the public sphere.[28]

Examples of progressive uses of the Internet seem to me to provide strong evidence that it makes a contribution to democracy, but they are not enough for Fuchs and Dean, nor for Darin Barney who argues that "these alternative and resistant practices still represent a tear in a salty sea of hegemonic encounters with the broad scope of digital technology and its culture. To take the measure of the present conjuncture we need careful work that documents and even promotes tactical political uses of these technologies, but we also need to place these uses in the broader context of what remains a very powerful set of technologies configured to advance and secure what Jacques Rancière has described as the 'unlimited power of wealth.'"[29]

To answer such objections, a theoretical framework must give the political Internet substance. After all, as Fuchs, Dean, and Barney suggest, political usages might be exceptional and the Internet defined by narcissistic self-advertisement and business. My main concern is to develop a coherent alternative to such critical assessments. To anticipate, I argue that politics on the Internet is the tip of the iceberg, arising in the midst of a broader revival of agency in many different types of online communities. These new forms of agency redefine and enlarge the public sphere. What we commonly identify as politics on the Internet is an instance of this broader phenomenon.

Social networking sites can bring dissenting opinion to the attention of large numbers of people quickly and cheaply, and eventually mobilize them in protest. Thus despite the dispiriting commercialism of Facebook and Google, and the role of corporate and government surveillance in stripping us of the last vestiges of privacy, there is another side to the story. Freedom of speech and assembly have a new venue in a society that has practically eliminated public political gatherings and speechmaking. The visible manifestations of politics on the Internet take shape against a background of discussion in web forums and on social networking sites. In this context user-generated content is political content. There is a huge literature attempting to understand the emergence of an electronically mediated public sphere on the Internet.[30]

What makes this possible is the very feature of the Internet that supports social networking—namely, its ability to mediate small-group activity, the many-to-many communication that distinguishes interaction on computer networks from other forms of mediated communication such as the telephone and broadcasting. Groups can form in the spaces for free discussion the Internet provides, debate their ideas and plans, and then use other features to broadcast a call to action.

The impact of social networking on the public sphere goes beyond these conventional political considerations. Not only does networking support protest movements but it has enlarged the range of concerns discussed in the public sphere. Online communities have begun to use the Internet to coordinate their demands for a fuller representation of participant interests. These new forms of online politics extend activity in the public sphere to technical issues formerly considered neutral and given over to experts to decide without consultation. The process continues to unfold as the public sphere embraces ever more domains of social life.

But, contra Fuchs, public activity around these new concerns is not motivated by struggle over the distribution of surplus value as are workers' struggles. Rather, insofar as network users have something in common with workers, it is not their economic claims but the technological mediation of their association. Factories were the first modern institutions which assembled masses around technologies. Marx understood the importance of technology in creating the mass base of struggle and contrasted the political potential of cooperative industrial labor with the passivity of isolated peasants.

Today technical mediation touches every aspect of society, not just the factory. The entire population of advanced capitalist societies is enrolled in many overlapping technical networks, each of which is organized by a hierarchical administration modeled on capitalist management. Not just production but also education, medicine, leisure activities, and transportation have been transformed by technology. Impressive numbers are involved in these many new functional networks, but for the most part the participants are not assembled locally in face-to-face contact as are factory workers. This has limited the political potential of these networks and made it easy to administer them in the interests of capital. Social networking is beginning to change this situation. Latent social groups can be assembled virtually online paralleling the many forms of technical mediation that unite the individuals in functional networks of one sort or another.

The case of medicine offers an example of effective mobilization in a domain usually considered to be apolitical. Online patient groups bring together untold numbers. The traditional isolation of patients is overcome and their relation to the medical institution transformed. Medical paternalism, already in decline before the Internet, is now much more generally challenged. Patients show up at the doctor's office with printouts about treatment in hand. They learned very early how to use their social networks to lobby for research funding.[31] This is an example of what Maria Bakardjieva calls "subactivism," a micropolitics of daily life capable of challenging administrative hierarchies and their policies.[32]

Politics is no longer the exclusive affair of traditionally constituted political groups debating the traditional issues. To the extent that so much of life is now mediated by technology, more and more of it will be subject to these new forms of democratic intervention—that is, if the community model of the Internet survives. This is the ultimate challenge for democracy on the Internet: to preserve the conditions of online community. So far the most significant mobilizations around technical issues have concerned the Internet itself. The defense of free communication and privacy has engaged millions of users. These struggles have prevented the enclosure of the Internet commons by business; users continue to maintain its openness to free communication and innovative usages. Human action, not technology, will decide the future of the Internet.

Subactivism is not the equivalent of the labor movement in an earlier era, but it could provide a different kind of mass base for struggles over control of economic and social life. The movements to which it gives rise are still quite weak and lack an overall strategy of change. But the unfavorable comparison with earlier revolutionary movements should not blind us to subtle changes taking place in the public sphere and the conduct of politics that may yet shape a new era. At the very least these changes testify to the significance of the political movements supported by the Internet, which cannot reasonably be dismissed as mere exceptions to the rule.

Conclusion: A New Dialectic

The fracture in the meaning of the Internet, the multifunctionality of its features, and the struggle over its future are not unique to this technology, although they may be more visible here than elsewhere. All technol-

ogies establish networks in the sense that they bring people and things together in combinations determined by a mix of symbolic and causal relations. And many of these networks are traversed by contradictory programs representing different and conflicting interests. The tendency to define the network by the program of its dominant group must be resisted. As I argue in Chapter 2, all programs are equal in principle. Each has a claim to appropriate the network's resources and to organize the network around the interests it represents.[33]

This is the pattern we observe in the case of the Internet, with frequent overlapping of functions and occasional conflicts. Most users are at ease in this complexity and don't try to sum it up in a single concept. They shift from one program (in both senses) to another as the need arises. But the critics have selected one aspect of the whole and conceptualized the entire network on the terms of a single dominant program. I have attempted here to restore the complexity of the network by analyzing it as a contested technology.

The condemnation of the Internet is premature. There are more pressing problems today than refuting Internet hype. What about the corporate forces attempting to transform the Internet into a broadcast medium for the distribution of entertainment? And the intensification of corporate and government surveillance? How can such challenges be defeated when we focus our critical energies on precisely the aspect of the Internet that is threatened by these hegemonic forces—namely, its communicative role? It is time to move on from counterhype to a serious confrontation with these threats to the Internet, imperfect though it may be. Keeping an open mind about the Internet is not a naïve, uncritical stance but, on the contrary, makes possible political engagement with its future.

THEORY

The previous section of this book introduced and illustrated a method of analysis of rational institutions but did not examine the concept of rationality itself. The following section addresses the question of the nature of the rationality embodied in the technosystem and in the struggles to reform it.

The rationality of capitalism is both social and instrumental in the sense that it is inseparable from biased institutional decisions even as it aims at technical control. It is formalized in technical disciplines that describe functional relations and in some cases codify institutional practice. Modernity is characterized by the hegemony of this type of rationality. It replaces religious and traditional worldviews in organizing major social institutions.

Philosophers have long criticized a form of life based on the pursuit of ever more powerful means without regard for any higher purpose. They have sought alternatives to the domination of instrumental rationality, either through spiritual renewal or a new concept of reason. But in the past higher purposes have always been validated by worldviews based on myths effectively refuted by the Enlightenment. Modernity is about the liberation of reason from such worldviews. However, the consequences call into question the belief in progress that inspired the Enlightenment.

The contributions of Heidegger, Lukács, and Marcuse fall short of supplying an alternative to instrumental rationality, but they do clarify the nature of functionality, revealing the imbrication of social meaning

and natural causality in its constitution. The instrumentalization theory sums up these two dimensions of rationality. Where the constructivist argument shows the role of the social in the underdetermined structure of technologies and institutions, the instrumentalization theory finds underdetermination in the structure of rationality itself. The context-freedom and purity of rationality is shown to be as mythical as the worldviews refuted by the Enlightenment. Rationality enters the social world socially.

Although modernity will always depend on instrumental rationality, this need not lead to dystopian conclusions. The instrumentalization theory reveals progressive possibilities underestimated by both Critical Theory and conformist opinion. Those possibilities depend on effective communication between lay and expert actors—between, in other words, public protest and technical implementation. A critical theory of judgment provides the basis for this account. Here the argument of the earlier chapters of this book is reversed: instead of showing the social dimension of rationality, the aim is to show the rationality of the social, as exemplified in social movements that address the technosystem.

Critical Theory has not yet come to terms with the central role of the technosystem in progressive development. Neither the early critique of instrumental reason nor Habermasian system theory are adequate. What Jean-François Lyotard called the "grand narratives" of progress are discredited. This book attempts to develop the methodological principles and the conceptual framework for analyzing specific cases of local progress or regression as they involve the technosystem. For this purpose, Critical Theory must renew its early dialogue with the social sciences. Previous chapters engage that dialogue which, in these concluding chapters, grounds a revised idea of progress.

■ CHAPTER FIVE ■

Reason and Experience in the Age of the Technosystem

The Gestalt Switch

Most social critics, including the pessimists among them, believe implicitly in the idea of progress. Even Heidegger imagined a vague future dispensation in which the crisis of modernity would be overcome, but he neither explained it nor called for action to bring it about. Lukács and the Frankfurt School envisaged a socialist alternative. As Marxists they were bound to assume the possibility of a transition to socialism based on the potentialities of capitalism, but their critique of the technosystem was so negative as to call that assumption into question. Contemporary Critical Theory relies on reform rather than revolution, but its concept of the political excludes the technosystem. Presumably an enlightened public could command its improvement where needed but the details of that process are unspecified. Social struggle over the technosystem is undertheorized if not completely ignored. The risk in all these failures to clarify the alternative is a return to some sort of disguised spiritualism, a renewed version of the split between (political) values and (technical) facts.

Against such spiritual solutions, Don Ihde argues that the crisis of modernity must be overcome through a "gestalt switch in sensibilities [that] will have to occur from *within* technological cultures."[1] Such a switch is possible because technologies are "multistable." The multistability of technology, Ihde's version of underdetermination, holds open the possibility of change "from within." The gestalt switch works with

principles endogenous to the technosystem rather than importing criteria from politics, philosophy, religion, or some other external source. This is the strategy I will pursue here.

The notion of a gestalt switch resonates with the Hegelian-Marxist reluctance to endorse values cut off from any institutional actualization, dangling in a realm of feeling and fantasy. Hegel was critical of what he considered merely personal dissatisfaction with the status quo. The underlying issue here is "actualization," the institutional realization of values. According to Hegel, the family, the economy, and the state exhibit a moral order. He attempted to show that individuals obeyed only their own reason in living in accordance with the requirements of these institutions. Individual and society, freedom and law, were reconciled.[2]

Critical Theory too argues that values are realized in the technosystem, but by no means in conformity with Hegel's theory. The Hegelian reconciliation with reality is everywhere frustrated by the widespread experience of mismatch between institutional logics and human needs. The mismatch inspires demands for change which the institutions repel, not with an affirmative relation to norms as Hegel proposed, but rather by claiming a monopoly on instrumental rationality.

Where Hegel's institutions had a moral foundation, our contemporary equivalents simply claim to be efficient. In opposition to this claim, protest and struggle are not based on mere fantasies but aim at the actualization of positive values in a new state of the system. But characteristically, those in command condemn public demands for change as irrational. The split between values and facts appears to be reinscribed in every conflict. Yet what we witness over and over as a result of such apparently irreconcilable conflicts is a values-based transformation internal to the rationality of the technical system. This is the reality of the gestalt switch as it enters modern life in one struggle after another. Although these struggles are piecemeal, they have far-reaching consequences as is obvious from the comparison of our present attitudes, way of life, and technical systems with those of fifty years ago.

Dialectical social theory must preserve the Hegelian-Marxist notion of actualization by relating it to a historically plausible *Aufhebung* or transcendence of the given state of society. Today we face processes of social change that are partial rather than total, yet the changes have fundamental implications for the future of society that go far beyond the usual limits of a reform. Environmentally sound technology, the emergence of new possibilities of communication on the Internet, the material

consequences of changes in the status of women serve as examples of epochal significance. The new politics of the technosystem is neither revolutionary in the Marxian sense nor merely reformist, confined to minor tinkering with the established system.

We do not know where these changes lead but we cannot doubt that they represent a universal advance, an *Aufhebung* of important aspects of the technosystem. In the age of the technosystem, critical constructivism gives an account of the process of transcendence without positing a final endpoint the nature of which we do not know.

This chapter attempts to work out a critical version of the gestalt switch. I begin by reviewing relevant arguments in Lukács, Heidegger, Horkheimer, and Marcuse, concluding with the turn to a theory of judgment to renew the quest of Enlightenment.

Reification and Dereification

The contrast between *Aufhebung* and spiritual renewal is exemplified by Lukács and Heidegger. Their theories of technical action are complementary, but their conclusions are radically different. Lukács interprets Marx's critique of political economy as a model for the critique of formal rationality as such. According to Lukács, Marx's critique was made possible by workers' resistance to the capitalist forms imposed on them. Lukács generalizes from this model to a dialectic of rational form and living content. He argues that everyday experience in capitalist society contains a critical moment that underlies theoretical critique. I will call this notion of interaction between reason and experience the "continuity thesis." It is shared in a different form by phenomenology where it appears most fully explained in Husserl and Heidegger.

Husserl understood the crisis of modernity as the general loss of meaning. For this he blamed scientific naturalism. He responds by arguing for the phenomenological grounding of science in the lifeworld. If the lifeworld is the source of meanings presupposed by science, scientific rationality is not alien to experience but is an extension of it along specific lines such as quantitative precision and deductive rigor. Formalized knowledge depends ultimately for its categories on everyday knowledge, which it renders "clear and distinct" for scientific applications. The same approach can be applied to rational technical disciplines. Their concepts are dependent on the lifeworld for their meaning. Despite its reification,

the cognitive basis of the technosystem is not independent of the life-world but rather forms a specialized extension of it.

Husserl's account focuses on the generalizing and formalizing procedures which institute science. Heidegger's existential version of the continuity thesis grounds objective knowledge in breakdowns of the lived experience of action. In Lukács's Marxist version, in contrast with phenomenology, continuity is conceived as a terrain of social and political struggle transforming society.

Lukács argues that, despite appearances, society is not composed of stable things subject to scientific laws. It is relational, dependent on the human actors it enrolls. This is most obvious to us today in the case of the Internet. It is a constant flux of ever-changing usages made possible by its material and organizational infrastructure. The same could be said of every institution in modern society, although the flux is usually less visible because the pace of change is much slower than on the Internet.

But all is not flux: modern society is based on markets, which have a rational form explained in political economy, and on administrations and technologies which apply causal schemes drawn from technical disciplines. Political economy and these technical disciplines presuppose that institutions are stable and law-governed, like the things of nature, and they have some success during peaceful times. Lukács calls the causal logic of the apparently stable things of which society is composed "reification" and the conflictual interventions of the underlying actors can be called correspondingly "dereification."

The theory of reification is paradoxical. Social "things" are inextricably entangled with human action. Society is structured to a certain extent by reified causal laws that are continually undermined by the dereifying actions of its underlying human base, a more or less empowered public. Naturalistic causality and teleology meet and conflict. Furthermore, the intentions of the actors are unstable and contradictory. As a result what appear to be ordinary things lack both stability and coherence. They are continually designed and redesigned in conformity with the actors' shifting interpretations and conflicts. To understand them we must convert nouns into verbs, apparently substantial things into social processes, rational principles into the common ground of debate.

Lukács's account of reification and dereification explains the rationality of capitalism and its transcendence in another type of rational social order. His theory conforms with Hegel's concept of dialectical

development: alienated human action returns to itself. Values and facts merge in a single historical flow. The potential for socialism (value) contained in capitalism (fact) is actualized. Teleology returns as a historical force rather than as a metaphysical property. Lukács calls this a "post-utopian" theory of social change.[3]

The contrast between Lukács's position and that of Heidegger is instructive. Heidegger's rather similar critique of technology allows for no dereifying response. Instead he calls on us to adopt a "free relation" to technology. This is the most theoretically sophisticated version of a spiritualistic alternative to the existing culture of the technosystem. I will argue that Lukács offers a better approach to understanding the challenge to the technosystem in the public sphere today.

The critique of the technosystem in both Lukács and Heidegger draws implicitly on the neo-Kantian concept of the construction of object domains. According to neo-Kantianism, domains such as art, science, politics, economics, and history each specify an object of activity or research. They impose an a priori conception of "what is" on the world. That conception is a form that frames the contents of an aspect of social life or nature. The physicist deals with matter in motion, the economist with commercial activity, and so on. These "forms of objectivity" are abstractions from the infinite complexity of reality. Lukács and Heidegger argue that form is not merely in the mind, as in neo-Kantianism, but in the world. It shapes experience in shaping technologies, administrations, and markets.

Both Lukács and Heidegger argue that formal scientific-technical rationality has become paradigmatic for the understanding of rationality as such. They identify the logic of the corresponding form of objectivity and explore its generalization as a cultural universal, no longer confined to science but shaping the modern lifeworld as a whole. Lukács writes: "What is important is to recognize clearly that all human relations (viewed as the objects of social activity) assume increasingly the form of objectivity of the abstract elements of the conceptual systems of natural science and of the abstract substrata of the laws of nature. And also, the subject of this 'action' likewise assumes increasingly the attitude of the pure observer of these—artificially abstract—processes, the attitude of the experimenter."[4]

According to Heidegger science constructs nature as the object of planning and control. It is subject to precise measurement and experimental manipulation. Whatever cannot be measured and manipulated is

insignificant. This construction now defines the real which is identified with the object of technology. Heidegger argues that the source of this construction is transindividual, not a social class or economic system as in Lukács, but an epoch in the history of being. The technological epoch is exemplified by machine technology but its spirit long precedes the Industrial Revolution and shapes the modern natural sciences from their earliest beginnings.

Lukács makes a similar argument but he attributes the origin of the construction to capitalist practices, reflected in science and a reified worldview. For scientific-technical rationality, nature and the social world are quantifiable entities and the human subject is confronted with a world that cannot be fundamentally changed, only technically manipulated. He identifies the sources of this world relation in commodity exchange, machine technology, and administrative and legal formalism.

Commodity exchange imposes the formal equivalence of dissimilar objects through quantification and formalization. Marx analyzed this complex in his discussion of the "fetishism" of commodities. Everywhere in capitalist society concrete goods take on the commodity form and present themselves as equivalent through price. As such they interact in accordance with a logic independent of human will. The nature of natural science is also essentially quantifiable, and Lukács conjectures that scientific methods owe something to the practices prevalent in a capitalist society.[5]

Similarly, the subject of deskilled industrial operations is external to the production process, an appendix of the self-acting machine. Obedience to the "law" of the machine's functioning is the condition *sine qua non* of human agency. Through what Marx called "real subsumption," human operators lose their skills and become fungible, infinitely replaceable variables in the equation of production. In the case of administration and law, a formalism modeled on the scientific-technical relation of law to particular instance determines instrumental practices congruent with capitalism.

The modern lifeworld is an ambiguous combination of the reified technosystem and persisting elements of tradition and lived experience. It makes a difference where the emphasis is placed in evaluating the potential for resistance. Heidegger's examples are traditional. He valorizes precisely those old-fashioned aspects of social life that are not technified. But they have only a weak redemptive power and serve mainly as symbols of a vaguely evoked future dispensation. In practical terms, his

critique cancels action for change, which can only reproduce the system. Hence his call for a spiritual solution to the crisis of modernity he calls "*Gelassenheit,*" letting be.

Lukács argues that the reified capitalist system is fraught with contradictions. There is a potentially explosive tension between the imposed capitalist forms and the lived experience of the proletariat. With certain modifications, this theory of resistance as dereification turns out to be fruitful for understanding contemporary struggles.

Dereification fulfills the requirements of the gestalt switch. It involves a twofold transformation of society, at the level of meaning and at the material level. The release of social institutions from capitalist control resignifies them by assigning them a different place in the system of meanings. This semiotic transformation is only possible in the context of collective initiatives that violate the "laws" of the system and impose different material operations. The gap between theory and practice, value and fact, is closed through the transformation of the technosystem. Lukács conceived this process as revolutionary, but it can take more modest forms as we have seen in the case of the environmental movement.

Forms of Rationality

Lukács's discussions of dereification are brief and elusive. Its relevance to the concept of rationality is barely sketched and gives us no picture of the world it would create. No doubt he assumed, as had Marx, that socialism would invent its own solutions to the problems it encountered on the path of social reconstruction. But this abstinence from speculative and utopian thinking leaves too many unanswered questions that can no longer await a hypothetical revolution. In this section and the next I will discuss attempts in the Frankfurt School to reformulate the questions left in suspense by the failure of the revolution and to provide original answers.

Once the proletariat is no longer active as the bearer of an alternative rationality, rationality must be reconceptualized in philosophical terms. As Adorno wrote, "Philosophy, which once seemed obsolete, lives on because the moment to realize it was missed."[6] Today this has become a practical matter as well. We are acutely aware of the need for a response to the conservative critique of public interventions into the

technosystem. A dogmatic notion of rationality, identified exclusively with scientific and technical disciplines, condemns these interventions as irrational. Underlying this rationalist dogmatism is the reified opposition of fact and value according to which means are rationally determined on the basis of science in the pursuit of efficiency, while ends are mere subjective preferences—"ideologies." Thus attempts by an ignorant public to change the means will impoverish society.

Philosophers argue about the conceptual validity of the distinction between fact and value, but it is not just a conceptual problem.[7] It has a social basis which Max Weber called the differentiation of value spheres. Differentiation describes the institutional separations between politics, economics, science, technology, the family, religion, and so on. While all societies are differentiated to some degree, modern ones are extraordinarily so. In them, Weber argues, the unity of reason is fractured. Means and ends respond to different and irreconcilable forms of rationality which Horkheimer called "subjective" and "objective" rationality.[8]

According to Horkheimer, reason in its objective form has intrinsic goals. Note that his use of the term "objective" has nothing to do with scientific objectivity. Reason is "objective" in the sense that its goals are considered valid guides to the deployment of technical means. This kind of reason is exemplified in premodern craft or today in planning the distribution of public goods such as education.

Objective reason in traditional societies had a basis in the claims of religion, ethics, and politics, validated in a shared worldview. But in modern societies all worldviews are questioned and the corresponding forms of authority are no longer able to found and prescribe universally recognized ends. Only science, which ignores the realm of ends, is granted universal validity. In this context, a different understanding of reason prevails which Horkheimer calls "subjective." This is a value-free rationality of pure means. Ends are rationally unspecified, attributed to psychological causes rather than reasons. The concept of subjective reason describes the instrumental rationality of a total system of means that incorporates no substantive end beyond the increase in its own efficiency and power.

Modernity is a social order in which subjective reason prevails, disappointing the hope of the Enlightenment that a secular wisdom would guide the use of the new powers science provides. Subjective ends place individuals and nations in conflict even as the instruments they have at

their disposal become more powerful and dangerous. The outlook is terrifying, no less so today than when Horkheimer wrote.

Horkheimer concludes that a new concept of reason is necessary, but objective and subjective reason form the broken halves of a totality that cannot be restored. Restoration was implicit in Marx's vision of socialism as human control of history. He assumed that workers would reconcile individuality and solidarity and in so doing resolve the antinomy of means and ends. Technical means would be put in the service of democratically decided goals instead of driven blindly by competition for profit.

Horkheimer believed this prospect to be out of reach for the foreseeable future. Marcuse was the only member of the Frankfurt School who argued for the possibility of overcoming reification and recomposing fragmented reason. He believed that an aestheticized form of experience had emerged briefly in the New Left, prefiguring a new concept of reason. Identifying aesthetics with the affirmation of life, Marcuse projected a science and technology based on harmony between human beings and nature. Although this has not come to pass, his focus on the tension between experience and the design of the technosystem was prescient. Horkheimer was too pessimistic. The rise of struggles over the technosystem has validated Marcuse's hope in some measure.

Transforming the Technosystem

Marcuse's concept of reconciliation is based on a meta-critique of the phenomenological concept of world, especially in its Heideggerian version. Marcuse draws on Hegel and Marx to provide a social content to Heidegger's ontological claims. In 1960 he published an article significantly entitled "De l'Ontologie à la Technologie: Les Tendances de la Société Industrielle."[9] This article promised a forthcoming book, which was to be *One-Dimensional Man*. It contained a curious reference to *Being and Time*. Marcuse writes,

> A machine, a technical instrument, can be considered as neutral, as pure matter. But the machine, the instrument, does not exist outside an ensemble, a technological totality; it exists only as an element of technicity. This form of technicity is a "state of the

> world," a way of existing between man and nature. Heidegger stressed that the "project" of an instrumental world precedes (and should precede) the creation of those technologies which serve as the instrument of this ensemble (technicity) before attempting to act upon it as a technician. In fact, such "transcendental" knowledge possesses a material base in the needs of society and in the incapacity of society to either satisfy or develop them. I would like to insist on the fact that the abolition of anxiety, the pacification of life, and enjoyment are the essential needs. From the beginning, the technical project contains the requirements of these needs. . . . If one considers the existential character of technicity, one can speak of a *final technological cause* and the repression of this cause through the social development of technology.[10]

This passage interprets and transforms Heidegger's transcendental analysis of worldhood. Heidegger had argued that our surrounding world consists in a system of instrumentalities that respond to our "care" for our own future identity. The system is constituted by references that link artifacts together in terms of the work to be done with the ultimate purpose of furthering the self-creation of *Dasein*. Heidegger's "care" is this original motivation, the human pursuit of identity.

For Marcuse this system has become "technicity," the historically specific system of technology rooted in human needs.[11] Heidegger's ontology of instrumental action unifies human being and world theoretically in terms of an unspecified end. Under the influence of Simondon, Marcuse's concept of technicity implies a developmental dynamic that reconciles human beings and technology in the future. He has transformed Heidegger's ontological account into a normative account of the failure of technology to realize its definite proper end—that is, the fulfillment of needs. Marcuse sets up the contrast between a truncated technological "a priori" aimed exclusively at domination and an alternative a priori that would fulfill the *telos* of technology by realizing the intrinsic potentialities of human beings and things.

In 1964 Marcuse finally published *One-Dimensional Man*. Chapters 5 and 6 are an implicit response to Heidegger's famous essay "The Question Concerning Technology." In opposition to Heidegger's history of being, Marcuse proposes a history of rationality, based on the distinction of objective and subjective reason.

To briefly sketch his conclusions, rationality in ancient Greece en-

countered a world of independent things. For the Greeks, exemplified by Aristotle, things are "substances" with an essential form and purpose. "Is" and "ought" are harmonized in the potentialities belonging to the essence. To say "Man is a rational animal" is to signify the essence of man in terms of the highest potential of the species. The Greek conception of productive rationality is realized practically in *technē,* the knowledge associated with craft and artistic creation. This knowledge includes the essence which is actualized in a material through *technē.*

Technē is superseded in modern times by the scientific mode of experiencing and understanding the world. The new scientific a priori has three essential features—formalization, quantification, and instrumentalization. Science does not address experience in its immediacy but transforms everything it encounters into quantities subject to formal laws. Things have no essence but are composed of functional units awaiting transformation and recombination. This stance eliminates purpose and hence also potentiality from the world. This is the basis of the value-neutrality of science, its indifference to the good and the beautiful in the interests of the true.

The world, now stripped of any valuative features and disaggregated, is exposed to unrestrained instrumental control. There is an inner connection between science and technology hidden in the cloister of the lab. Marcuse writes, "The science of nature develops under the *technological a priori* which projects nature as potential instrumentality, stuff of control and organization."[12] This instrumentalism appears innocent within the framework of scientific research; science learns by manipulating its objects in experiments. But innocence is lost when the possibilities of instrumental control are exploited on a much larger scale by technology.

In support Marcuse cites several passages from Heidegger's later writings on science and technology. For example, Heidegger explains that mechanization expresses the "essence of technics"—Marcuse's a priori. "Modern man takes the entirety of Being as raw material for production and subjects the entirety of the object-world to the sweep and order of production."[13] But Marcuse rejects Heidegger's history of being. He agrees with Lukács that the congruence of science, technology, and society is ultimately rooted in the social requirements of capitalism and the world it projects. As such science and technology cannot transcend that world. Rather, they are destined to reproduce it by their very nature. They are inherently conservative, not because they are ideological in the usual sense of the term, or because they are false. Marcuse never

calls into question the cognitive value of science and technology. Rather, they are conservative because they are adjusted to serving a social order which views being as the stuff of domination. Thus, "Technology has become the great vehicle of *reification*."[14]

On this account capitalism is more than an economic system; it is a world in the phenomenological sense of the term. This world is the historical project of a specific social subject. As such it is only one possible world among many. The subject of this world, capitalism, can be displaced by another subject. Thus the question of the future is raised. In *One-Dimensional Man* the transcendence of capitalism is also the transcendence of its form of rationality. Marcuse writes,

> If the completion of the technological project involves a break with the prevailing technological rationality, the break in turn depends on the continued existence of the technical base itself. For it is this base which has rendered possible the satisfaction of needs and the reduction of toil—it remains the very base of all forms of human freedom. The qualitative change lies in the reconstruction of this base—that is, in its development with a view of different ends.
>
> I have stressed that this does not mean the revival of "values," spiritual or other, which are to supplement the scientific and technological transformation of man and nature. On the contrary, the historical achievement of science and technology has rendered possible the *translation of values into technical tasks,* as elements in the technological process. The new ends, as technical ends, would then operate in the project and construction of the machinery, and not only in its utilization.[15]

But it is unclear how this is supposed to work. Marcuse argues that the introduction of imagination into the operations of rationality will reunify Horkheimer's fragments. Instrumental rationality must be informed by an imagined future in which intrinsic potentialities are realized. Or put another way, rationality must recognize potentialities identified through the imagination. Adorno had a paradoxical phrase for this which crosses the line between subjectivity and objectivity: "exact imagination."[16] The point is that something is hidden from a purely instrumental relation to reality—potentiality—that is revealed to the imagination.

For Nikolas Kompridis this concept of receptive imagination suggests a similarity between Critical Theory and Heidegger neither acknowledged. He writes, "The emphasis on receptivity ought to be interpreted

in the light of a non-instrumental relation to transformative practice, and that non-instrumental possibility is built into the idea of disclosure."[17] As in the case of Lukács's concept of dereification, Marcuse's concept of the recognition of potentiality implies a noninstrumental transformation of the horizon of meaning that does indeed have something in common with Heideggerian disclosure. But the Marxist conception of a disclosive moment is intrinsically entangled with a reform of instrumental practice rather than a Heideggerian withdrawal.

In Marcuse's later *Essay on Liberation* receptivity is emphasized even more clearly than in *One-Dimensional Man*.[18] The new concept of reason emerges from a different mode of experience, of "seeing," from the prevailing one. "The leap from the rationality of domination to the realm of freedom demands the concrete transcendence beyond this rationality, it demands new ways of seeing, hearing, feeling, touching things, a new mode of experience corresponding to the needs of men and women who can and must fight for a free society."[19] The new sensibility projects an aesthetic lifeworld oriented toward needs rather than domination. It is modern and therefore technological but in a different way, respectful of the potentialities of its objects, both human and natural.

The critical theorists confront the obstacle to the gestalt switch and suggest various alternative paths to actualizing it. But despite their best efforts neither Horkheimer nor Marcuse escape the antinomy of value and fact. From the standpoint of an authentic *Aufhebung* of modernity, the "new concept of reason" holds a promise on which it cannot deliver. It stands as a harmonistic ideal rather than a concrete alternative. Horkheimer treats it as an unsatisfied and unsatisfiable exigency while Marcuse describes it hypothetically as a revolutionary possibility. In both formulations, it takes the place of value in the antinomy. I propose a different approach. I argue that rationality itself has double aspects that cross the divide between value and fact. Perhaps the Frankfurt School failed to establish a new concept of reason because it did not have an adequate understanding of the old one.

Technique and Enlightenment

Ian Angus presents a synthesis of these theories in *Technique and Enlightenment*.[20] He elaborates on Horkheimer's distinction of forms of rationality in terms of Husserl's phenomenological theory of the crisis of modernity. Angus argues that in premodern societies a unified world-

view organized perception. The lifeworld appeared as a coherent totality within which ends emerged. A cosmic order sacralizes the labors of the farmer and the lord alike and assigns them the ends they must serve. Premodern technique—craft—took these ends as starting points for the elaboration of useful artifacts. Because the worldview at the basis of this operation organized and ranked ends, craft was under social control. Objective reason was in charge.

Enlightenment shatters this arrangement by discrediting worldviews. This makes possible formalized technical disciplines and frees technique from the organization and ranking that formerly contained it. Subjective reason triumphs and tends toward universalization. Scientific legitimations for the pursuit of technical ends are substituted for premodern situationally determined legitimations. As in Lukács and Marcuse, the only way to block the uncontrolled development of technique is to return to the lifeworld for new perspectives based on experience. In the remainder of this section I will explain the argument in more detail.

Angus defines modern reason as a combination of formal knowledge and instrumental practice.[21] The emphasis on formalization clarifies Lukács's concept of reification. Reification derives from Marx's theory of the commodity form. Essential to that form is the abstraction from *all* content implicit in the monetary measure of value. Formal abstraction is different from generalization. General concepts retain a material content derived from their basis in the perception of individual objects. The general concept "shirts" is related to particular shirts as their common nature. Similarly "shirts" stands under the still more general concept "clothing" which retains a connection to particular instances of the type it generalizes. Formalization breaks that connection to the individual and substitutes variables that can refer to any object whatsoever. In effect, the commodity is a mere "x" in an infinity of possible equations: so many shirts = so many bananas, so many tons of steel, so many piano lessons, and so on.

Formalization and instrumental practice share an alienation from the lifeworld that results in Husserl's "crisis." Natural science retains only a slender connection to the lifeworld context from which it derives through the artificially isolated experimental milieux. Modern technologies are similarly isolated from their context, although less fully, and many of their remaining connections to the lifeworld are unpredictable and uncontrolled. A technocratic universalization of technique substitutes this formalized instrumental reason for traditional worldviews.

This marks a fundamental change in the social role of technique. In all societies, technical knowledge reduces the original complexity of the lifeworld to serviceable abstractions which Angus calls "types." Types are distinguished from the lifeworld background in the pursuit of various conventionally defined ends. The lifeworld itself is overlooked in favor of the foregrounded types. Where consecrated by a traditional worldview, the types form a coherent whole that is unquestionable, taken for necessary, and real, ontologized.

When modern reason introduces formalization into means/ends relations it isolates them from each other and from their lifeworld source so that they can be deployed in any relevant situation. The parallel with scientific formalization is clear: "Technique is the functioning of formal logic in the life-world."[22] The conventional types are reduced to fragmented residues which no longer form a coherent whole. On the contrary, the relations of the fragments are conflictual rather than harmonious. The invisibility of the background and the ontologization of the conventions then becomes problemlematic as technique is neither organized by a worldview nor integrated to the totality.

The original Enlightenment program was based on the assumption that scientific and technical advance would result not only in material but also in moral progress. Formalization and instrumentalism are indeed progressive in both senses in a context where traditional worldviews and ends are predominant, but once those worldviews are defeated, science and technology cannot go beyond their critical role to become a substitute for tradition. When they attempt to do so they legitimate any and every end in general while handing over selection and implementation to an irresponsible technocracy. This marks the end of the phase in which instrumental reason played a progressive role in demystifying prescientific mythico-religious worldviews. "The waning belief in overall human progress in the twentieth century is rooted in the realization that technical ends (towards which a genuine progress of means does occur) cannot be rescued from conflict and mutual destruction by the same mode of thought that contributed to the accumulation of means."[23] Angus calls this the "reversal" of the contribution of instrumental reason to Enlightenment. A higher-level ordering principle could overcome it but such principles have been decisively discredited by the rise of the sciences.

However, formalization not only causes the crisis; it makes a solution possible. There is a difference between the authoritative claims of traditional worldviews and the universalization of technique. The destruction

of traditional worldviews opens the lifeworld to multiple perspectives and enables the now-independent spheres of knowledge to develop. In the traditional context only one standpoint is authorized and so the ends it selects appear as universally valid. But modern societies understand that ends are mere conventions about which opinions legitimately differ. Thus with the triumph of instrumental reason the practical context in the lifeworld becomes thinkable and is exposed to critical judgment. This promises a solution.

Recognition of context is not a simple return to immediacy. The modern ideal of knowledge is subsumption under formal rules, but instrumental rationality can provide no criteria for the appropriate choice of rule. This is the source of the crisis. Only a nonformal knowledge, a revised understanding of reason that reveals its relation to the lifeworld, can overcome the crisis. Because formalizations substitute a variable for a whole range of possible objects, they can only be related to the lifeworld indirectly, through a critique of their incompleteness and presuppositions. Critical judgment identifies fundamental contingencies in the relation of formal knowledge to the lifeworld. It shows the limits of formalization and cancels its universalization at the expense of other ways of knowing.

At this point Angus might have cited Lukács as a source. His approach agrees with the notion of dereification as the practical critique of capitalist forms. Instead he turns to Arendt's theory of reflective judgment. This allows him to operate on the terrain first explored by Lukács without Marxist assumptions. With Arendt, the turn to shared experience is a search for an alternative to subjective rationality.[24]

I will return to a more detailed discussion of Arendt's theory in Chapter 7. Briefly, Arendt proposes an innovative development of Kant's concept of judgment. Kant distinguishes subsumptive "determinant judgment" from another type of judgment he calls "reflective" which proceeds from the particular to the universal. This involves the imaginative reconstruction of the object in relation to concepts. Particular experiences thus play a central role in reflective judgment. They exemplify the universal at which the judgment aims. Arendt applies this conception to political knowledge and debate which, she claims, similarly proceed from particular to universal.

Angus appropriates Arendt's concept of reflective judgment for his argument. "Technique ignores the practical world of meaning within which it is pursued. A new enlightenment will have to consider the im-

portance of individual examples and the unformulated context of defined ends."[25] Reflective judgment can address the limitations of instrumental reason. But to serve that purpose it must be freed from Arendt's traditional distinction of *technē* and *praxis*. The distinction separates technique from the ethico-political sphere. But the Enlightenment was thoroughly entwined with the rise of science and technique. Arendt's distinction makes that relationship incomprehensible.[26]

Furthermore, Arendt treats the public sphere as a matter of fact. She takes democratic debate for granted, independent of the matter under debate. Angus argues, on the contrary, that the public sphere cannot be introduced as an ontological presupposition prior to its own history. The public sphere is constituted by the critical relation of Enlightenment to premodern worldviews. It is not a presupposition of critique but is formed in the process of critique. The crisis of modernity can only be resolved by the constitution of a new public sphere through a critique of instrumental reason.

Judgment, as a basis for this critique, does not cancel the achievements of instrumental reason. In fact, Angus argues that "instrumental reason implies and rests on an unformulated concept of judgment."[27] By this he means that the formation of means/ends complexes in modernity is the outcome of implicit judgments that identify potentials in the lifeworld, even where the act of judging is not consciously understood as such or subject to public discussion. This concept of implicit judgment can be clarified by reference to the constructivist concept of interpretive flexibility. Ends are not simply given but emerge from actors' engagement with the problems they identify. Enlightenment today requires the "full concept" of instrumental reason which includes judgment—interpretation—as it operates within technique.[28] The implicit judgments at the basis of instrumental reason must now be made explicit.

Judgment dereifies what were formerly understood as absolutes and reveals them as processes of constitution of self and world. It follows techniques back to their origins, establishing the relation between ends and the lifeworld from which they emerge. It brings reason and experience into critical contact. The original context leaves traces in the specification of the means. These traces, which I call the design code, can be clarified by judgment but they are not legitimated by any formalized science or technical discipline. They are in fact the object of the empirical study of science and technology discussed in earlier chapters of this book.

Conclusion: Values and Facts

The argument has developed the implications of the continuity thesis for the notion of a gestalt switch and the division of rationality between subjective and objective forms. This takes us to the threshold of a theory of the new politics of the technosystem. This theory is developed in detail in Chapter 7, but a brief account is in order here.

Successful public interventions into the technosystem appear as a puzzle to the dominant positivistic understanding of rationality. But in fact these interventions are becoming more and more frequent and often have constructive outcomes. The pretension of subjective rationality to split value from fact is refuted in practice. Value and fact are rigorously distinguished only in theory. In everyday life they mix as in the good old days of Aristotle.

In the lifeworld, all facts are associated with values. Some of these values have moral content: friendship, democracy, health, childhood. Similarly, a negative value is attached to a simple fact such as lead in the water supply. Functional objects are both what they are and what they are for. Functionality thus crosses the line between value and fact, as discussed in the next chapter. Each descriptive category carries with it prescriptive implications and signifies a range of possible obligations. As soon as we assign such descriptions, we register their valuative significance. The double aspects—factual and normative—apply to the technical sphere as to every other aspect of life. The normative domain is not cut off from the technosystem and from everyday experience in a theoretical heaven as one might conclude from the writings of political philosophers.

Adorno came to the ominous conclusion that experience in advanced capitalism was so corrupted by commodification and the mass media that it could no longer provide a touchstone of alternative values. While there is plenty of evidence for the corruption of experience, the effect is clearly not total. We have significant examples of progressive change through democratic interventions based on the evidence of experience. In addition to continuing class conflict, diminished in scope and intensity but by no means resolved, there are many types of public involvement: hacking of computerized systems, lawsuits, hearings and forums—especially around environmental issues, and lay participation in the work of scientific experimentation and technical design.

Although their scope and effectiveness are still limited, these inter-

ventions into technically rational systems enlarge the public sphere and orient technical development. Yet they have been systematically ignored by political theorists. Where they are noticed at all, resistances are generally viewed not dialectically but from the one-sided perspective of the dominant actors. From that perspective rationality stands opposed to ignorance and disorder. The fact that public opinion often errs is no more significant than the many failures of scientific experiments. The most important trials are the ones that succeed.

A theory able to explain those successes will have to satisfy three requirements: a social account of design and redesign of the sort explored in the first part of this book, an explanation of the generalization of participant interests in public debate, and a description of the dialogue between formal and nonformal, everyday rationality.

Today participant interests are often recast as matters of justice to recruit a broad public to the cause. I discussed the example of the sidewalk ramp in earlier chapters. All technosystem struggles have a similar trajectory: from interests to rights. The dialogue between forms of rationality then becomes practical, activated in political struggles over design. Such struggles do not collapse the technosystem into the lifeworld or vice versa. Rather they initiate a process of mediation transcending the division between the forms of rationality. The elaboration of a theory of technosystem rationality culminates in a new understanding of the logic of the interaction between expert and lay forms of knowledge.

The changes brought about by the generalization of technical politics require a revision of the very notion of the technical. It can no longer be identified with a narrow functionalism that confines itself to the immediate operations of devices and systems. From the critical constructivist standpoint, the role of the social in design is essential. Design involves an understanding of causal relations, but it also involves social meanings that select among underdetermined causal options. The combination of these two aspects determines design codes and specifications and gives a specific formal bias to the result.

In premodern societies, causal aspects and meanings are combined seamlessly in craft traditions. In modern societies, the reified formal rationality of the technical disciplines and experiential knowledge of the technical achieve a partial separation at the level of discourse, but in the material reality of artifacts and systems they interpenetrate through and through. The politics of the technosystem depends on the fact that the normative aspect of the technical sphere acquires a certain independence

of the technical mentality. In public debate normative claims are often formulated in opposition to the design of the existing technical means in order to demand revisions at the corresponding causal level. Such claims are based not on technical disciplines but on experience with the technosystem.

Phenomenology explains the refinement of everyday rationality by science, but in democratic interventions the movement is reversed as the lifeworld attempts to redefine scientific-technical principles. As Chapter 2 argued, this is possible without loss of validity because rationality is always context dependent in its sociotechnical deployment.[29]

Here is where the theory of judgment comes in. Rational criteria have a dual character. For a technical expert a criterion such as consistency has a purely technical meaning, but in the lifeworld the same concept also plays a normative role—for example, in the demand for consistent treatment of all citizens. Such demands are communicated in the public sphere by redefining personal problems as matters of justice, while at the same time, the demands communicate with experts since the concepts deployed to justify them have technical counterparts.[30]

Neither expert nor lay actors have a monopoly on rationality. Rationality is distributed across the lines dividing expert from lay and facts from values. The point is not that these lines are unreal. They are eminently real: without them, no modernity. But they are porous and allow translations in practice for which there is so far no adequate theory. Steps toward such a theory can be based on an analysis of the double aspects of the technosystem as both formally rational and normative.

An analysis of the concept of functionality in the next chapter provides the starting point. I present a critical discussion of the differences between analytic theory of function and the corresponding phenomenological theory implicit in the writings of Heidegger and Lukács. I introduce the instrumentalization theory in Chapter 6 and develop it further in Chapter 7, explaining the nature of technical politics in terms of contemporary theories of judgment. Chapter 7 also concretizes the theory of judgment Angus finds in Arendt. Applied to the specific case of technical politics, the argument shows the relevance of empirical studies of science and technology to Critical Theory.

■ CHAPTER SIX ■

The Concept of Function in Critical Constructivism

Introduction

Modernity theories generally deplore the organization of modern societies around instrumental rationality. Whether they call it the *Gestell*, reification, or technological rationality, the object of critique is essentially the same. Underlying this approach are assumptions about the nature and limits of functionality. Functions and functional objects have a place in social life, of course, but the critics argue that modern societies treat everything as a function. Functional understanding has become a universal perspective, an a priori principle for the constitution of objects generally with disastrous consequences.

What is it about functionality that gives rise to the crises and pathologies of modernity? To answer this question we must analyze the nature of function. This task has been undertaken in recent years with some success by analytic philosophers. But they do not engage with the social context and its consequences. In this chapter I will review their position briefly as an introduction to a social account of the implicit theory of function in Heidegger, Lukács, and Marcuse.

Theories of Function

What is a technical object? How is a rock changed when it is used to crack open a shell? What transformation does a branch undergo when it is swung high to knock down a piece of fruit? Clearly the objective prop-

erties of these simple objects are not altered by their technical employment. The functions they have acquired are purely relational—that is, they would not exist except for the role human beings assign the objects in their practices. But the ascription of technical function cannot be arbitrary; in this respect it is unlike the assignment of linguistic meaning. The properties of the objects count; they are part of what motivates the choice of these specific objects. The stick only acquires its fruit-gathering function because of its weight and length, the rock its shell-opening function because of its hardness. Technical objects have a foot in two worlds. Their function joins a world of human intentions and a world of objective properties.

Various analytic theories of technical function have attempted to tease out the exact nature of this relation, sometimes emphasizing objective properties, sometimes human intentions, and in the most convincing formulations, achieving a balance between the two sides of the relation. The purpose of these theories is to explain how engineers use the word *function,* or how the word is used in everyday speech, or in both contexts where the theorists can identify a common basis. This approach abstracts from many social and cultural aspects of function in order to achieve a precise conceptual analysis.

Wybo Houkes and Pieter Vermaas have proposed the "use-plan" or "ICE" theory of function which synthesizes many analytic contributions to what they call the "dual natures" project.[1] In their theory the subjective side of functionality consists in beliefs and purposes together constituting a use-plan, while the objective side consists in specific physical properties. A rational use-plan presupposes beliefs about those properties based on direct experience or on information obtained from experts. "In summary, we arrive at an analysis of artefacts as objects with a twofold dual nature: they are objects that have intentional characteristics and that have physical characteristics, as well as objects that are used and that are man-made. Functional descriptions are relevant to the first, intentional-physical duality since these descriptions allow users and engineers to connect and disconnect teleological and structural descriptions of artefacts. Hence, technical function is a useful concept, that serves as a conceptual hinge between the two natures of artefacts."[2]

Note that the concept of plan in this theory is not to be taken literally but is a way of reconstructing artifact use after the fact. Vermaas and Houkes allow for the informal and incomplete intentions that are

more common than the prior elaboration of a detailed plan. The theory is tested against several desiderata, such as whether it can support a distinction between "proper use" and occasional or accidental use and whether it can explain the malfunctioning of useful objects.

Although I agree that the ascription of a function does presuppose beliefs, I want to better understand what we *do* when we envisage the world with a technical intention. What is the orientation of the subject toward the object in this particular kind of belief? How does it differ from, for example, the kind of belief pursued in a scientific context or in business or in games? As I will show, answering these questions involves understanding the specific type of object that underlies the ascription of function and the corresponding form of subjectivity.

My attempts to answer these questions parallel the dual natures project. My own "double aspect" project began in 1975 with an invitation from Frederic Fleron to a conference at the Villa Serbelloni on "Technology and Communist Culture." This was a first opportunity to think seriously about the nature of technology. Technological determinism was dominant in social science at the time. Determinists argued that democratic control of the economy was incompatible with technological "imperatives." I rejected this conclusion yet also rejected the notion that technological means are value-neutral.

A footnote to the conference proceedings summed up the basis of the argument I have been developing ever since. "I would reserve the term 'technique' for specific technical elements such as the lever, the wheel, the electric circuit, and so on, all of which are in themselves neutral applications of objective knowledge of nature. These elements are like the vocabulary of a language; they can be strung together to form a variety of 'sentences' with different meanings and purposes. 'Technologies,' defined as developed ensembles of technical elements, are greater than the sums of their parts. They meet social criteria of purpose in the very selection and arrangement of the intrinsically neutral units from which they are built up. These social criteria can be understood as 'embodied' in the technology and not simply as an extrinsic use to which a neutral tool might be put."[3]

Critical constructivism is a development of this early insight. I called this a double aspect theory of technology with the implied reference to double aspect theories of the mind/body relation. When Descartes sundered mind from body, he relegated the body to the mechanical realm. A purely mechanical explanation of technology leads to naïve instru-

mentalism or technological determinism. I intended to block Cartesian dualism in the understanding of the mechanical itself.[4]

Causality and culture intersect in functionality. I am aware that in one common definition culture would encompass knowledge of causal relations, as well as every other form of belief. Rather than pausing to clarify this terminological issue, I will assume a more or less common sense understanding of the terms. From that standpoint the important distinction is the form and source of the belief: causality involves "if . . . then" relations which, in sophisticated applications such as technology, are identified or explained by technical disciplines. Culture describes the system of meanings and practices characteristic of a society or social group. The distinction between them is anchored in the differentiation of technical disciplines in modern societies. This social fact explains why the common sense distinction has a certain validity.

Analytic discussions emphasize cognitive aspects of the interaction between causality and culture: the ascription of a function rests on an individual subject's belief that the materials possess natural properties suitable for use. Critical constructivism focuses on social aspects of the phenomena. The theory is action-theoretic not just in attending to the beliefs and intentions of actors but in the sense that it analyzes the subjective and objective conditions of functionalization as a social process.[5]

This process extends well beyond the paradigmatic realm of artifacts in modern societies. As I have argued in earlier chapters, technical artifacts obey rules that correspond to the causal relations identified in the technical disciplines that preside over their creation. These disciplines themselves are informed and guided by social interests and cultural assumptions. The economic realm is similarly governed by rules that create opportunities for the technical manipulation of goods and markets. And like technical artifacts, markets are designed by actors in accordance with cultural assumptions and under political influence. Administrations too resemble the technological domain in creating cases defined under rules that resemble natural laws in form. In the background of these procedures lie sciences of management that correspond for administration to the role of natural science and engineering for technology. Thus much that has been learned about technology can be generalized to other aspects of the technosystem. The double aspect theory of technology serves as the basis for a reconstruction of modernity theory.

Critical constructivism proposes a phenomenology of functionality. Where the analytic theory of function identifies one of the "dual na-

tures" with the naturalistically conceived objective properties of things, critical constructivism focuses instead on the derivation of objective aspects from the technical disciplines which identify them and the user experiences they support. This is not relativism; the point is not epistemological. Rather, the intent is to ground a social analysis of the specific type of objectivity characterizing the technical domain.

Social constructivism shows that the problems to which technical solutions are addressed depend on the interpretations of actors with the power to influence design. The interpretations and therefore the corresponding functions depend on the cultural framework within which the actors understand their own needs and the constraints of the environment. Thus function must be situated in relation to the culture and way of life it serves. This has implications for our conception of modernity as a rational form of society and for the related notion of progress.

Heidegger and the early Marxist Lukács loom large in critical constructivism. Both write about technology in ways that reflect an implicitly social concept of functionality. In so doing they work with a very different ontology from analytic philosophy. They understand the functional object in terms that derive from neo-Kantianism and phenomenology. The object is not "real" in any of the usual senses of the term, but rather it is the correlate of an apprehension or intention. But nor is the object subjective; it is a perspective on experience, a cross-section ordering a segment of reality.

This type of object is not simply a sum of physical properties but is what might be called a "relevance structure." This conception of objects does not contradict the analytic philosophers' concern with physical properties in the attribution of function, but it calls attention to the selection that privileges some properties over others. For philosophers of technology in the Continental tradition artifacts are objects of the subjects of such selection. To this I would add that in modern societies the selection is not made by individual consciousness but rather institutionally and through the constitution of technical disciplines.

In what follows I will show how the technical object and subject are construed in Heidegger and Lukács. This involves a rather artificial splitting up of their arguments into the constituent elements of a theory of function, but proceeding in this way provides the resulting theory with a rich content. Although Heidegger and Lukács go quite a ways toward a theory of function, viewing them in this light reveals many missing elements as well. I will identify those elements as I review their theories.

The concluding sections of this chapter will bring together the results of this analysis in what I call the "instrumentalization theory."

Technical Function and World in Early Heidegger

Heidegger developed two theories of technical artifacts, an early one based on craft and a later one concerned with modern technology. The early theory as presented in *Being and Time* is a phenomenology of the everyday technical lifeworld. By "world" Heidegger means a system of meaningful entities that refers back to an agent capable of interpreting its environment, entertaining purposes, and acting. This phenomenological concept of world must be distinguished from the usual common sense and naturalistic concepts. Because it presupposes meaning and intention, "world" is not identical with the totality of entities, as common sense would have it, nor with the cosmos studied by natural science. Common sense and science treat what Heidegger calls "world" as a system of subjective attributions with no ontological significance. But Heidegger regards world in his sense as ontologically fundamental and claims that our ordinary common sense and natural science are founded on it.

Heidegger develops his concept of world as an "existentiale," that is, a "category" in the Aristotelian sense, but a category of human existence. The universality of such categories overleaps any particular cultural limitation to define the human as such in its relation to being. What is generally called culture enters this picture as another existentiale under the name *das Man*, the "they." The linguistic trick implied in this term is simple: "They" say all the obvious certainties of the culture, which therefore are not attributable to anyone in particular.

Heidegger's analysis of worldhood is intended to overcome the subject/object ontology he identifies with the tradition of modern philosophy. The world is referred ultimately to Heidegger's term for the reconceptualized subject, *Dasein*. Under the influence of Dilthey, Heidegger originally called *Dasein* "factical life." This designation indicates the two features that distinguished his concept of subjectivity from the traditional one. On the one hand the subject is not to be conceived as a spiritual entity, a substantialized thought, a cogito, but as a living being, hence a being essentially connected to its surroundings.[6] On the other hand life must be grasped from the inside as a way of being rather than

from the outside as an object. *Dasein* signifies this lived relationship of life to its world and itself.

Being and Time explains the concept of world on the model of the workshop and its tools.[7] The workshop example illustrates the unitary subject-object he calls "being-in-the-world." Tools are linked together by their relations in the work and to the user's goals. Their functionality is granted by their place in the whole to which they belong in accordance with their potentialities. "Now in the production of equipment the plan is determined in advance by the serviceability [*Dienlichkeit*] of the equipment. This serviceability is regulated by anticipating what purpose the piece of equipment or indeed the machine are to serve. All equipment is what it is and the way it is only within a particular context. This context is determined by a totality of involvements [*Bewandtnisganzheit*] in each case."[8]

The totality is a system of references between the entities in *Dasein*'s world. *Das Man,* culture, sets the terms of the references. *Dasein* and its tools belong together. "Being-in-the-world" consists in the connections between technical artifacts and the ordering role of the human being at the center of the technical network. Heidegger calls this system "significance" (*Bedeutsamkeit*) and treats it as an open space of meaning within which particular usages or projects are enabled.

Heidegger also defines world as "beings in their accessibility."[9] By "accessible" he means understandable *as,* taken *as,* enacted *as*. Thus the chair on which I sit is not simply there as an object but is treated by me as a chair, that is, as intended for sitting. No such relation to the chair is possible for the papers I stack on it in my preparations for leaving the office. Those papers are supported by the chair, but not *as* a *chair. Dasein* establishes a relation of meaning different from the causal relations among things. In this sense, then, worlds are existential situations, not collections of things. Perhaps the closest our everyday talk comes to Heidegger's own usage is in expressions such as "the world of the theatre," "the Medieval world." Such worlds are not merely subjective but nor are they the sum of the objective things they encompass. They are essentially related to *Dasein* without being reducible to it.

Dasein's principal characteristic is concern with its own being. This concern is played out in the constitution of an environment distinct from nature as understood by natural science. Scientific nature is an object of knowledge that includes much that is of no concern to the living subject. Those irrelevant aspects are discovered in objective contemplation but

are not part of the original world-constituting relationship. That relationship consists in the network of functional references that enables *Dasein* to get around and to further its aims, *to be*.

Heidegger analyzes *Dasein* and its world from within their active relation. The difference between the first person stance of the actor and the third person stance of the observer comes down to a matter of focus. The actor focuses on what ties the object into the network of references. Heidegger's workshop is full of objects understood exclusively through their functional properties. The hammer is hard, has an appropriate weight in the hand, and can be swung in a specific arc at the nails to which it "refers" in performing the work for the actor who wields it. It is, says Heidegger, "ready-to-hand." It is not composed of iron atoms nor is it made in a certain factory on a certain date, nor was it formerly owned by Mr. X or Ms. Y. Those objective "present-at-hand" attributes are of course accessible to an observer in principle but they are not focused in the active employment of the artifact; they are not part of the subject's "world."

The understanding associated with action is not explicit propositional knowledge but is what we now call "tacit" knowledge, practical know-how, "circumspection" in the English translation of Heidegger's term *Umsicht*.[10] Circumspection is an interpretive relationship to objects but it enacts a meaning rather than formulating it. Correspondingly, the subject of circumspection is to be understood through its involvement in the technical network. It is not a separate *cogito,* a pure mind, but is an active being enmeshed in a world of objects with which it is essentially concerned.

The ultimate basis of the world is the "for-the-sake-of" for which it is constituted, the identity of *Dasein*. This is not another instrumental moment in the network of the ready-to-hand but rather establishes the network in terms of a specific self-understanding. *Dasein*'s identity is this or that type of being and as such gives meaning to its instruments.[11] For example, Heidegger's example of the workshop refers back to the identity of the carpenter. Social roles in general provide the basis for identities which in turn designate a domain of related artifacts, a world.

Although Heidegger did not develop a theory of function, his argument illuminates important aspects of the phenomenon and invites completion along lines compatible with his contribution. His essential insight is the concept of "involvement." He says that entities must be "freed" for their involvement through entry into the system of references. The entry

of an entity takes place through those attributes that make it available for the referential relation. Today we would call them the "affordances" of the object. Heidegger develops this concept in an unusual account of production that has suggestive implications for the understanding of functionality.

In *Being and Time* Heidegger is primarily concerned with everyday action rather than production. His comments on production are accordingly quite brief, but they do clearly distinguish its materials from the objects of natural science. The former belong to the world even before they are worked up into a specific technical object for a specific purpose.[12] Exactly how they belong Heidegger does not say.

The closest he comes to a theory of production is an analysis of Aristotle's concept of *dynamis* in the *Metaphysics*.[13] Heidegger interprets Aristotle as a proto-phenomenologist. On phenomenological terms, the material of production, Aristotle's "matter," is "freed" in some nonspecific way that invites a variety of uses. The selection of some among those possibilities would, in eliminating the ambiguity of the material, remove it from the context in which it is originally revealed in its indeterminate multiplicity and reduce it to its useful qualities in a specific use-context.

Thus materials are not objective things in the full sense, nor are they already technical objects; they belong to the world through their potentialities—that is, through what they can "bear" or "tolerate" (*pathein*), the many referential relations in which they could be involved even before they enter a specific production process. The production process that realizes one among those potentialities is a narrowing down, a limitation (*peras*), through incorporation of the material into a specific network of references. Aristotle, and perhaps Heidegger as well, concludes that production actualizes the *telos* not just of the maker but of the materials. Employing the example of pottery, Heidegger writes, "With the transformation of the clay into the bowl, the lump also loses its form, but fundamentally it loses its formlessness; it gives up a lack, and hence the tolerating here is at once a positive contribution to the development of something higher."[14]

A tree can serve as an example of the implications of the theory. Even while it grows it belongs to the world as a potential source of useful objects, such as a telephone pole, lumber, paper, and so on. The reduction of the tree to a single potential begins by interpreting it as referenced in one of these various ways, removing it from its natural setting, associ-

ating it with other objects such as saws, and stripping its branches and bark. These procedures involve a choice of a specific referential system—for example, one that takes the tree as lumber for building a house. Certain useful qualities of the tree are privileged over others. Those qualities tie the lumber into the referential system of carpentry and its tools, practices, and designs. Further references are supplied by the detailed specifications of the building plan. Ultimately a product is realized through imposing successive limits on the potentials of the growing tree and in so doing actualizing a house.

Specific functions are a simplification of the multiple networks of references for which the object is available. The reduction of the object to its functional aspect is also its entry into a world of meanings. This is clear in the example of the house. From Heidegger's descriptions of tool use one might think that only hammers, nails, and lumber are involved, but we know that the referential framework of a house includes much more than this bare technical minimum.

In the final design the lumber acquires qualities it would not otherwise possess, such as aesthetic features, conformity to rules of the trade, and so on. The boards in the American construction system are posed horizontally, whereas in Scandinavia they usually stand vertically. The rules of the trade differ as does the aesthetic effect. There are also legal regulations to which the house must conform, the building code determined by local legislation. These additional references are normative mediations of the construction process which intervene at various stages to further narrow the range of possibilities. They compensate for the simplifications that enable the materials to appear as materials. All this would be included in what Aristotle calls "form" and what I call "cultural meaning." Through these mediations the final product takes its proper place in a social context, a cultural system. Functionality in our usual narrow sense is an abstraction from this always present, richer system of references.

In everyday nonphenomenological language this amounts to removing the object from its natural context, reducing it to its useful properties, associating it with other technical objects, situating it in a new humanly created system of meanings, and mediating it in terms of norms that correspond to qualities it did not possess in nature. But Heidegger resists this common sense formulation because it presupposes the object as a thing in itself, prior to its involvements in a world. For him practi-

cal relatedness comes first and is ontologically fundamental. Functionalization operates within the world, not in a relation of the subject to objective nature. The difference between these two accounts is of great significance to Heidegger but less so for a theory of function.

This concept of functionalization can be articulated with the notion of ascribing a function in the use-plan conception of Houkes and Vermaas. In their framework a functional ascription presupposes the belief that the object possesses the causal properties necessary to perform the function. What are those properties? Clearly they are not selected from the sum total of what an objective view of the object would reveal, nor are they the product of disinterested observation. In making a functional ascription, the subject need only consider the relevant properties of the object. That small subset corresponds on the side of "belief" to Heidegger's concept of "circumspection."

For example, the individual who assigns the function of hammering nails to the hammer must believe that it is hard enough to do the job. But that belief is contingent on understanding the hammer exclusively in its belonging to the workshop, as a carpentry tool, as opposed to understanding it in relation to the other contexts in which it participates as a thing. The belief that enables the ascription focuses on the hardness of the hammer as the condition of its functionality to the exclusion of an infinity of other properties. The positive quality of the hammer as a technical object is thus also a limit. Whether one calls that limit the "constitution" of a world or a "belief" about things, it is essential to the nature of function.

Technification in Heidegger

The analytic concept of belief in the ICE theory is vague. It covers both the teleological understanding of tools from a cultural perspective and the objective knowledge underlying modern technology. Heidegger's early work acknowledges the objectivity of science but does not explicitly relate science to technology. Instead, as we have seen, his analysis is based on an existential interpretation of craft. It is only after World War II that he develops a full-fledged theory of technology. That theory is an account of how science depends on and supports a practical intention to control and dominate nature. Heidegger interprets the modern technical

relationship to reality as an ontological clue, just as he did in his earlier analysis of craft. But technology reveals a very different reality in which objectivity enters the world as a determining power.

Modern science, Heidegger claims, is essentially technological. It sets out a "ground plan" of being as a lawful order of facts. This constitutes a realm of objects subject to scientific explanation and technical control. Quantification is one important aspect of the process in which experience is reduced to an object of science. Science constructs a representation of the world on that basis and makes predictions that guide the technological transformation of what is. Technology is thus the opposite of world in *Being and Time*. The world is a totality of ready-to-hand things engaged with *Dasein*. By contrast technology is the realization in machines of a representation before a cognitive subject of present-at-hand things. Technology is the triumph of detached representation, and of the subject of such representation, over the involved stance of the acting subject described in the early work.

Technology does not construct a world in the sense in which Heidegger originally understood that concept, but de-worlds its objects and reduces them to raw materials in a process planned in advance in view of predictable results. Modern technology "enframes" man and nature. It "challenges" nature and makes "unreasonable demands" on it. Things no longer realize potentialities but are stripped bare of qualities, of their very thinghood, to take their place in a technological system. They are no longer objects in the sense of having a being that confronts us (*Gegenstand*); they have become mere resources, a "standing reserve" (*Bestand*).[15]

This Heideggerian theory of technology treats functionalization as the loss of substantial reality. Things are extracted from their surroundings, decomposed, stored up, moved around, and transformed to perform unnatural feats. On the terms of the earlier analysis this amounts to the loss of the complex systematizations and mediations that situate objects in a world—that is, the meanings and norms imposed as the support for the manipulations in which technical practice consists. What remains is only matter and energy, the bare minimum on which to exercise control.[16] "What is distinctive about modern technology is that it is no longer a mere 'means' at all, and no longer merely stands in the 'service' of something else, but it itself is unfolding a kind of domination of its own."[17]

This theory of technification provides still more specification of the

"beliefs" associated with functional ascriptions. As noted above these beliefs concern only those properties of the object relevant to its operation in its technical setting. Heidegger's late work adds to this limitation the specific property of being law-governed and hence predictable. The relevant beliefs must include the idea of a law under which the object can be made to serve in a plan. This explains the privileged role of causality in the beliefs associated with functionality in modern societies. The role of cultural meaning and significance described in Heidegger's earlier work is eclipsed in modern times by an implicit naturalistic ontology. The theory of technification also offers a sketch of a theory of modern technical subjectivity, emphasizing the detached cognitive standpoint of the planner.

Heidegger's negative evaluation of modern technology presupposes an implicit critical standard, the teleological view of nature underlying his early theory. But he does not defend the earlier view explicitly in his later work. He never advocates a teleological concept of the materials of production even as he criticizes modern technology. To do so would be to regress to premodern *poiesis,* and Heidegger does not believe it possible to go backward in what he calls the "history of being."[18] But the way forward is obscure.

There is a further difficulty with Heidegger's later theory. It is unclear whether he believes that the functionalization of an object changes its essence, or if that change is due to the resulting material transformation objects and human relations undergo when they enter the functional realm. He argues for example that the hydroelectric plant placed on the Rhine transforms the river into a resource.[19] But is it the simple functional ascription of the river that has this effect or the actual material intervention represented by the power plant?

Contemporary critics of technology inspired by Heidegger generally maintain the ambiguity but offer more concrete accounts. Technification is a process with effects that flow from the nature of functionality. The cognitive narrowing and limitation associated with a functional perspective cut off dimensions of objects and persons that are worthy of preservation and respect, but modern culture privileges the causal characteristics of artifacts above all else. Albert Borgmann gives the example of the family dinner, a ritual occasion shattered by the reduction of dining to a functional minimum through the mere ingestion of microwaved or fast food.[20]

Such arguments imply that the spread of a functional standpoint

beyond certain purely technical bounds is a spiritual catastrophe. The theorists plead for limits on the functional realm.[21] This plea responds to the radical simplifications involved in constructing the technical object, simplifications that are incompatible with many other relations to objects that sustain them in their thinghood and worldly character. The problem from this standpoint is thus not the existence of function but its imperialism in modern societies.

This type of critique depends on a teleological interpretation of the human context from which technical functions are extracted. Thus the focus shifts from technology itself to the reordering of human relations it imposes. The critics suggest reforms intended to protect those relations from technification. In this way the critique of the generalization of functionality in modern societies is saved from the passivity and reactionary nostalgia that sometimes threatens Heidegger's own discourse. But a social critique is substituted for Heidegger's ontological theory. We are squarely in the domain the early Marxist Lukács explored with his theory of reification.

Lukács's Philosophy of Technology

Georg Lukács was a Hungarian philosopher and literary critic who wrote most of his work in German and participated in his early years in the German intellectual world that also shaped Heidegger's philosophy. However, the politics of these two philosophers could not be more different. Lukács became a Marxist at the end of World War I and in 1923 published a classic work of Marxist philosophy entitled *History and Class Consciousness*. In this book he put Marxism in touch with contemporary sociology and Hegel. The result is an original reconstruction of Marxism as a critique of modern rationalized society. Lukács had a profound influence on the Frankfurt School and on what Merleau-Ponty called "Western Marxism."[22]

Lukács's *History and Class Consciousness* anticipates Heidegger's later theory of technology. Both argue that modernity (in Lukács's case, capitalist modernity) is characterized by the tendency to functionalize the entire world. Like Heidegger, Lukács contrasts the concrete objects and relationships of premodern societies with the stripped-down products of modern technology and the dehumanizing effects of administrative systems.[23] However, as a Marxist Lukács emphasizes the role of

commodification rather than technology and holds out hope for a socialist alternative. Heidegger treats all modern societies as similar, after the demonstration of the absolute power of technology in the world war and the betrayal of the promise of the Soviet Union.

Lukács was no more interested than Heidegger in the philosophy of function but his reflections are rich in implications for such a philosophy. As noted at the outset, functionality is a two-sided affair, affecting both the subject and the object. Heidegger's theories of worldhood and technification have been helpful in thinking about the objective phase of functionality, while Lukács's theory of reification is useful for its subjective phase. Furthermore, Lukács's theory makes explicit the technical character of the whole technosystem, including administrations and markets.

Lukács argues that the capitalist economy is law-governed as though part of the natural world. It is a kind of second nature, resembling the first nature insofar as it too is subject to technical manipulation. He writes, "What is important is to recognize clearly that all human relations (viewed as the objects of social activity) assume increasingly the form of objectivity of the abstract elements of the conceptual systems of natural science and of the abstract substrata of the laws of nature. And also, the subject of this 'action' likewise assumes increasingly the attitude of the pure observer of these—artificially abstract—processes, the attitude of the experimenter."[24]

Even though the economic and social system come to resemble the nature of natural science, there is a difference of principle between them. In the case of nature, the laws are matters of fact, whereas the laws regulating the capitalist economy are the product of human actions, specifically a multitude of spontaneous decisions through which individuals pursue their economic interests. Lukács calls the capitalist economy "reified" in the sense that it appears as a thing when in reality it is an unconscious product of human actions. However, the thing-like appearance of the economy is not an illusion. It has real consequences to the extent that it shapes human lives and motivates people to perform the very actions that reproduce it.

The circular relation between economic laws and the technical manipulations which unconsciously generate the laws is fundamentally different from the case of nature in which the laws are not effects of human action.[25] Individuals can break out of the circle of reification through cooperative action to change the system. This dereifying practice is syn-

onymous with the proletarian revolution. It is not a technical manipulation of the economy in accordance with its laws but the overthrow of those laws through the transformation of their practical basis in human action.[26]

According to Lukács the functional subject is uninvolved in the objects it functionalizes. Lukács calls its practice "contemplative" in the sense that it does not aim to change the nature of its objects but only to manipulate them. Manipulation posits the law of the object as fixed in order to control superficial features that stand under the law. As Bacon wrote, "Nature to be commanded must be obeyed."[27]

In economic terms, this amounts to taking up a position with respect to what the objects will become in any case as determined by their laws. This is most obvious in the case of the stock market. The action of the "contemplative" subject consists in buying stocks it expects will increase in value. The subject positions itself with respect to the lawful development of the economy rather than attempting to shape that development. For Lukács this is the "model" of practice throughout capitalist society.[28] In a mechanized production process the worker stands in a similar contemplative relation to self-acting machinery. The bureaucrat too acts manipulatively under the rule rather than changing the rule. The subject posits itself in the "inviolate" position outside the system on which it acts.

This is a narrowed relationship to the world to which corresponds a narrow subject stripped bare of personal qualities that would interfere with successful manipulation. Despite this critique, Lukács is not opposed to technical practice in principle; it will after all be required by any society, including a socialist society. But he believes that a world and a subjectivity narrowed down to the measure of technique cannot fulfill human potentials.[29] The problem is reification, the universalization of the technical outlook and its consequences.

The analytic theory of function remains at the level of individual technical action on nature and so does not consider the social arrangements which support that action. The theory conforms more or less to Lukács's concept of contemplative action. The functional subject's beliefs concern laws over which it has no control and which it can only use, not change. This seems self-evident in the case of material objects, which provide most of the examples in the analytic theory. These examples are appropriate for an individual subject engaged in a single round of action based on a conscious goal.

But functionalization extends far beyond the kitchen utensils, guitars, and automobiles that provide examples for the analytic theory. As Heidegger and Lukács argue, technological and administrative systems structure human action and cannot be regarded as neutral means. They shape and damage human life even as they serve. And Lukács is not wrong to view economic action as a functional relation. Entering a store, the buyer confronts the salesperson in his or her function as an economic agent. Of course sympathy may arise between seller and buyer, or antipathy for that matter, exceeding the limits of a functional relation. But in the normal case the two parties to the transaction "use" each other for their own ends in accordance with an intention and associated beliefs. The point is not that this is inherently bad but that multiplied millions of times over it constructs a coherent system, the capitalist economy, which compels the adoption of a technical stance in more and more of social life.

Lukács argues that what I call the technosystem imposes a reified form on life and behavior. This form fragments and isolates social objects as though they were self-subsistent things, like things of nature, related only externally, causally. The reified form results from capitalist market relations and is adapted to the pursuit of profit. Human beings, in the fullness of their existence and needs, are forced into the form without regard for consequences. This process both generates a potential and represses it. What human beings can become is laid out in their relations within the reified system, but only as potentiality, not as actuality. The revolution is the struggle to realize that potential. Thus once again, as in Heidegger, the concept of potentiality provides an alternative to technical domination. For Lukács this alternative can be realized where functional relationships are set in place by a conscious collective political subject. But whereas for Heidegger potentiality lies in the Greek past, for Lukács it awaits the communist future.

The contemplative stance of the reified subject determines its identity. In avoiding causal feedback from its objects, the subject of technical practice shifts the interaction to the level of meaning. Lukács mentions only two cases but others can easily be imagined. He argues that journalists and bureaucrats, individuals who invest their personality in their work, identify with the reified system. These middle class individuals have a sense of self and beliefs about the world in which the limitations of capitalism have become personal limitations of character and understanding. By contrast, workers' identity cannot be formed by their work since the production process demands only mechanical gestures

of them.[30] Insofar as their participation in technical practice is identity forming, this is through the realization that they are more than the social role to which they are condemned. They are thus capable of initiatives that challenge the system as a whole. This is the origin of class consciousness.

The initiatives of the working class are not *ex nihilo* creations but rather are rooted in conditions which can be dereified to release blocked potentialities. This notion of dereification bears some resemblance to Heidegger's description of authentic resoluteness as release from the pregiven references of *das Man* to an original decision. "The resolution is precisely the disclosive projection and determination of what is factically possible at the time."[31] Indeed, initiative in a technologically advanced society must have an innovative character that breaks with sterile conformism. But neither Heidegger nor Lukács applies this insight specifically to the technosystem.

As in the case of Heidegger's concept of world, so with Lukács's concept of the functional subject and its practice, the focus is excessively narrow. Lukács has no concept of social imagination with which to understand original initiatives, creative action. But creativity would be essential to the fundamental social change he envisages. He underestimates the role of the imagination through which individuals may transcend the narrow limits of their position in the economy and take unprogrammed initiatives in which new functions are discovered. This is as true of the middle class individuals with their reified consciousness as of the workers whose ability to transcend their situation he attributes to their contradictory situation. Initiative and imagination are powerful forces under capitalism, though often exploited or repressed, and their importance must not diminish in a socialist society.

In his early work under Heidegger's supervision, Herbert Marcuse developed the implications of political initiative for revolutionary communism. His unusual synthesis of Heidegger and Lukács draws together the concepts of authenticity and revolutionary praxis. His late work completes the picture, relating revolution to the imagination of alternative social and technological institutions. As discussed in Chapter 5, technology now enters directly into the theory as an object of imaginative reconstruction. Design is thematized in its relation to the values that inspire revolutionary social change. Thus Marcuse can be understood to theorize the aspects of initiative, imagination, and design that are underdeveloped in Heidegger and Lukács.[32]

Instrumentalization Theory

In earlier books I have developed what I call the "instrumentalization theory" to account for functionality as a social phenomenon.[33] The theory explains how the various dimensions of technique are reflected in the structure of the technical subject and object. For example, the identification of functional affordances requires the decontextualization of relevant aspects of the object of technical control and its association with other similarly decontextualized objects to form a technically coherent system. As Angus argues, the decontextualized aspects must be distinguished from the full reality of the object in its lifeworld context, unmediated by a technical perspective. But the object is not reducible to the causal relations established by this operation. A system of meanings lies behind the constitutive choice of specific aspects rather than equally viable alternatives. Functions only achieve specificity and purpose through incorporation into such a referential system of meanings, hence through a cultural recontextualization. Designs invariably reflect the double aspects of technical functionality. *There is no purely technical; the technical is always already cultural.*

The instrumentalization theory leads to two related accounts of the double aspects of the technical. First, at the level of the design of artifacts and systems, causal and cultural functionalizations complement each other and make specification possible. The interpretive act that configures design coordinates a causal concatenation with a social meaning. Second, design is never fixed once and for all. As constructivism argues, new actors can open the "black box" and resignify the object in terms of new demands. The resignified object will be granted new technical characteristics through the inclusion of new components or new institutional requirements. This is what happens when public controversies lead to the redesign of technical artifacts and systems. Actors excluded from the original design process initiate changes that respond to their interests and understanding.

Table 6.1 sums up the various aspects of functionalization introduced throughout this chapter in the course of the discussion of Heidegger and Lukács.

The understanding of functionalization splits along two axes, causal and cultural aspects, and objective and subjective aspects. From a consideration of Heidegger's early theory of worldhood I derive the following causal and cultural attributes.

Table 6.1 Instrumentalization Theory

	Causal Functionalization	Cultural Functionalization
Objectification	Decontextualization (commodity, case, technical element)	Interpretation
	Reduction	Mediation
	Association	Systematization
Subjectivation	Autonomization (buyer/seller, administrator/client, maker/user)	Identity
	Positioning	Initiative
	Designing	Anticipation

Modified from Andrew Feenberg, *Questioning Technology* (New York and London: Routledge, 1999), 208.

- The functional object is removed from its natural context, stripped of its useless qualities, and associated with other objects.
- Simultaneously it is interpreted in its new meaning and integrated to a cultural system from which it receives the ethical and aesthetic standards of the world it enters.

From Lukács's theory of reification, I identify the following aspects of functional subjectivity:

- The subject is autonomous with respect to the objects of technical practice at the causal level, but its role has consequences for identity.
- The subject positions itself with respect to the given "law" of the object and is also capable of initiatives transcending the reified framework of law.

Marcuse's synthesis of Heidegger and Lukács adds designing to the list of subjectivations.

Explaining the terms of Table 6.1 in more detail, the causal level concerns the construction of objects and subjects as nature, again in a practical sense—that is, as subject to rules or laws that regulate their behavior. The cultural level concerns the meanings artifacts acquire in the lifeworld to which they belong. These meanings are not merely ascribed after the causal level is set in place but also guide the choice and configuration of the causal concatenation in which the design consists.

Cultural assumptions may be universally shared as in primitive societies, or they may be imposed by hegemonic social forces. In the latter case these social forces are exercised directly by influential groups, "actors" in the terminology of social constructivism.

The causal and cultural layers of the design process are analytically distinguishable phases. They are visible from different perspectives but cannot be separated and laid out side by side as though they were distinct things in external relations. One phase involves the relevant rule-based or causal foundation of the functional ascription, and the other posits the guiding cultural meanings that determine relevance and signify the object. The two phases together identify potentials that are selected and combined in the realization of the design. The layers interpenetrate in the sense that a causal relation is realized in an artifact or system only insofar as it responds to a cultural meaning and vice versa.

Except in the case of the very simplest of artifacts, functional ascriptions involve more than a subjective intention; they determine a choice of components and the relations between them—that is, a design. Realization in a design can take many different paths. There is no universal rule under which to make the choice of functions from among the infinite possibilities, although all such choices must conform to causal principles. It is this contingency or underdetermination of design which opens the way to a politics of technology.

This initial distinction between layers can be analyzed further into the objective and subjective conditions of design. In the phenomenological language of Husserl and Heidegger we would say that the "object is revealed as . . ." and the "subject constitutes itself as . . ." We have seen that for Heidegger the object is "freed" for entry into a world. In ordinary language this means roughly that the object is envisaged under the aspect of its technical potential and the subject adopts a technical attitude toward it; that is, again in Heidegger's terms, the subject acts toward it out of its concern with its own identity or "being" as he calls it.

The ascription of function requires more than a general belief in causal appropriateness; it also requires a specific type of cognitive operation, a technical mentality that goes beyond the immediate form of the object and reveals it in the light of its technical potential in a specific context.[34] Functioning always ends up serving functions selected by social actors. In the instrumentalization theory the initial correlates of this operation on the side of the object are called decontextualization, reduction, and association. Technical potential is uncovered through isolating the object

from its natural context, reducing it to its usable qualities, and associating it with other objects. In a capitalist context, the object is reified.

The object must be processed in order to be incorporated into an artifact. The processing does violence to the object, transferring it from nature to lifeworld, with the qualification that the concept of nature may be different in different cultural contexts. As we have seen, Heidegger conceptualizes this process and the associated concept of nature in two different ways corresponding to different stages in technical development, either as the actualization of a potential or reduction to raw materials.

Realization of a technical idea in an artifact or system takes place through operations that guide decontextualization, reduction, and association. I call these operations interpretation, mediation, and systematization. The identification of a technical potential is a specific type of interpretative act. The technical object is taken up in the system of references that Heidegger describes as a world. This system consists in the meanings that correspond to the causal relations underlying readiness-to-hand. Lukács points out that price is among these meanings, but objects have a use value as well. At that level the object belongs to a lifeworld in which it is imbricated with many other aspects of nature and human life. Thus the object cannot enter the social world without acquiring meanings as well as causal associations. Such meanings consist in the significance of the object in the culture, along with aesthetic and ethical mediations of its design. Technical objects thus not only lose qualities as they are reduced but also acquire qualities as they are integrated to a social world.

The instrumentalization theory identifies a basic technical attitude that envisages objects in the world as artifacts or components. This attitude constituting the technical subject has three aspects I call autonomization, positioning, and designing.

The subject is autonomous in the sense that it diminishes or defers causal feedback and precludes sympathy or identification, the attitudes associated with human relations. The point of technical action is to change the world, not the technical subject.

As Lukács argues, the subject does not strive to create something new but takes up a position with respect to what the object is and will become, a position that opens up its useful potentials. This is a manipulative attitude, one that seeks control of the object through an understanding of its properties, the "law" of its movement.

The subject designs artifacts and systems by combining resources found in the environment. Design work goes beyond mere positioning in innovating new configurations of the resources that prescribe new patterns of action.

Correlated with these causally related functionalizations are three other cultural aspects of technical activity: identity, initiative, and anticipation. The technical subject acquires an identity through its practices. For example, it can be described as a particular type of user, as when we say of persons engaged in driving that they are drivers. Where there is extensive and long-term technical work, professional identities are established by repeated functional involvements. Both Heidegger and Lukács understand identity as the intimate connection between technical subjects and objects.

In every case, but most importantly in professional activity, the technical subject exercises a certain freedom or initiative, guided by anticipation of the future, in the discovery of the potentials of its materials. The scope for initiative varies but it is an inevitable aspect of the technical relation. At a minimum, the initiative is defined by the range of activities enabled by the design of the object. But it may go beyond the normal range and inspire new designs. This is the basis of both design work and the creative appropriation or reinvention of technologies by users.

Design requires an orientation toward the future, an anticipatory stance. Thus technology is bound up with a certain relation of the subject to time. That relation is explicit in Marxism, a philosophy of the future. But it must be generalized to cover technology as such, in every social context. Something new comes into being through all technical activity and that is only possible because the subject projects itself beyond the present.[35] The concept of innovative initiative appears too in Heidegger, Lukács, and Marcuse, although it is limited by being tied to notions of authenticity and revolution that have existential and political rather than technical applications.

Commodities and Cases

The instrumentalization theory was originally formulated to understand the design of technical artifacts. Its application is especially clear in that domain, but there are also parallels to other aspects of the technosystem. Recall that the technosystem consists in three institutional frameworks:

markets, administrations, and technologies. To each corresponds a form of social rationality. These forms are modeled on rationality as it is realized in mathematics and natural science, the paradigms of our modern idea of rationality. Markets exhibit mathematical equivalence, administrations relate rules to cases on the model of the relation of scientific law to particular facts, and technology seeks optimization and efficiency through measurement and calculation. The instrumentalization theory applies with some modifications to markets and administrations. In all three spheres possibilities of technical control are designed into objects or institutions in conformity with a combination of causal and cultural principles. I will show briefly here how the terms of the instrumentalization theory apply to these other domains of the technosystem.

Consider commodities sold on markets.[36] Commodification has its own logic that is generally summed up in four principles: alienability, excludability, rivalry, and standardization. These principles correspond to the causal functionalization of technology. Commodification involves decontextualizing an object through defining or designing it in a form that can be exchanged—that is, "alienated"—from its original surroundings. Designing the object to exclude access by others and blocking substitutions effects commodification at the level of market relations. Standardization involves a simplification of the object by removing concrete differentiating features. The result, a commodity, is associated with other commodities through its place on the market.

The cultural interpretation of an object as potentially salable begins the process of commodification. Systematization and mediation follow, as necessary features of the commodification process. No object can be placed on the market without establishing its relations to other objects through the medium of exchange. Aesthetic and ethical mediations also shape the design of commodities as they do technologies.

The subjective side of commodity exchange conforms to the instrumentalization theory. Owners of commodities are autonomous insofar as they separate themselves from their commodities by placing them on a market. They position themselves in the sense that they seek the best time and place for the sale. The formation of identity consists in a type of ownership, anything from landlord to trader to shopkeeper or, in the case of the consumer, associations such as stylish, sexy, competent, and so on. Initiative appears in the options opened by ownership—for example, to modify the commodity or the conditions of its production, use, and design.

This economic application of the instrumentalization theory was anticipated in its general lines in Lukács's concept of reification, as was the application of the theory to administration. Administration consists in the establishment and handling of cases falling under general rules. Decontextualization and reduction are essential to this process. Administration cannot engage with whole persons in a concrete human context. No matter how "humanistic" the administration, it must abstract the case from the complexity of life to subsume it under an appropriate rule. But in doing so, it recontextualizes the case in a framework defined by established cultural meanings and mediations. Ethical mediations are often represented by law, and in some cases, such as zoning regulation, aesthetic mediations are also involved.

Administration has a subjective side as well, but interestingly this aspect is doubled because the "case" is active in "handling" its case as well as the administrator. The autonomization of the administrator as a professional is obvious as is his or her identity as such. But the person administered may also adopt a detached attitude toward the situation created by the administrative intervention. This complexifies the roles of positioning and initiative. The administrator attempts to resolve the case in a way that satisfies certain criteria while perhaps also taking initiatives in doing so—for example, to obtain a secondary gain of some sort or to adapt a rigid rule judiciously to an ambiguous case. At the same time, the object of administration may attempt to "game" the system in such a way as to obtain an advantage from its case.

Conclusion

The technosystem is a field of technical practices aimed at control of the environment, whether natural, economic, or administrative. To that end the environment is interpreted and structured as an ensemble of sociotechnically rational functions. The instrumentalization theory challenges the supposed isolation of sociotechnical rationality from the social world with a more realistic account of design and behavior. It broadens the context within which functional ascriptions and relations are understood by treating the human side of the "dual natures" of technologies, commodities, and cases as a social rather than an individual psychological phenomenon. Functionality is not a subjective idea, nor a material fact, nor some combination of the two. In the most important

cases, those that are defining for modern life, it is a social process in which the technical mentality meets cultural or political desiderata and constraints in the design of concrete artifacts or systems.

This picture of functionalization shows why it is the focus of the critique of modernity. The functional world is constructed through an initial abstraction that leaves behind the richness and complexity of both lived experience and the human subject. The various compensatory aspects of functionalization, the infusion of the object with values and meaning, cannot completely overcome the simplifications of the original abstraction. The residue excluded by functionalization comes back to haunt technical achievements where they fail to take into consideration the most significant dimensions of their objects and contexts. And this failure is inevitable since nature and human life simply cannot be reduced to functional relations.

Until the emergence of total functionalization in late modernity, nonfunctional relations prevailed in most domains of social life. But the technosystem strives to be all-encompassing. This ambition leads to three disastrous consequences. Technical relations concentrate power in the impersonal, distanced subject of technical action and set off dynamics of struggle in multiple settings where personal relations and/or democratic cooperation would be preferable. The blind spots that inevitably accompany functionalization lead to problems such as the environmental crisis. And the technical manipulation of cultural meanings generates a nihilistic skepticism about meaning as such.

These consequences of universal functionalization cannot be mitigated by simply pushing back the boundaries of technical mediation. Modern society is so completely technified that a return to "nature" is inconceivable. Only a gestalt switch within the technical world can respond to the crises and pathologies of modernity. That requires democratic interventions into the technical domain to overcome the autonomy of technical control, the blind spots of progress, and the cynicism of a society in which culture has become a branch of marketing.

The next chapter develops a systematic analysis of the rationality of democratic interventions. In the course of this discussion, I return to the attributes of functionalization identified in this chapter to characterize the politics of the technical.

■ CHAPTER SEVEN ■

The Logic of Protest

Introduction

This chapter addresses the logic of public intervention into the technosystem in terms of rhetorical theory. Rhetorical analysis of public debate presents an alternative to Habermas's rationalistic theory of deliberative democracy. The goal is to understand the rationality of actual protest rather than to posit an ideal of valid communication. Similar concerns have led some critical theorists to return to themes of first generation Critical Theory. In this chapter I rely on the contribution of Albena Azmanova. The application of her theory to the technosystem puts the critique of instrumental rationality in a new light. Horkheimer, Adorno, and Marcuse attacked its hegemony and argued for the possibility of another form of rationality that would fulfill the dream of enlightenment without its destructive consequences. But it must be admitted that they were not able to effectively articulate the nature of this alternative. As discussed in Chapter 5, Horkheimer simply juxtaposed subjective and objective rationality without reconciling them. Marcuse came closest to giving content to the new concept of reason but within an unconvincing revolutionary paradigm. For that he was criticized by Habermas and his followers.[1]

In reality Marcuse was far ahead of his time. He had already disposed of the notions of technological neutrality and determinism long before constructivism. But his argument was formulated in the context of a political eschatology. A new technology was to break the continuity

of domination, completely transforming the human relation to nature. Missing in Marcuse's account is not only a method for studying existing technology but any concrete politics of technology, and for a good reason: no such politics existed until the end of his life when environmentalism began to be a theme of struggle of some consequence. But by then his argument was so tied up with disappointed revolutionary hopes that it faded from view in the conservative political climate of the 1980s.

Today technical politics has become routine and Marcuse's theory can be reformulated in the less melodramatic terms of the instrumentalization theory. Like Marcuse's "two-dimensional" ontology, the instrumentalization theory is also based on the normative character of rationality. Subjective reason is not actually value-neutral on this view but always already fraught with values insofar as it is adapted to the "facts of life" established by capitalism. Those "facts" come to be embodied in the design of the technosystem. Objective reason is no longer grounded in a worldview but in historical struggle informed by rational reflection on real possibilities of progressive change.

Marcuse's remarkable anticipations are noteworthy but if they are to carry conviction today it will be necessary to reconstruct them from an entirely different starting point. In this chapter I will build on the instrumentalization theory to present a dynamic concept of sociotechnical rationality. The instrumentalization theory was originally proposed for the analysis of design in terms of the dual nature of functionality. Here I will elaborate the theory further to account for public engagement in processes of redesign of artifacts and institutions. Public protests often take a dramatic form to attract attention and change attitudes, but to influence the design process they must also engage in dialogue with experts. If it is to have an impact, that dialogue must remain within the general framework of the modern understanding of rationality. The question of the rationality of protest thus comes down to the use of what Kant called "public reason" in a new context—the technosystem.[2]

Constructivist approaches to technology and technical systems demystify deterministic and technocratic claims. The instrumentalization theory serves this purpose as well. But now we must pivot from demystification to a positive account of the political implications of the social contingency of the technosystem. Contingency implies multiple "right" answers to technical questions, depending on who is asked—that is, depending on the interests and beliefs that shape the answers. The essential role of the public distinguishes the search for solutions to technical prob-

lems from scientific and mathematical research. It opens the technical sphere to the uncertain judgments we associate with politics.

And yet it is impossible to collapse the technical into the political because, as the previous chapter argued, technical success depends on objective properties of objects. We are forced to recognize the peculiar nature of technical judgments as neither wholly subjective nor wholly objective. This describes Kant's concept of reflective judgment in his third *Critique*. Reflective judgment crosses the usual boundary between personal preferences and shared and grounded beliefs. It does not offer proofs but rather appeals to the other. This is the domain of rhetoric, not science. This is precisely what is required by a theory of technical politics.

The Role of Judgment

The interaction of expert and lay, the technically rational and the reasonable, takes place in the public sphere. Claims are made and arguments are offered. This involves rhetoric which Aristotle defines as "the power to observe the persuasiveness of which any particular matter admits."[3] He goes on to explain that rational arguments "concern subjects about which we use *common topics,* which are common to moral, scientific, and political questions."[4] It is interesting that this definition cuts across the distinctions between the spheres so carefully differentiated in modernity.

Aristotle's list of common topics is eclectic. I aim for a more targeted list specific to debates over technosystem design. These common topics are rational concepts and arguments deployed in design and redesign. They are based on what Albena Azmanova calls the "phronetic background" shared by all participants in debate. Implicit rather than explicitly articulated, the phronetic background includes criteria, distinctions, and categories underlying reasoning about explicitly formulated disagreements.[5]

Kant distinguishes two types of judgments which he calls "determinant" (or "determinative") and "reflective." He writes: "Judgment in general is the ability to think the particular as contained under the universal. If the universal (the rule, principle, law) is given, then judgment, which subsumes the particular under it, is *determinative*. . . . But if only the particular is given and judgment has to find the universal for it, then this power is merely *reflective*."[6]

Technical experts and the representatives of the institutions which employ them base many of their decisions on determinant judgments in which general categories subsume particulars. The modern social world is largely constructed around such judgments rather than around particular rules of thumb based on customs and traditions as in the premodern past. The formulation of rational rules grounded in technical disciplines is the very stuff of modern governance, both in the usual political sense and in many contexts of daily life where standard behaviors are prescribed by institutions and artifacts.[7] Determinant judgments make it possible to control social and natural processes. This is the necessary precondition for highly complex and mutually interdependent institutional and technical arrangements.

However, debate in the public sphere often begins not with determinant judgments of principle but with the experience of particular harms or injustices, taken as examples of larger problems.[8] A different type of judgment is involved in generalizing and communicating this experience.

In search of an account of the role of experience in the public sphere, Hannah Arendt theorizes political debate in terms of reflective judgment. This is a departure from Kant who applies the concept to questions of taste. The judgment of beauty takes its starting point in the experience of an object which reveals something indeterminate and nonempirical about the world, something that cannot be classified under a preexisting concept. Kant explains the specific objectivity of judgments of beauty, distinguishing them from mere preferences and from determinant judgments of empirical qualities of objects. Arendt draws on Kant's concept of reflective judgment to defend the autonomy of the political from the encroachments of both relativism and technocracy. Public debate is granted its own special type of reasoning.

Kant introduces several other concepts Hannah Arendt adapts to a political context. He does not expect reflective judgments to yield an outcome with the same demonstrable status as scientific truths. Instead, he argues that the judgment of beauty is an appeal to others to consult their own reactions to the object. That appeal requires the subject to rise above his or her private feelings to achieve an objective standpoint which Kant calls an "enlarged mentality." Ideal identification with other possible spectators on the beautiful frees the subject from personal inclination. Because the faculties of thought and imagination are common to all human beings, everyone possesses a "*sensus communis*" that evokes similar reactions. Thus it is possible at least in principle to reach agree-

ment on judgments of beauty in a way that differs from both empirical evidence and shared preference. Arendt argues that like judgments of beauty, political judgments are appeals to others that cannot rest on empirical data but must reach out to a shared *sensus communis*.

Arendt's innovative application of the concept of reflective judgment has had considerable repercussions. It has played a role in the "linguistic turn" in political theory where notions such as deliberative democracy have reshaped the concepts of rationality and justice. I am only concerned here with rationality and do not propose a theory of justice. For my purpose I will draw on some of Arendt's innovations in the remainder of this chapter. But there are many difficulties. A number of recent contributions have refined Arendt's approach in order to better explain the political application of reflective judgment.[9]

Kant's theory of reflective judgment is difficult to apply except in the case he himself envisaged. A work of art falls under the general concept of beauty through a judgment in which the work is a self-sufficient measure of itself. But what is one to do with the nuanced cases that arise in political debate where arguments cannot be settled by appeal to principles nor left to their own internal self-sufficiency? To answer this question, Arendt proposes the idea of exemplarity which has something of the particularity and normative force of the work of art without its monadic isolation. Alessandro Ferrara elaborates this notion with the suggestion that reflective judgment based on examples is not entirely independent of critical standards but yet not determined by them. He writes, "The relevance of general notions seems at best that of guiding or orienting a kind of judgment that is much more open than the judgment that can fall back on established rules, but not as open as the judgment about the well-formedness of a work of art."[10]

This seems right; however, there is another problem relevant to the concerns of this book. There is a significant difference between the play of public reason in the technosystem and more familiar debate over policy and law. The difference is adumbrated in Arendt although she failed to follow up on its implications, nor have those who follow her lead in political theory. Arendt writes, "This [public] world, however, is not identical with the earth or with nature. . . . It is related, rather, to the human artifact, the fabrication of human hands, as well as to the affairs which go on among those who inhabit the man-made world together. To live together in the world means essentially that a world of things is between those who have it in common, as a table is located between those

who sit around it; the world, like every in-between, relates and separates men at the same time."[11]

This passage suggests two domains of public judgment: "the affairs which go on among" men and women and the "world of things" that "relates and separates" them, but only the former appears in contemporary theories of political judgment. This one-sided development is explainable in terms of the distinction, discussed in Chapter 1, between substantive and formal bias.

Recall that substantive bias involves prejudice while formal bias is imposed through the rational procedures that govern the "world of things." Civil rights movements have accustomed us to moral protest against substantive bias in the affairs that go on among men and women. The occasion for protest in such cases is obvious and unmediated. When black people were ordered to sit in the back of the bus or use separate rest rooms, no one could doubt the motive and meaning of the discriminatory act even before it was generally condemned.

Formal bias presents a more complex obstacle to claims of discrimination because it is embedded in standard procedures that have a technical rationale. Identifying bias in the world of things is difficult and persuading others of its existence even more so. The individual confronted with such bias must reason "reflectively" from his or her own particular case toward a possible universal under which it stands, and then communicate that perception publicly.

For example, the engineers and automobile companies in Detroit were not the first to identify smog as a problem. It was the citizens of Los Angeles who initiated political demands for better automotive technology. Citizens arrived at this conclusion not through consulting manuals of engineering or medical textbooks, nor from deduction from principles, but from direct experience of the inconvenience and hazards associated with dirty air. They generalized from starting points in their own experience to demands for technological change, exactly the reverse of the process normally followed by the engineers who eventually addressed the problem by applying existing technical knowledge.

Similarly, when black people encountered "red-lining," discrimination in mortgage lending, they did not face a racist individual obeying a prejudice but a bureaucrat obeying a system that allocated loans according to the risks supposed to be associated with the racial composition of neighborhoods. The leap from personal disappointment to a perception of bias was difficult, and public acceptance that the system was flawed

was slow. In this case, too, reform eventually came and now seems obviously justified. But justice required more than a change in attitude; it required a reworking of the technical system, a recalculation of risks, a redefinition of neighborhoods—in sum, a change in the whole rationale of mortgage lending.

Penetrating the veil of legitimacy of formally biased systems is difficult not just for ordinary citizens but also for political philosophers. This explains their preference for examples and issues drawn from cases of substantive bias. But this preference makes less and less sense as the design of the technosystem becomes increasingly controversial.

As I argued in Chapter 5, the technosystem can only be changed from within through a gestalt switch. Chapter 6 showed the basis for the switch in the double aspects of the logic of functionality. Technical experts play a role in any technical change, but they are not alone. Users and victims judge the technical systems in which they are involved on the basis of their experience and their participant interests. These are "oriented" reflective judgments, shared both with the general public through universalizing procedures such as warnings and rights claims, and with experts who can translate them into technically rational language and design.[12]

Determinant and reflective judgment are different performances of rationality, appropriate in different contexts but able to communicate in the public sphere. This communication underlies public argument over the politics of the technosystem. In this chapter I will employ the instrumentalization theory to explore the role of reflective judgment, so understood, in the rhetorical structure of that politics. I will show how technical citizens transform their interests into rational claims on the approval of others and attain what we might call, following Arendt and Kant, with an additional reference to Simondon, an enlarged *technical* mentality.

Double Aspect Theory

In what does the new technical public reason consist? It cannot be reduced to sociotechnical rationality understood as causal insight into the adaptation of means to ends. Adaptation presupposes the prior constitution of functionality and its place in the social, precisely what the instrumentalization theory explains at a more fundamental ontological

level. At this level, operations and categories play both a technical and a normative role. Sociotechnical rationality in practice—Simondon's technical mentality—addresses the causal aspects of design explicitly, while implicitly encompassing normative aspects. Technical operations and categories imply better and worse ways of performing technical operations and designing artifacts and systems in terms of the social world to which they belong.

The instrumentalization theory argues that causal and cultural functionalizations are brought together in the design process through rational operations. The rational operations associated with functionalization are familiar categories of technical thought and action. For example, the decontextualization of useful affordances depends on an act of interpretation. The specific kind of interpretation involved is abstraction, which allows aspects of the objects to be isolated from the whole. A similar story can be (and will be) told about each of the instrumentalizations.

An operation such as abstraction cannot be separated from cultural contextualizations. There must be guidelines orienting the operation and these are drawn from social, economic, political, and cultural registers. Some of these guidelines are explicitly formulated—for example, zoning regulations. But many others are implicit in the "phronetic background." Azmanova calls these "paradigms of articulation and signification"; they are the implicit "articulations of relevant reference points and drawing of meaningful conceptual distinctions" presupposed by rational operations in practice.[13]

The rational operations connecting causal and cultural levels have the double aspects of technical relevance and normativity. For example, the technically rational operation in which a tree is cut down for lumber releases its resource potential by removing it from its natural setting. This is abstraction in material form. The tree is constituted as lumber, a functional artifact, *in accordance with* the legal and cultural meaning of lumber in forestry and construction, and it is endowed with the quality of usefulness for which it can be judged more or less suitable for a particular work. The outcome of the operation exhibits both technical and normative aspects and these are intrinsic to the object, not externally related things magically joined like the Cartesian mind to body through some sort of technical pineal gland.

The cultural aspect of this process may be conventional, but the encounter between culture and technique is not arbitrary. Rationality plays an obvious technical role in design. For experts who manipulate the re-

sources that go into the product this seems to exhaust its significance. The result is codified in their manuals and regulations in purely technical terms. Although reference to such rational codifications lends legitimacy to existing technical and social arrangements, the case is more complicated.

Technical artifacts and systems are situated in the lifeworld where they are appropriated or suffered by ordinary people. They become objects of explicit normative judgment when they cause problems or distress. These judgments activate the same or similar rational operations and categories that originally presided over the constitution of the technical functionalities. Everyone, not just experts, is capable of operations such as abstraction. In technosystem struggles rational principles in their original lifeworldly form are reapplied to the technosystem through judgments based on experience, often informed by counterexpertise.[14] The design process is reactivated through interventions based on the operations as they appear in the lifeworld.

These vernacular versions of the principles differ from the refined expert versions in being charged with explicit normative content. They belong to what Foucault calls "subjugated knowledge" and can be invoked critically to realize such potentialities as health and justice. Thus rationality is ambivalent and can provide a basis not only for technical work but also for normative critique. These nonscientific judgments support an understanding of the technosystem I will call "reasonable" in the common sense meaning of the term—that is, thought through with some care but not systematically elaborated within a disciplinary tradition.

For example, criteria such as consistency cross the divide between experts and participants even as they are differently deployed by each. The association of resources in the construction of a technical artifact or system rests on the search for consistency in the technical sense, but the results may fall short in the eyes of its users or victims. For a technical expert consistency has a purely technical meaning but in the lifeworld the same concept also plays a normative role—for example, in the demand for consistent treatment of men and women, straight and gay, black and white. Where the lifeworld is inconsistent with existing technology, the double aspects of social rationality motivate technical change.[15]

This configuration is similar to the concept of emancipatory struggle Jacques Rancière derives from the example of the movement of Paris textile workers in 1833.[16] The inequality between workers and their *maîtres*

was obvious to all, but instead of denouncing equality as an illusion, the workers demanded its realization. Rancière presents this demand in the form of a syllogism—major premise: the *Charte de 1830* guarantees equality; minor premise: the *maîtres* do not treat us as equals; conclusion: therefore the *maîtres* violate the *Charte*.[17] This reasoning leads not to cynicism but to demands to bring the conclusion into line with the major premise. The situation is treated as a materialized error rather than as a given fact.

In making their demand, the workers placed themselves on the same discursive plane as the *maîtres* and other official participants in the prevailing system, and so escaped from the total subordination of those deprived of reason and speech. But of course the word "equality," like the terms of technical reasoning, has a different meaning for subordinate actors than for those authorized officially to employ it. Establishing congruence between these usages is a political act.

The interpretive act that configures designs by coordinating a causal concatenation with a cultural meaning can be repeated at any stage in the development of a technical artifact or system and there is no a priori rule determining which actors can play a part. Reflection on transformations of the technosystem reveals the operative norms of progress. The process draws on the basic rational operations of the technical domain which also structure the progressive struggle to reconstitute the technosystem in accordance with justice or human potential. When successful, the struggle leads to a higher stage of development of the technical artifact or system, higher in the sense that it better fulfills the needs or recognizes the rights of individuals.

The Common World

The double aspects of technical rationality make possible communication between actors with different relations to the technosystem. Factual and normative claims can be harmonized in the course of debate. I will draw on the theories of political judgment of Alessandro Ferrara and Albena Azmanova to explain this conclusion.

Azmanova rejects attempts by Rawls, Habermas, and others to base political philosophy on a context-independent concept of justice. She criticizes the notion that a rational consensus at the level of formal rights can compensate for the collapse of consensus belief in a substantive

worldview. As I argue in the introduction, there is no inviolate position standing above the political fray from which to judge social arrangements, not even the position of the philosopher of rights. But this is not a reason to give up on the concept of justice. Rather, it must be located within the concrete social world as an emergent achievement of public debate over oppression and discrimination. This requires a change in focus from a positive theory of justice that abstracts from particular social identities to a theory of struggles against injustice of individuals with subordinate identities. "The normative goal of critique, therefore, is not the articulation or production of a societal consensus over principles of justice codified as rights, but the unveiling and elimination of socio-historical patterns of injustice. The proper purpose of critique, and of political action guided by it, is emancipation, not justice."[18]

Here Azmanova aligns herself with critics of Habermas and Honneth such as Nancy Fraser who attempt to recover a focus on structural sources of social and economic domination and exploitation. This leads her to dismiss not only universalizing claims but also communitarian and social-psychological concepts of normativity. Injustice is not overcome by recognition as a community or individual with a specific identity. Rather identity is relevant insofar as it characterizes a structural position within an unjust social order. The standards brought to bear on such positions derive from the phronetic background shaped by social practices rather than from tradition.

Azmanova is thus critical of Alessandro Ferrara's notion that the normative dimension of argument in the public sphere involves an appeal to the adversary to join together in an enlarged community. A shared "superordinate identity" would transcend differences in perspective through an oriented reflective judgment. This notion of the "self-congruity of an identity" suggests an overarching community standard or self-image that should be consistently adhered to.[19] Ferrara allows for change, but in much communitarian theory similar notions lead to an unrealistic reification of the existing community. Real communities are not united around shared values but divided by their different understandings of the many things they share. Community cannot therefore be posited as the source of consensus but is rather an ever-renewed result of conflict and debate.

Nevertheless, while I agree with the critique of communitarianism, there is a place for the concept of community identity in the understanding of the technosystem. Not everyone in technologically advanced so-

cieties discovers their identity through oppression and injustice. Much of the population is engaged professionally in serving a supposed public good through administrative and technical activities. Those activities translate the officially defined needs of the community into working systems and artifacts. For the agents of the technosystem the definition of the public good represents the operationally effective moral self-understanding of the community. It provides the normative basis for professional identities and has an important role in motivation and performance.

Similarly, victims of the existing system posit the "people" as arbiter and appeal to the general public, the "community," to impose change on the competent personnel. In this context technosystem struggles take on a special importance as challenges to the established definition of the public good, and therefore of the nature of the community and the identities of the professionals who serve it. Justice is served by reforms but more is involved: at stake too is the self-image of the society and its members. Who are we? What kind of a society do we live in? These questions are answered in practice by significant reforms.

Although they can be misleading, the concepts of identity and community are thus unavoidable in the everyday life of the technosystem. With this caution in mind, we can agree with Ferrara that debate over the technosystem often leads to a significant redefinition of the public good and hence to change in the "superordinate identity" that cuts across and makes intelligible the lines of disagreement of the community. The new identity, on which professionals must rely, is constituted not only by a change in attitude and opinion but by changes in technical disciplines and the material world. The expert/lay fragments into which rationality is split meet in a dialogue of multiple rationalities. And when the lines separating lay and expert are crossed, so are the lines separating discourse and material reality.

The example of the Alzheimer's medication discussed in Chapter 2 illustrates these considerations, but like many such struggles in the contemporary depoliticized environment the issues I raise here are not clearly focused. One might be tempted to see the caregivers as a "special interest" and the NHS staff as a neutral medium that simply transmits scientific knowledge. All that we have learned from Critical Theory and STS contradicts this impression. Scientific-technical knowledge exhibits formal bias in sociotechnical applications. Special interests are routinely reinterpreted by their advocates as rights or matters of general welfare

in appeals to the public. And, as STS argues, the translation of social demands into specifications is a complex process that makes an independent contribution to outcomes. Gramsci explained it long ago in Marxist terms: "Intellectual and moral reform must be tied to a programme of economic reform; moreover, the programme of economic reform is precisely the concrete way in which every intellectual and moral reform is presented."[20] This remark is valid for the technosystem as a whole, not just the economy. To better grasp the real nature of the process, we need a different paradigm.

The significance of technical politics was much clearer in the 1960s and 1970s when the public formulated its conflicts with its professional/technical representatives in ideological terms. In the United States, "radical professionalism" affected many sectors of the technosystem as small but not insignificant minorities of scientists, doctors, urban planners, and others attempted to change their relation to the public in opposition to the dominant capitalist definition of their roles.[21]

The most dramatic revolt occurred in the French May Events of 1968, in the course of which most of the government administration and many in the business world joined a general strike that paralyzed the whole economy. Millions of protesters called into question the legitimacy of the state and its official definition of the public good, seen as biased by the interests of capital. Those whose professional identity was based on placing their competences in the service of that definition were suddenly unmoored. They doubted the meaning of their work and the source of its legitimacy.

Here is an example taken from a leaflet issued by the General Assembly of the Ministry of Housing. "Civil servants in the service of the community, we have become, paradoxically, and for many of us against our will, the symbol of red tape. As a result of an erroneous conception of the role of the Administration and the lack of consultation in decision-making and implementation, instead of being the driving force of Urban Affairs and Housing, we are the brakes that everyone would like to see disappear."[22] The writers go on to appeal for the people to redirect their activities more productively. It is clear in such examples that technosystem struggles engage the whole society in normative self-examination.

STS itself originated in a similar if less dramatic disillusionment with official science policy. Wiebe Bijker reports that he and many other students of science and engineering were drawn in the 1970s to the "sci-

ence-technology-society movement" of the day, which questioned nuclear power, the arms race, and environmental pollution. STS arose from a "detour into the academy," the purpose of which was to achieve a more sophisticated understanding of science and technology. Thus at least for Bijker and the colleagues for whom he speaks, STS bears the marks of an earlier radical professionalism.[23]

The Structure of Debate

Azmanova proposes a theory of public debate that can be adapted to the study of the politics of the technosystem. She distinguishes between four levels in the normative structure of society on which political judgment operates:

L1. Institutional rules and procedures
L2. A multiplicity of values and interests
L3. Principles of justice
L4. A "phronetic" coding with paradigms of articulation and signification[24]

These four levels are interrelated in complex ways. L1, institutional rules and procedures, describes the forms of governance and the corresponding practices of the governed in their everyday behavior in those domains determined by law and institutional policy. To the domains Azmanova mentions, we must add the technosystem. L2, values and interests, corresponds to worldviews and conceptions of the good life. This level reflects cultural differences between communities and other sources of personal beliefs and values. Again, the technosystem plays an unacknowledged role here. L3, principles of justice, consists in the moral norms that are recognized as properly regulating interactions between citizens, regardless of their belonging, attitudes, and choices at L2. The problem of political judgment arises in the relations of L1 and L2. How can a community divided in its conception of the good arrive at policies, binding rules of conduct, that apply equally to all? Principles of justice, L3, are too abstract to determine policy, even if everyone can agree on them through the kind of refined rational argumentation presupposed by liberal theorists. Yet divided communities do reach agreement through public debate on policy issues. It is L4 that makes this possible.

L4 is the hermeneutic level of meaningful distinctions that frame dis-

cussion. It prestructures public reason even before disagreements are expressed. Azmanova calls it "phronetic" because it is based on everyday practices. She is careful to distinguish this level from culture in the sense in which that term is deployed in communitarian theory. It is not a system of shared beliefs and values characteristic of a community but background assumptions about meanings and categories and a ranking of those assumptions. The beliefs and values people bring to bear on the issues described by the categories may differ, but the categories themselves are more fundamental still and can support divergent worldviews. The phronetic background thus orients the participants in political debate toward significant issues and makes communication possible even where disagreement is unresolved. "Conflicting discourses within one code of understanding seem to be commensurable even when in conflict."[25]

Azmanova's schema is useful for interpreting many kinds of political struggle. Her rejection of communitarianism in favor of categories mediated by social practices enables her to navigate successfully between transcendental principles and social relativism. But she does not have much to say about the actual practices that give rise to the phronetic background, nor about its effects at L2, the level of beliefs and values. And she makes no mention of struggles over the technosystem. This is perhaps a lingering effect of her starting point in the critique of the political philosophies of Rawls and Habermas, two thinkers who systematically ignore the technosystem and emphasize the diversity of worldviews, which creates supposedly irresolvable conflicts over the "good." Their conception of public debate operates exclusively at the level of ideas, far from the mundane facts of everyday social life.

But once the terrain is shifted to social practices and their hermeneutic effects, a different picture emerges. Many of those practices are structured by the technosystem. This is one of the principle sources of the phronetic background, L4. Thus the hermeneutics of political discourse is a reflection of structures of human action that can be studied and understood.

The technosystem is also relevant at L2. Individuals are drawn together in social groups by their shared relation to markets, administrations, and technologies. For example, workers in a factory are assembled by the equipment that mediates their labor. Many latent groups form around such mediations. Even though they are not always aware of forming a group, clients of social services or patients treated by the medical system are assembled virtually by the technosystem and

can become conscious of their commonalities under certain conditions. Group belonging and the associated practices form beliefs, values, and "participant interests" where their implications for the members are articulated.

The phronetic background of political discourse can be represented as pairs of concepts reflecting a selection of aspects of the world that have public relevance at a given time and place. An obvious example is the racialized categories of "black" and "white." These categories stand in the background of discussions of race but they are not the objectively most important traits of the population. Small children, for example, find racial differences uninteresting or do not even notice them. They lack the "orientation" provided by these categories which are unfortunately present in everyday political discourse and many professional activities characterized by discriminatory practices.

The example of racialized categories is also significant for showing the double aspects of the phronetic categories as both descriptive and normative. Black and white are not neutral terms but stand in a clear hierarchical relation. That is the source of great injustice against which protest can be mobilized precisely because everyone, racists included, can understand the issues in terms of this phronetic background.

Azmanova's examples are inspired by race and gender struggle, and by her own struggle against communism in Bulgaria. But she does not actually explain how actors argue for their goals in the technosystem, whether through changed administrative regulations, markets, or technologies. That is the task of the next sections.

Technical Topologies

In this and the following sections I will present the phronetic background of the technosystem. These are the *topoi,* the bases of argument in the public sphere over technical artifacts and systems. I focus on the rational operations that mediate the relationship between causality and culture. These operations are invoked to challenge the given form of the objects. I identify seven operations corresponding to the six functionalizations: abstraction, translation, consistency, feedback, prescription/abduction, and prediction. Table 7.1 modifies Table 6.1 to present rational operations as they connect causal and cultural dimensions of instrumentalization.

Table 7.1 Dialectics of Instrumentalization

	Causal Functionalization	Cultural Functionalization	Operation
Objectification	Decontextualization (commodity, case, technical element)	Interpretation	Abstraction
	Reduction	Mediation	Translation
	Association	Systematization	Consistency
Subjectivation	Autonomization (buyer/seller, administrator/client, maker/user)	Identity	Feedback
	Positioning	Initiative	Prescription/Abduction
	Designing	Anticipation	Prediction

The following paragraphs briefly review these operations which will be explained more thoroughly in the remainder of this section.

The decontextualized properties of objects that suit them for technical employment are interpreted by abstracting their cultural meaning. An infinity of properties that could be foregrounded through decontextualization are narrowed down to the few that make sense in the prevailing cultural universe. The complexity of the object is reduced for technical use, but the reductions may be compensated by ethical and aesthetic mediations translated into technical properties of the object. The object must also be associated with other objects to function technically. Systematization involves the imposition of cultural consistency on the associated artifact or system, which must be adapted to the system of references that constitutes the cultural world to which it will be integrated.

A similar account can be given of the subjective functionalizations. The autonomized subject of technical practice is independent of the objects on which it acts at the causal level, at least in the short term, but feedback from its activity shapes its identity and may eventually have causal impacts as well. Design depends on prediction, through which the anticipated purpose of the object is served. The technical subject positions itself for control of its objects through understanding and applying their law. At the cultural level this gives rise to two types of initiative: first, a range of possible actions prescribed by the technical artifact

or system and, second, the discovery of new potentials not included in the original design. Innovation depends on engagement with technical means which opens a range of initiatives that can be enlarged by a new perception of the object and its context. I will call this operation "abduction," in the sense of C. S. Peirce. As will become clear, it is a form of reflective judgment.[26]

The technical and normative role of the rational operations are described in Table 7.2. They can be conceptualized as phronetic categories in Azmanova's sense. No single list can encompass all the possible categories that might be invoked by the actors in every situation. The categories selected here are representative of a broader range too numerous to list. They arise from the practices of engagement with technical artifacts and systems. Both lay and professional actors, each in their own way, experience the systems as cognitively and normatively significant, as shaping for their understanding of themselves and the world. The rationalizations under which these technical/normative categories stand describe the practices which, again, are lived somewhat differently by lay and professional actors, yet not so differently they cannot communicate.

Explaining these relationships draws illustrations from the three types of technosystems—markets, administrations, and technologies.

Abstraction. Provision/Obligation. The abstractive operation by which technically relevant aspects of reality are identified, separated from their immediate background, and provided as technical elements also interprets those elements in terms of a meaning. For example, collecting wood to make a fire separates the wood from its natural surroundings, an operation that corresponds cognitively to abstracting an aspect from a given whole. That this is a cognitively relevant activity is evident in the fact that the agent interprets what he or she is doing as "collecting wood." This activity both supplies the wood and a criterion under which to judge its adequacy for its purpose—that is, it lays out a normative framework which I have labeled "obligation." If the wood is wet it fails its purpose and the actor is obliged to repeat the operation.

In modern societies technical abstraction is well understood by both expert and lay actors. The designer abstracts the useful properties from his or her object. The users of the resultant object understand their own behavior as dependent on interpreting it under its specifically technical aspect, abstracting from its other aspects. This creates the mixture of

Table 7.2 Dialectics of Instrumentalization

	Causal Functionalization	Cultural Functionalization	Operation	Technical Role	Norm
Objectification	Decontextualization (commodity, case, technical element)	Interpretation	Abstraction	Provision	Obligation
	Reduction	Mediation	Translation	Layers	Values
	Association	Systematization	Consistency	Adaptation	Inclusiveness
Subjectivation	Autonomization (buyer/seller, administrator/client, maker/user)	Identity	Feedback	Effects	Responsibility
	Positioning	Initiative	Prescription/Abduction	Innovation	Progress
	Designing	Anticipation	Prediction	Specification	Order, Efficiency, Well-being

strategic and normative obligations that govern users' practices. The relations of obligation that flow from design and which determine these practices correlate with the erroneous practices that are proscribed by the proper functioning of the system. These correlated categories lay out a field within which disagreements between professional and lay actors can be articulated and debated.

Translation. Layers/Values. The rational operation involved in the delegation of ethical and aesthetic values to technical objects is called translation. For example, a shopkeeper receives boxes of goods to sell. The procedure I call "mediation" has to do with how those goods are disposed to be attractive to eventual buyers. The mediation translates an aesthetic value into a practical form by arranging the goods in a specific order. The goods are not presented haphazardly (i.e. "immediately") but acquire a temporary aesthetic layer in their commercial presentation. Similarly, all technical design involves translating discursively formulated ethical and aesthetic desiderata into material or organizational forms. In the process values are delegated to the artifacts and systems.

This is a complex social process in modern societies. Mediations often start out as participant interests universalized as ethical or aesthetic values. The professional actor is responsible for finding a technically viable actualization of these values. Lay actors are deeply influenced by such actualizations which they live out in their practical relation to the world. They may also demand changes where participant interests are poorly served by existing designs. In such cases, the role of translation becomes explicit as discursively expressed values seek technical actualization. The investment of the technosystem by explicit ethical and aesthetic values in the course of design shows up in the specifications as layers of functionality.

Values correlate with their opposites, the unethical and the unaesthetic. A public perception of a technical artifact or system as unmediated, stripped bare of desirable values, may lead to demands for change, or as in the case of the domestication of certain industrial materials such as wrought iron and chrome, the bare artifact may be invested with aesthetic value.

Consistency. Adaptation/Inclusiveness. Decontextualized objects must be associated with other objects to be useful and these associations must

be consistent with both technical requirements and cultural meanings. A technical device must be adapted to its material environment to function. For example, voltage requirements of a hair dryer must be compatible with the voltage delivered by the electric outlet, and so on. But the device must also be designed to conform with meanings and values. The demand for consistency at this level is just as essential as material adaptation.

Adaptation correlates with the incompatible and the inclusive with the exclusive. This pair of categories has a different scope for professional and lay actors. Consistency as a vernacular criterion opens up possible appeals to extend the values realized in the existing technosystem to excluded groups or new domains. Organizations and designers labor to bring consistency into their handling of technical and social operations and arrangements but may nevertheless be confronted with unanticipated demands for inclusion. When women first demanded equal pay they extended the rational principle of consistency beyond its customary reach. Where the sociotechnical adaptation of technical objects leaves out lay actors capable of understanding and protesting their exclusion, concretization in Simondon's sense is a particularly successful path to wider inclusion through redesign.

Feedback. Effects/Responsibility. The technical subject is distanced from its objects, yet there is inevitably feedback to the actor from the objects of action. This feedback establishes the identity of the actor at the cultural level, as for example the carpenter, the pilot, and so on, each named after their tools. Causal feedback occurs as well, as in the case of environmental pollution.

The subjects of technical design and practices are shaped by their relation to their objects. The practices of the technical subject have intended effects in the world. Effects are inevitably accompanied by side effects which may be desirable or undesirable. To the extent that technical action has effects and side effects, either intended or unintended, responsibility is engaged. The fulfillment of that responsibility is a rational guide to action in the technosystem. The correlate of responsibility is irresponsibility, which may be more or less excusable, more or less immoral, depending on the case. It is responsibility which binds technical actors to the purposes of the ideal community defined by the design of the technosystem and public debate.

Prescription/Abduction. Innovation/Progress. Prescription/abduction describes initiatives opened by the technosystem, both the initiatives it prescribes, and also the innovations it makes possible. In special cases innovations transcend existing normative limitations and constitute a moral advance. In such cases we speak of "progress" in the full sense of the term, not merely a technical advance but an improvement in the human condition. Innovation correlates with stability, which may be considered more or less desirable depending on the case. The abductive leap is not formally rational but nevertheless is recognized as essential to rational thought. Both professional and lay actors are capable of abductions that transform the technical environment.

Abduction, as the key to innovative change, requires further explanation. C. S. Peirce introduced this term to signify the process in which new ideas arise in the course of inquiry. He characterized the logic of abduction in the following way:

> The surprising fact, C, is observed.
> But if A were true, C would be a matter of course.
> Hence, there is reason to suspect that A is true.[27]

In sum, a new idea is triggered by an observation that does not fit the established theory.

The practical correlate that describes the relation between positioning and initiative, ordinary and innovative usages, would be formulated as follows:

> The surprising feature, C, is observed.
> But if A were designed/performed, C would be a matter of course.
> Hence, there is reason to design/perform A.

In this version of the principle, it is the discovery of an unexpected technical affordance that inspires new designs or practices rather than new ideas. Several varieties of what I am calling abductive practical inference are described by Charles Spinosa, Fernando Flores, and Hubert Dreyfus in a book of Heideggerian inspiration entitled *Disclosing New Worlds*. They develop a theory of "history-making," the intervention of agents bearing new ideas and practices. These agents act in three principle ways: "articulation," finding new fields of application of traditional values; "cross appropriations," adopting practices from one domain of life in another domain; and "reconfigurations," bringing marginal prac-

tices from the periphery to the center of a lifestyle. The authors offer several technical examples. They mention Gillette's introduction of the disposable razor as a reconfiguration of a marginal everyday practice, the use of throwaway objects, and Kennedy's decision to send a man to the moon, an articulation of American pioneering values in a new sphere.[28]

All three forms of innovation are illustrated by the discussion of the Internet in Chapter 4. The Internet is a gigantic metaphor—cyber-*space*—transferring familiar values and practices to a new setting. Values such as transparency take on new importance as they are articulated in Facebook. Group practices are cross-appropriated in online forums, many of which represent people such as medical patients or hobbyists who would not normally have formed face-to-face groups. Marginal practices such as anonymous interaction are reconfigured from face-to-face social domains such as bars to digital venues such as dating sites, web forums, and political commentary.

In these examples, the identification of unsuspected potentials leads to a reconceptualization of the object to better serve new usages. The application of the concept of abduction can also be extended to include cases where the "surprising feature, C" threatens rather than promises. In such cases the abductive argument would be reversed: the point would be to *stop* designing/performing A in order to eliminate C. This would describe the logic of much environmental protest.

Generalized, abduction contains the very idea of innovation on which all progress rests, whether cognitive or historical. Society evolves through unexpected initiatives—abductions—of users, workers, or potential victims. Once an artifact or system is deployed, existing functions may be transformed through the action of these social groups. In such cases, the process is often characterized by struggle. Lukács's concept of dereification describes the initial premise of such struggle, the liberation from the routine usages associated with the given technical systems and the emergence of a collective subject of change.[29]

Prediction. Specification/Order, Efficiency, Well-Being. Design depends on more or less successful prediction of users' behavior. Predictions are necessary to anticipate the conformity of the specified design to its purpose. The rational bases of markets, administrations, and technologies (i.e. equivalence, universality, and efficiency) describe the most general technical purposes of the technosystem. They determine the actual de-

sign of existing institutions and the norms under which these institutions are supposed to operate. Equivalent exchange on markets distributes goods rationally while also exemplifying fairness. Universal rules enable the functioning of administrations while also realizing the values of justice, order, and predictability. The efficient use of resources and labor contributes to well-being. Appeals to fairness, justice, and well-being legitimate both the established society and action to change it.

The Rhetoric of the Technosystem

The categories the public deploys in public debate over the technosystem encode what Foucault calls "subjugated knowledges." Recall that by this term Foucault means the understandings of subordinate groups in modern social institutions. Their knowledge is informal, experience based, and explicitly normative in contrast to the official formalized "sciences" that articulate the governing principles of the institutions.

Michel de Certeau makes a corresponding distinction between the official institutional "strategies" and the "tactics" of those subordinated within institutions. Strategies aim at prediction and control. They are elaborated in an institutional "place" and backed by an established power. Tactics are punctual, disorganized, dispersed. They have neither a place of their own nor any institutional backing. They move in the interstices of the system toward goals that differ from, but do not necessarily contradict, the strategies of the powerful.

De Certeau argues that "the discipline of rhetoric offers models for differentiating among the types of tactics." As the Sophists claimed, rhetoric defies the logic of strategic knowledge to make the "weaker position seem the stronger." In a modern context, the "weaker position" is not just an argument but also a subordinate social location. Rhetoric is the discipline that best exemplifies the contrary logic of tactics based on subjugated knowledges. It "offers an array of figure-types for the analysis of everyday ways of acting even though such an analysis is in theory excluded from scientific discourse."[30]

De Certeau does not draw the same conclusions from his "rhetorics of technology" that I do, but his argument complements mine by calling attention to the different logics coexisting in the world created by the technosystem.[31] Many of the various categories described in the previ-

ous section are the basis of tropes or figures deployed in argument—Aristotle's *topoi*.

For example, abstraction corresponds to synecdoche and translation to metaphor. To abstract is to take the part for the whole and to translate is to posit an identity of terms expressed in different languages. Thus the discovery of technical affordances strips away (abstracts from) unneeded features of the object, and the investment of the stripped-down object with new aesthetic and ethical attributes specifies (the target language) the artifact with discursive meanings (the source language) privileged by influential actors.

The section of Aristotle's *Rhetoric* entitled "Demonstrative Common Topics" contains numerous examples of arguments from consistency. These are "enthymemes," that is, incomplete or merely probable syllogisms.[32] Rancière's explanation of the textile workers' demand for equality is an example. The citizens of Flint, Michigan, whose water supply was contaminated with lead, demanded clean water in accordance with the law. Their argument could be reformulated as the following enthymeme: "If the law is meant to be obeyed everywhere by all, then it must be obeyed in Flint by you, Governor Snyder."[33] "Black Lives Matter" is an extremely condensed demand for consistency. The implied enthymeme is "All lives matter in principle, thus it is unjust that in practice black lives matter less than those of others." (Conservatives who counter the slogan "Black Lives Matter" with "All Lives Matter" simply reveal their own willful obtuseness.)

Feedback corresponds formally to the figures chiasmus and antimetabole in which phrases repeat words or syntactic structures in reverse order. These figures fascinated the young Marx, no doubt inspired by Feuerbach's reversal of the relation of man to God. Marx writes, for example, that "*man makes religion,* religion does not make man," and "the arm of criticism cannot replace the criticism of arms."[34] The application of the figure in ecology takes the "Newtonian" form of a reversal of cause and effect: polluting the environment comes back to haunt the polluters. "What humans do to nature, nature does to humans."

De Certeau concludes, "The actual order of things is precisely what 'popular' tactics turn to their own ends, without any illusion that it will change any time soon. Though elsewhere it is exploited by a dominant power or simply denied by an ideological discourse, here order is *tricked* by an art. Into the institution to be served are thus insinuated styles of

social exchange, technical invention, and moral resistance, that is, an economy of the '*gift*' (generosities for which one expects a return), an aesthetics of *tricks* (artists' operations), and an ethics of *tenacity* (countless ways of refusing to accord the established order the status of a law, a meaning, or a fatality.)"[35]

Conclusion

The instrumentalization theory is intended to open up the imagination to a possible transformation of industrial society. It does so by showing how the causal determinations of technical systems are contingent on culturally specific notions of well-being. The theory provides an alternative to technocratic rationalism by showing the rationality of public intervention into the technosystem. It goes beyond theoretical critique to show the role of social struggle and political agency in sociotechnical development.

The instrumentalization theory is politically significant not because it advocates or supports any particular policy but because it makes politics thinkable in the world of the technosystem. In the absence of a theory supporting a social understanding of the technosystem, technocracy beckons. Philosophy of technology is called to challenge this conclusion with an account of the co-production of society and technology in the making of worlds. The struggle over the technosystem is the gestalt switch in the structure of modernity.

Conclusion

The Question of Progress

Introduction

Critical Theory has always been based on utopian hopes, however expressed and despite disappointment. This implies an understanding of history as progressive, or at least potentially so. The Enlightenment is usually identified as a turning point. Relativist and postcolonial challenges to that understanding pose a dilemma for Critical Theory.

To affirm progress since the Enlightenment is implicitly to condemn the lack of it in those parts of the world untouched by that particular historical experience. The charge on one horn of the dilemma is Eurocentrism. But to deny progress disarms critique and protest and so by implication offers comfort to an oppressive system. The charge on the other horn is conformism. Is there a way out?

The escape from the dilemma lies in a notion of local progress. In the case of the technosystem, political obstacles must be defeated and a dialogue initiated between public demands and expert implementation. This is progress not as a tendency of history but as an achievement of struggles against injustice. The normative basis of such struggles is not limited to the familiar formulations of Western ideals that have come down to us from the Enlightenment. Since modern forms of life have followed science and technology into every corner of the globe, translations should be possible between the progressive desires of peoples everywhere, however formulated and with whatever differences arise from the variety of cultures and conditions.[1]

From Grand to Local Narratives

During Nixon's visit to China in 1972, Premier Zhou Enlai was asked about the impact of the French Revolution. He is supposed to have replied that "it is too early to say."[2] It is delightful imagining the wily politician, heir to 5,000 years of Chinese history, expressing reservations about our brief Western experience with progress. Given the unexpected and terrifying events of the twentieth century, his answer might apply to modernity as a whole.

Jean-François Lyotard summed up a growing tendency throughout the twentieth century to dismiss the idea of progress as an illusion.[3] He argued that the "grand narratives" of progress in knowledge and freedom that inspired the nineteenth century have been refuted by the "postmodern" understanding of social organization and science. This critique is mild compared with Walter Benjamin's complaint that faith in progress has gilded the horrors of history in a false glory or the similarly outraged denunciation of progress in Adorno and Marcuse, who saw it as an alibi for the destructiveness of modern technology. Yet all these thinkers held out hope for change, at least in principle. Their critique was meant to save the notion of progress from ideological abuse.

According to Amy Allen's provocatively titled book *The End of Progress,* the abuse continues to plague Critical Theory itself. Allen is sensitive to the complaints of postcolonial theory that Europeans are blind to the entanglement of their normative ideals with the horrific facts of colonial domination and genocide. Eurocentric claims to civilizational superiority must be rejected. At the same time, Allen rejects romantic antimodernism. She is still pursuing that "rational critique of reason" Adorno promised.[4] This complicates her argument. She relies on Adorno and Foucault to thread her way through the narrow passage between Enlightenment and irrationalism.

This sets her at odds with the contemporary critical theorists Habermas and Honneth. She agrees with them that norms are "contextual" in the sense that they emerge in history from historical processes. Such contextualist arguments usually justify relativism, but Habermas argues that the contingency of history is transcended in a learning process that achieves universally valid results.

Allen argues, contra Habermas, that no overall historical learning process validates Western political norms. Her contextualism is more radical; she writes, "Metanormative contextualism or contextualism

about normative validity consists in two claims: First, moral principles or normative ideals are always justified relative to a set of contextually salient values, conceptions of the good life, normative horizons—roughly speaking, forms of life or lifeworlds. Second, there is no über-context, no context-free or transcendent point of view from which we can adjudicate which contexts are ultimately correct."[5] The very notion of civilizational learning implies the transcendent superiority of the West. She criticizes what she terms a "backward looking" idea of progress as a "fact" about the past, while continuing to endorse a local, context-dependent idea of future progress. She thus rejects relativism—progress does occur—without positing a transcendent point of view, even one that emerges in history.

The contextual nature of norms is an instance of the general contextual nature of rationality. "Truth," Foucault claims, "is a thing of this world."[6] If there are no context-free universals, context-freedom cannot serve as a meaningful standard of validity and so the failure to meet that standard does not imply relativism but rather the pragmatic principle of openness to revisions and dialogue with those whose contexts differ.

I cannot review Allen's whole argument here; it is effective in showing that Critical Theory is caught between the twin dangers of relativism and foundationalism despite its best efforts to advance a third position. Yet I was surprised on reading in the first chapter her intention to ignore the issue of scientific-technical progress.[7] A brief mention of Bruno Latour's claim that "We Have Never Been Modern" justifies this elision.[8] But how can one discuss progress without mentioning science and technology? The very idea of normative progress rests on an analogy to scientific-technical progress. Only if the latter can be explained in the local, future-oriented terms Allen approves can the former be effectively reformulated on those terms.

Despite her critique, Allen remains loyal to the Habermasian program in one important respect: she presupposes the clean separation of normative and technical rationality. This assumption brings Critical Theory into the orbit of mainstream political theory, where it shares the implausible inheritance of the social contract according to which politics arises from the unmediated relations between men. Political theory treats its technical basis as an exogenous variable. This is what makes it possible to discuss norms without reference to technical rationality. There is tacit agreement that the technical logic of the institutions can serve whatever ends are imposed on them within limits they define. Since

political theory leaves the definition of the limits to the experts, it ends up with conservative conclusions. This makes no sense in modern societies structured by a technosystem increasingly contested by the public.

Overlooked is the fact that the obstacles to progress are often not political in the usual sense but are embedded in the design of the technosystem. In such cases, progress is realized *essentially* through technosystem change rather than the legal and policy changes that are the focus of democratic theory. Treating the technical conditions of progress as external "facts" obscures the role of democratic struggles in changing the technical base itself.[9]

Consider, for example, the Black Lives Matter protests taking place as I write this. Few doubt that there are racist police officers in the United States and that this is one of the sources of the problem. Nor is there any dispute about the rights of black victims of extrajudicial killings by police. But given the difficulty of changing attitudes toward race, racism cannot be the primary focus of reform. At issue are technical and administrative measures such as body cameras, training in the use of lethal force, and effective disciplinary procedures. The system must be redesigned under public pressure regardless of the attitudes of individual officers. That is an instance of the local progress Allen invokes as a substitute for global progress. It is inextricably entangled with the technosystem.

Allen agrees that consideration of sociotechnical issues may be required to complete her argument, but she does not undertake this challenging task. Here I will discuss several points Allen raises that are clarified by reference to sociotechnical rationality. I will focus first on her discussion of the irreversibility of normative advance and the constitution of the "space of reasons" within which normative dialogue proceeds.[10]

Foucauldian Correctives

For analytic purposes, Habermas and Honneth relate normativity to the first-person perspective of the participant and the empirical facts of power to the third-person perspective of the observer. As a member of my society I respond to rules of proper behavior as norms, while as an observer I perceive the power relations through which the rules have achieved normative status.

But not all norms depend on power; some respond to a rational advance in reflexivity and autonomy. That advance starts out from the given social context which it transcends critically toward moral commitments that are both personal and universal. The first-person normative standpoint is supposed to be able to distinguish these rationally validated norms from those that are imposed by an external source. The reconstruction can reveal whether my obedience to the rules is rational, or depends simply on habit or introjected fear of the consequences of nonconformity. At the collective level the learning process that disentangles reason from power is a universally valid progressive advance.

What is wrong with this theory? Allen argues that neither first- nor third-person standpoints give an accurate picture of the situation. What is required is a Foucauldian "participant-observer" genealogy, an ethnology of our own culture.[11] Foucault's approach as Allen describes it problematizes our self-certainties and encourages humility by revealing the power relations that preside over our becoming rational subjects of normative claims. Subjects become the subjects they are through the practices determined by the power relations in which they participate. I take this to imply that the distinction between rational and external sources is weakened because now even what we interpret as reflexivity and autonomy depend to some extent on power rather than transcending it.

This suggests the need for caution in judging members of other societies. Reflexivity and autonomy may take culturally inflected forms we might overlook and ascribe to a lower level of moral development. For example, Japanese culture is group centered. The subjectivity shaped by Japanese culture is oriented toward group harmony rather than self-assertion. Autonomy is exercised primarily through the original commitment to group affiliation. Since everyone derives benefits from group belonging, what we think of as autonomy often appears to Japanese people as selfishness, a morally inferior rather than superior stance. This leads to serious tensions as Japanese tradition is increasingly eroded by Western attitudes, but it is not clear that this is "progress" in autonomy rather than regress in the capacity for moral commitment.

If this is the right way to understand Allen's point, it would explain why we must not insist dogmatically on the validity of rights claims that seem obvious to us. Is it an advance to achieve a critical relationship not just with respect to public institutions but even over against the family? Not every society thinks so and in the absence of Western-style social ar-

rangements such absolute individualism makes no sense. This difference might play a role in different evaluations of marriage policies. We may see in the freedom we advocate an expression of pure normative rationality, but our very subjectivity is contextually conditioned by a society that guarantees our survival as independent individuals. Thus, imposing the policies we find acceptable is judged unreasonable by others who do not share the context that has made us who we are.

I sympathize with Allen's argument for humility but wonder if her example of gay marriage does not reveal the limitations of her approach.[12] Are such examples the principal issues that confront us today, either domestically or in dialogue with non-Europeans? Including the technosystem in the argument allows genealogy to do further work in a much larger field.

Allen criticizes Axel Honneth's claim that normative advance has an irreversible character because it remains in collective social memory. For both Habermas and Honneth it is specifically the disentanglement of reason from power that cannot be forgotten.[13] The "learning process" is unidirectional even if regression may occur at other levels. Is this really the way things work? For example, is the normative force of the abolition of slavery primarily perpetuated in social *memory?* I do not think so. Is it simply an effect of what Foucault calls "sovereign power"? Again, this cannot be right. This is a normative advance that has been realized in social, legal, economic, and technological arrangements so thoroughly and deeply that regression is inconceivable. Put another way, neither memory nor power has the power to make a normative advance irreversible. For that it must be embedded in the technosystem, in what Foucault called the "capillaries" of society. This takes place, he argues, through a specifically modern form of power that is dispersed and impersonal.

Not only are we as subjects products of a world in which slavery was abolished, that world has been transformed in response to this normative achievement. The achievement is verifiable from both first- and third-person standpoints, both in our psyches and in our technical arrangements. The entanglement of norm and fact is ineradicable. The issue Foucault does not address in any detail, but which is essential to Allen's position, is the progressive nature of at least some of the changes made possible by such realizations.

This argument reinforces Allen's critique of Honneth, and it also helps to explain an aspect of her argument with Forst, who believes the demand for justification is intrinsic to human nature. Social life takes

place in a "space of reasons" in which justifications are offered and received. The exercise of power on this account would involve limiting the reasons to which agents can appeal to those favoring obedience. Allen objects that Forst, like Honneth, overlooks the problem of the constitution of subjectivity which she elucidates in terms of a Foucauldian theory of social practices.[14] If the subjects who enter the space of reasons are preconstituted to respond to power, reason and power cannot be separated. One might even say that reason is simply a supplement of power that power gives itself. This appears to be a straightforwardly relativistic conclusion incompatible with Critical Theory. Azmanova's approach offers an alternative to relativism by focusing on the implications of the context dependence of the space of reasons. Governance rules determine practices which in turn modify the phronetic background. The normative implications of the practices are internalized and frame the context of public debate.[15] This frame establishes the categories that are relevant in the space of reasons. But the framing is not deterministic; rather, it opens a field of possibilities. If the practices cause enough suffering, they can be challenged by contesting the rules in terms of the very categories they make relevant. This can trigger further changes in the phronetic orientation underpinning the space of reasons, altering the boundaries of validity. New constellations of valid reasons alter social practices, which in turn alter governance rules.[16]

The contextuality of rationality manifests itself in what can be taken as a reason in the space of reasons. In modern societies, the boundaries of that space are laid out by the practices embedded in the rational order of society. The technosystem is the sum of these rational arrangements. Finding the fissures and cracks through which alternatives can enter is not a simple matter. It must follow the tracks of discontents, pathologies, and radical social movements. As Sartre said of the French May Events of 1968, social movements "enlarge the field of the possible." On Forst's terms, that means to enlarge the space of reasons.

Technical Power

The Foucauldian concept of power on which Allen relies introduces a tension in her argument. This concept corresponds to the impersonal power of the market Marx identified in the capitalist system, as contrasted with the "sovereign" power of feudalism. Colonialism involved

a confusing mix of both types of power. Conflating the two types risks reducing reason to power. Romantic irrationalism would then challenge technocratic rationalism, a conclusion of some postcolonial arguments.

As a critical theorist, Allen must reject that conclusion. She defends the idea that progress can occur locally through reforms that respond to rational norms. Although gender issues are the only ones she discusses at length, I take it that she would include among worthy reforms the achievements of many progressive movements, such as environmentalism, movements for workers' rights, disability rights, criminal justice reform, protection of privacy and free speech, protests against economic and racial inequality, and so on.

In the case of gender struggles, both forms of power are implicated but many of the others primarily challenge the impersonal power of the technosystem. From the standpoint of those movements, there must be no confusion over the nature of power. In the case of environmentalism, for example, this has to do with responsibility for environmental problems. If they are attributed to the ill will of powerful individuals, or worse yet to bad decisions by consumers, the role of technology is minimized. In reality technology is the main culprit and no serious advance can be made without changing it.[17] That requires more than a change of personnel or attitude since engineers and other technical workers act in accordance with technical disciplines. Those disciplines codify the impersonal power of technology in conformity with hegemonic social demands. If the problems are not addressed at that level, they cannot be solved. As is clear from this example, establishing the real relation between the two forms of power is difficult but necessary.

The difficulty is due in part to the invisibility of technical power. The technocracy exercises that power under two assumptions that tend to naturalize it—first, that technical progress is on the whole desirable and, second, that it can occur only along the established trajectory of development. Significantly, the second assumption tends to feed back into the first, defining the norm of progress in terms of technical potential. The most flagrant recent case concerns privacy: since privacy is routinely violated on social networks, we are told that transparency is progressive. The inspiration for this supposed instance of progress is clearly a function of technical developments rather than the reverse.[18]

An effective critique of Eurocentrism must deal with the global spread of this technocratic outlook. The whole world has accepted Europe's scientific-technical superiority in the last two centuries. Technical power

and its associated concept of progress is far more pervasive and influential now than older forms of sovereignty. To be sure this is a contingent fact and neither epistemologically nor normatively decisive, but what a fact! It has created a world in which global corporations apply modern scientific-technical methods only to be contested by popular movements that demand alternative applications of the same modern scientific-technical methods. Agroecology and climate science, not traditional ethnosciences, much less Azande witchcraft, are the cognitive tools of resistance to industrial agriculture and greenhouse gas pollution. This is not to say that premodern sciences and techniques contain no useful knowledge, but for the most part that knowledge becomes effective today where it is combined with modern scientific-technical knowledge in hybrid forms.[19]

The simple opposition between modern and premodern is no longer an active force in the contemporary world. The West, as the originator of modernity, can claim to be more "advanced" in some respects than nations that have only begun to emulate it recently. But that is no reason for arrogant self-congratulation given the many serious problems confronting Western modernity. A non-Western nation that sought original solutions to these problems would have lessons to teach the West. Already one can credit the struggle against colonialism with having initiated moral progress in the West in the understanding of race and human rights.

Eurocentrism intrudes on the lifeworld of non-European societies primarily through capitalism and technology. These are the forces transforming life throughout the world, often with little regard for the needs and rights of peoples. It is true that normative ideals such as democracy are also imposed on non-Western societies, but so far it seems that democratic norms are "metabolized" effectively by non-European nations and become channels for the expression of traditional power relations while legitimating capitalist development.

I have studied this process in the case of pre–World War II Japan.[20] This example is particularly interesting because Japan managed to avoid colonization while modernizing. The result is a test case for the "multiple modernities" hypothesis Allen resists in Habermas's hopeful formulation. Prominent Japanese philosophers anticipated the postcolonial argument. They rejected the temporalizing structure of the Western concept of modernity in terms of advance and backwardness, and argued instead that modernity brings about the coexistence of multiple civili-

zations. So far so good, but the Japanese case exhibits two apparently contradictory tendencies—one backward looking, the other forward looking, and neither emancipatory.

On the one hand, structures of authority inherited from the past were adapted under a veneer of Western constitutionalism and democratic movements suppressed; so much for democratic norms. On the other hand, forms of technical rationality that had been contextualized by the traditional culture before contact with the West were "differentiated" and allowed to flourish independently. The process of valuative mediation of technical rationality which was so important in premodern Japan was blocked. Japan retained many culturally original features, but ended up more similar to than different from the Western models it imitated. This does not prove the universality of Western modernity but rather testifies to the mimetic passion of the Japanese confronted with the West.

This pattern is not unique. It confirms Samir Amin's argument, which Allen cites, that the selective uptake of Western rationality has little to do with democratic norms. But that raises the question of whether postcolonial critique of Enlightenment *norms* gets at the real crux of the problem. Perhaps the most important issues involve technical rationality rather than legal or moral norms which serve mainly as ideological legitimations.

The point can be made in another way more directly related to my concerns here. The lifeworld of Western societies is itself colonized by "Western" rationality. Eurocentrism begins at home. The reconstruction of the entire social world around the institutions and technologies of capitalism is the original version of the problem Allen poses with respect to non-Western nations. Marx and Engels describe it in *The Communist Manifesto:* "All that is solid melts into air." Resistance to the new forms of oppression based on technical rationality is precisely what inspired Marx and the first generation of the Frankfurt School. Today it is global. Despite tremendous differences between nations and regions, the whole planet confronts a common fate.

The Critical Constructivist Point of View

The discussion so far has shown the imbrication of normative and technical issues. They cannot be cleanly separated and that has implications for both philosophy and social science. Critical constructivism attempts

to cross those disciplinary boundaries to gain a concrete understanding of the nature of progressive struggle under the new conditions of modern life. In this section I will leave behind the argument with Allen to summarize the critical constructivist approach to the concept of local progress she has introduced.

The extensive development and global reach of the technosystem confirms Critical Theory's early critique of universal technification. The technosystem rests on the peculiar hegemony of technical reason in modern societies. The critique of progress recognizes the failure of technical reason to deliver the moral advance promised since the Enlightenment, but no retreat is possible. Any revision of the idea of progress must contend with this conundrum.

The historical dilemma of modernity consists in the achievement of political freedom without any generally recognized principle, such as a religious worldview, regulating the application of technique to human beings and nature. As a consequence, rationality is reduced to an instrumental rump. In practice, this means that industrial development is driven almost exclusively by control problems and the demands of the market.

The operations characteristic of this form of rationality are modeled on science and mathematics. Quantification is a familiar example. Administrations are irresistibly drawn to it as the surest evidence of validity. Other similar operations, such as precise measurement and classification under universal rules, extend to the whole technosystem through the technical disciplines which organize it. Sociotechnical rationality is legitimated as the source of progress by a generalized concept of control of nature through the efficient ordering of human and natural resources. But this concept cannot unify society as did worldviews in earlier times.

The apotheosis of sociotechnical rationality has the effect of elevating functionality from a specialized attribute of certain artifacts into an ontological principle. Despite appearances, this rationality is not neutral, available to serve any conception of the good life whatsoever, but always already embodies a particular conception in its design. The instrumentalization theory shows the implication of cultural norms in the design process. Functional ascriptions reflect the dominant culture, the perspective on experience that guides the selection of useful properties. The functional transformation of society imposes ends privileged by the means that organize social life and those means bear the mark of capitalism.

Norms are not separate from the "facts" because they must be confirmed by the existing sociotechnical arrangements to be effective. Indeed, we learn their concrete meaning only in technical translation. Nor are the facts separate from norms since they have been constructed in accordance with them. Hegel would call this realized "rationality," the specifically modern form of *Sittlichkeit*. This concept was essential to Hegel's strategy for overcoming Kantian ethical formalism. Allen and other critical theorists dissatisfied with Habermas are attempting to overcome his ethical formalism without a similar concrete basis in the social world.[21]

The limitations of this quasi-Kantian approach are explained in David Ingram's study of Habermas. Ingram comes back repeatedly to the problems Habermas encounters applying the procedural forms governing rational dialogue to substantive normative issues. The forms prove inadequate by themselves to render judgment on ethical contents, as in the case of abortion or the right to material subsistence or workplace democracy. For example, Habermas excludes workplace democracy on the grounds that it is incompatible with the division of labor. The application of democratic norms is limited by a dubious "system logic." Similar substantive assumptions must supplement the normative framework in every case. Ingram concludes, "Habermas's own applications of his theory in the realms of technology (genetic engineering), religion and politics, multiculturalism, feminism, and immigration—just to name a few—belie his claim that philosophers need only (and can only) justify procedures for critical reasoning, as if these procedures could somehow be understood and applied apart from substantive value commitments. To put it in Hegelian terms: all thinking is mediation."[22]

Formalism in political theory is unconvincing because ethical "substance" today is technically based. Without an understanding of the technosystem and its role in social life, it proves impossible to grasp the ethical issues properly. One risks ending up with ill-informed assertions such as Habermas's claim concerning what is and is not compatible with the division of labor. Or else one systematically reduces complex normatively relevant aspects of the technosystem to psychology, as Honneth does in his discussion of social memory and reification.[23] By contrast, critical constructivism follows the *"Spuren der Vernunft" in* the transformations of the technosystem.

The drive to further those transformations does not come from the outside, from spiritual movements or conventional politics, but emerges

inside the technosystem itself. Experience is reshaped to conform to a reified world, but it overflows its reduction to functional elements. As ever more efficient means are developed and extend to more and more domains of social life, the ends they are designed to serve are called into question by those who do not share the presuppositions that presided over their selection. The immanent tensions between the lifeworld and the technosystem give rise to social movements that seek to replace market demand and control of labor as criteria of progress.

The first such immanent resistance was the proletarian movement. It responded to the conditions created for labor by the Industrial Revolution. In its socialist declension, its goal was not retreat to an earlier form of society or to impose moral values on capitalism but to overturn the control structure of industrial development. Today we see resistance to rational artifacts and systems emerging in many domains of social life, not just in the factory. The struggles reveal the normativity of technical rationality as it is realized in the social world.

The constructivist concept of underdetermination explains the conditions of possibility of successful public interventions into the design of the technosystem. This concept describes the contingency of technical developments and releases the analysis of the design process from technocratic assumptions. The constructivist argument holds that there are often technically viable alternative designs for systems with different social implications; the successful design is thus not exhaustively explained by purely technical considerations. Underdetermination means that the trajectory can be changed and that in turn frees normative decisions from technical determination. This has liberating political implications. There is no "one best way" but many context-dependent ways among which to choose. The trajectory of the existing system does not necessarily determine the future. Public action can place society on a different trajectory in conformity with different values.

Historical experience suggests that inclusiveness, development of human capacities, and rational self-interest in concerns such as health motivate progressive demands for change. Technical arrangements achieve closure—stabilization around a specific technical code—in a variety of ways. Constructivist studies of science and technology have played an important role in our understanding of struggles for these values, but the normative issues remain largely implicit. Case studies of technical controversy should acknowledge these normative issues and outcomes and recognize a form of *progressive closure* that contributes to social

development. A notion of progress is essential to public interventions. No one would fight for change who did not believe it to be progressive.

The social interpretation of Simondon's theory of concretization shows how to incorporate progressive values into the analysis of cases. Simondon introduced a specifically technical concept of progress compatible with Critical Theory, as Marcuse notes in *One-Dimensional Man*.[24] Concretization in Simondon's sense of the term consists in the multiplication of functions performed by the structures of technical objects. Technical efficiency depends in large measure on the discovery of elegant ways of combining functions in a limited number of components (Simondon's "structures") to avoid redundancy and waste.

In Simondon's original formulation, concretization operates at the purely technical level, but on constructivist terms, functions correspond to the demands of social actors. Concretization multiplies the actors and concerns served by the design of the technosystem. Progress is now defined in terms of designs and innovations that include populations previously excluded by formally biased designs, or that realize hitherto excluded human potentialities, or that successfully reconcile technical requirements with natural limits, both of human beings and the environment. These progressive developments respond to the exclusions and harms of the capitalist form of industrialism we inherit.

Concretization in this sense can support a concept of progress as a local, context-bound phenomenon uniting technical and normative dimensions. Technical progress is joined indissolubly to the democratic enlargement of access to its benefits and protection from its harms. In a society where practically all significant activities are mediated by the technosystem, this covers the larger part of social ethics. Even problems that seem remote from technology turn out to be implicated in technical issues of some sort, as students of fields such as medical ethics have discovered.

The concepts of underdetermination, formal bias, and concretization explain how public interventions into the technosystem can be democratic, technically successful, and progressive. Democratic demands and technical rationality meet in the public sphere. This is an encounter of cultures as complex as any between nations and religions. It reveals a divide within the "space of reasons" between everyday rationality and its refined expression in technical disciplines.

This divide gradually subverts the consensus around sociotechnical rationality. Since the realities revealed in the conflict of functional form

and living human content cannot be represented by an effective worldview of the traditional sort, some other solution to the problem of social order must be found. In the nineteenth century the technosystem was to a large extent exempted from public discussion through the uncontested intervention of experts. Suppression of dissent in the name of property rights and technocratic ideology secured consensus for more than a century of industrial development.

The twentieth century saw two contradictory phenomena affecting the role of the public. On the one hand, the mass media overwhelmed the classic public sphere by framing the issues effectively and imposing ideas favorable to official policy. On the other hand, especially after World War II, expert authority was challenged and technosystem issues entered the public sphere, where they were subject to a surprising resurgence of public debate. The emergence of public discussion on the Internet has weakened the mass media while opening new possibilities of democratic dialogue within the technical networks and, notably, between their lay and expert members.

The communication process in which this dialogue consists depends on conceptual bridges across the divide in the space of reasons. Philosophers have shown the possibility in principle of bridging the divide without anticipating the form it takes today.

In different but complementary ways, both Lukács and Husserl challenge the separation of scientific-technical rationality from the lifeworld. They argue that the refined language (of political economy or natural science) is rooted in vernacular concepts and practices available to ordinary people. Formal rationality derives from and interacts with the informal rationality of everyday life. Both forms of rationality exhibit double aspects, as both cognitive and normative. In the case of scientific-technical rationality, the normative aspect is largely implicit, but it is explicit in the exercise of public reason and this forces it to the surface for experts too.

Critical constructivism situates these multiple and conflicting types and claims of rationality in specific contexts rather than affirming the universal validity of one or the other. The concept of multiple rationalities has political implications in modern societies structured around rational institutions. To understand those implications it is necessary to recognize the double aspects of rationality as it is practiced by both expert and lay actors.[25] In technosystem struggles the two forms of rationality communicate rationally, as the categories in their original form in

the lifeworld enter into dialogue with their refined form in the technical disciplines. Progressive change culminates in the translation of public demands into new designs in response to experience with the system.

Critical constructivism enlists the constructivist concept of underdetermination in a political argument that began in the Enlightenment, continued with Marxism, and is now renewed in the social movements to reform the technosystem. This approach relates early Critical Theory to contemporary theory and practice. It situates struggles over the technosystem in a larger historical context in which the imperatives of capitalism have determined criteria of technical advance contested by democratic interventions. Subjugated knowledges and participant interests arise from the networks capitalism establishes and motivate struggles over the design of the technosystem. Experience within the technosystem assumes a rational form capable of interacting with technical expertise.

Critical constructivism thus satisfies Allen's demand for a revision of the concept of progress by revising Critical Theory itself.

The Rationality of Struggle

Against the conservative defense of the established system on the grounds that it represents the unsurpassable facts of life, Critical Theory affirmed long before constructivism that "the facts are *made,* mediated by Subjectivity."[26] The question is who has made them and whose interests do they serve? Posing this question is an exercise in the critical use of reason. It is an instance of what Kant called "Enlightenment," that is, "man's emergence from his self-imposed immaturity."[27] In Kant's day religious leaders were the "guardians" who kept people in ignorance. Today his challenge extends to the technocracy. Critical constructivism understands the politics of the technosystem as a dialectic between official rationality and the informal everyday rationality of protest. Enlightenment means assuming a place in the dialectic.

Kant intended no limits on Enlightenment. Against those who argued that certain classes of people were not "ripe" for freedom, he replied, "We cannot *ripen* to this freedom unless we are already set free—we must be free in order to be able to use our faculties purposely in freedom [and] we never ripen for reason except through our *own* efforts, which

we can make only when we are free."[28] This is the story of struggle in the technosystem.

The instrumentalization theory gives critical constructivism a methodological basis not only for an analysis of devices and systems but also for an approach to understanding normative change in the technosystem. Following Habermas normative validity has been identified with procedural validity, but progress is also measured by the substantive values at issue.

The technosystem is no ordinary object of empirical study. It is the framework of our existence. It is based on a specific conception of life on which we cannot avoid taking a stand, whether consciously and explicitly, as Kant demands, or passively in submission to the uncontested facts.[29] Progress is not technical *or* moral but technical *and* moral. One cannot leap over this dual structure with technical arguments about the conquest of nature or philosophical arguments about rights. In a society based on technical rationality the process of transcendence must itself have a rational structure—it must make sense on technical terms just as technical change must make sense on moral terms.

Early Critical Theory broke with naïve confidence in progress and established normative criteria that neither the capitalist nor the communist worlds could meet. Today we can go beyond that pessimistic conclusion, not to revive the old-fashioned theory of progress but to appreciate instances of progress where they occur. And they do occur. Local progress has had an immense impact on modern societies even as the grand narratives have failed.

Might new grand narratives emerge in the future from the accumulation of progress in so many particular domains? We would then be at the beginning rather than the end of progress. The possibility cannot be excluded; if history is contingent, its contingencies may include a general transformation.[30] But that would presuppose a crisis of advanced capitalism encompassing ideology as well as economics and technology. The Great Recession set off a renewal of the left that makes such a prospect more plausible than at any time since the 1970s. But the limits of the reaction to the crisis and the rapid rise of the right suggest that it will not be easy to return to a grand narrative of progress. Despite all the problems we confront today, it is far from certain that a general crisis would lead to a general advance.

In any case, only a study of actually existing progressive movements

can prepare an adequate understanding of a possible large-scale social change.[31] Replacing the grand narrative with the many local narratives will free the imagination to explore alternatives to both the existing society and the failed revolutions of the past.

Notes

Introduction

1. Charles Thorpe, *Oppenheimer: The Tragic Intellect* (Chicago: University of Chicago Press, 2006), 6.

2. Jean-Baptiste Fressoz, *L'apocalypse Joyeuse: Une Histoire du Risque Technologique* (Paris: Éditions du Seuil, 2012).

3. Barry Commoner, *The Closing Circle: Nature, Man, and Technology* (New York: Knopf, 1971).

4. Although the fullest extent of this change is due to technology, human beings have always been interested in overcoming some aspects of nature even with simple means. This is particularly true of the body.

5. Michel Serres, *Le Contrat Naturel* (Paris: Francois Bourin, 1994), 34.

6. Alain Gras, *Grandeur et dépendance: Sociologie des macro-systèmes techniques* (Paris: Presses Universitaires de France, 1993), 182, 189–191.

7. *The Rio Declaration on Environment and Development* (1992), http://www.unesco.org/education/pdf/RIO_E.PDF.

8. Douglas R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Basic Books, 1979), 10.

9. Louis Antoine de Saint-Just, *L'Esprit de La Révolution* (Paris: UGE, 1963), 39.

10. Hofstadter, *Gödel, Escher, Bach,* 686.

11. F. Scott Fitzgerald, *The Beautiful and the Damned* (New York: Oxford University Press, 2009), epigraph.

12. Robert Leighton, "Escher! Get Your Ass Up Here!," *The New Yorker,* February 4, 2013, 70.

1. Marx after Foucault

1. For extensive discussion confirming this evaluation, see the many articles in Christian Laval, Luca Paltrinieri, and Ferhat Taylan, eds., *Marx & Foucault: Lectures, Usages, Confrontations* (Paris: Éditions la Découverte, 2015). The authors do not underestimate the differences. See, for example, Etienne Balibar's chapter, "L'Anti-Marx de Michel Foucault," 84–102.

2. Georg Lukács, *History and Class Consciousness,* trans. R. Livingstone (Cambridge, MA: MIT Press, 1971), 102; see also 96, 103.

3. Jacques Bidet, *Foucault avec Marx* (Paris: La Fabrique éditions, 2014), 174.

4. Theodor Adorno, *Negative Dialectics,* trans. E. B. Ashton (New York: Seabury Press, 1973), 85.

5. Michel Foucault, *Discipline and Punish: The Birth of the Prison,* trans. A. Sheridan (New York: Pantheon Books, 1977), 27–28.

6. Michel Foucault, "Truth and Power," in *Michel Foucault, Power/Knowledge: Selected Interviews and Other Writings 1972–1977,* ed. C. Gordon, trans. C. Gordon, L. Marshall, J. Mepham, and K. Soper (New York: Pantheon Books, 1980).

7. For a thorough review of Foucault's concept of rationality, see Fabrice de Salies, "L'histoire critique de la raison par Foucault: Comme remise en cause de la rationalité," *Philosophie* 123, no. 3 (2014): 68–97, doi:10.3917/philo.123.0068. For a summary of Weber's conception of modern rationalization, see Rogers Brubaker, *The Limits of Rationality: An Essay on the Social and Moral Thought of Max Weber* (London: George Allen and Unwin, 1984).

8. Engels made much of Rousseau's influence on Marx. For a discussion of the issue see Giovanni della Volpe, *Rousseau and Marx and Other Writings,* trans. J. Fraser (Atlantic Highlands, NJ: Humanities Press, 1979), 86.

9. Andrew Feenberg, *Between Reason and Experience: Essays in Technology and Modernity* (Cambridge, MA: MIT Press, 2010), chap. 8.

10. Michel Foucault, "The Ethic of Care for the Self as a Practice of Freedom: An Interview with Michel Foucault," in *The Final Foucault,* ed. J. Bernauer and D. Rasmussen, trans. J. D. Gauthier (Cambridge, MA: MIT Press, 1988), 16.

11. Jean-Jacques Rousseau, *The First and Second Discourses,* trans. R. D. Masters and Judith R. Masters (New York: Bedford/St. Martin's, 1969), 59.

12. Michael Löwy and Robert Sayre, *Romanticism against the Tide of Modernity,* trans. C. Porter (Durham, NC: Duke University Press, 2001), 35.

13. The risk of regression to which such approaches are exposed is very real: Christian fundamentalists have been able to appeal to science studies in defense of their right to teach "intelligent design" in the schools.

14. Rousseau, *The First and Second Discourses,* 157–160.

15. Karl Marx, *Karl Marx: Early Writings,* ed. and trans. T. Bottomore (London: C. A. Watts, 1963), 121.

16. Jürgen Habermas, "Technology and Science as Ideology," in *Toward a Rational Society: Student Protest, Science, and Politics,* trans. J. J. Shapiro (Boston: Beacon Press, 1970), 97.

17. Michel Foucault, "Les Mailles du Pouvoir," in *Dits et Ecrits II: 1976–1988,* ed. D. Defert and F. Ewald (Paris: Quarto-Gallimard, 2001), 1006.

18. Friedrich Nietzsche, *The Birth of Tragedy and the Genealogy of Morals,* trans. F. Golffing (New York: Anchor, 1956), 209.

19. Michel Foucault, "Nietzsche, Genealogy, History," in *Language, Counter-Memory, Practice: Selected Essays and Interviews,* ed. and trans. D. F. Bouchard (Ithaca, NY: Cornell University Press, 1977), 139, 142.

20. Ibid., 86.

21. Karl Marx, *A Contribution to the Critique of Political Economy,* trans. N. I. Stone (Chicago: Charles H. Kerr, 1904), 293.

22. Karl Marx, "Wage Labor and Capital," in *Karl Marx and Frederick Engels: Selected Works,* by Karl Marx and Friedrich Engels (New York: International Publishers, 1968), 81.

23. John R. Searle, *The Construction of Social Reality* (New York: Free Press, 1995), 9.

24. Marx, "Wage Labor and Capital," 81.

25. Karl Marx and Friedrich Engels, *The German Ideology,* ed. C. J. Arthur (New York: International Publishers, 1972), 14.

26. Lukács, *History and Class Consciousness,* chap. 1.

27. In the period when Foucault was developing his theory, French social thinkers were fascinated by the idea that a system or structure of some sort could provide the paradigm for a science of culture. Claude Lévi-Strauss was the most successful advocate of this approach.

28. Foucault, "Truth and Power," 123.

29. Michel Foucault, "*Onmes et Singulatim:* Toward a Critique of Political Reason," in *Michel Foucault: Power,* ed. J. Faubion, trans. R. Hurley and Others, (New York: The New Press, 2000). See also Carl Death, "Counter-Conducts: A Foucauldian Analysis of Protest," *Social Movement Studies,* vol. 9, no. 3, 235-251, August 2010.

30. Foucault, "The Ethic of Care for the Self," 18; Andrew Feenberg, *Transforming Technology* (New York: Oxford University Press, 2002), chap. 3.

31. Foucault, *Discipline and Punish,* 206–207.

32. Donald Mackenzie, *Knowing Machines* (Cambridge, MA: MIT Press, 1996), chap. 2.

33. Karl Marx, *Capital,* trans. E. Aveling (New York: Modern Library, 1906), 475.

34. Ibid., 47–48.

35. "Formal and Real Subsumption of Labour under Capital. Transitional Forms." *Marx's Economic Manuscripts of 1861-63, Part 3) Relative Surplus Value*, trans. Ben Fowkes, http://www.marxistsfr.org/archive/marx/works/1861/economic/ch37.htm.

36. Andrew Ure, *The Philosophy of Manufactures* (London: Charles Knight, 1835), 18.

37. Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1974).

38. James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, MA: Harvard University Press, 1986).

39. Michel Foucault, "Questions of Method," in *The Foucault Effect: Studies in Governmentality,* eds. and trans. G. Burchell, C. Gordon, and C. Miller (Chicago: University of Chicago Press, 1991), 78–79.

40. I have offered examples of such struggles in several of my books: on medicine and computerization in Andrew Feenberg, *Alternative Modernity* (Berkeley: University of California Press, 1995), chaps. 5 and 7; on educational technology, Feenberg, *Transforming Technology,* chap. 5; on environmentalism, Andrew Feenberg, *Questioning Technology* (New York: Routledge, 1999), chap. 3.

41. Michel Foucault, "Two Lectures," in *Power/Knowledge,* 81–83.

42. Angela Davis, *Are Prisons Obsolete?* (New York: Seven Stories Press, 2003).

43. Michel Callon, Pierre Lascoumes, and Yannick Barthe, *Acting in an Uncertain World: An Essay on Technical Democracy,* trans. Graham Burchell (Cambridge, MA: MIT Press, 2009).

44. I call this exigency of capitalism "operational autonomy." This concept is explained in Feenberg, *Transforming Technology,* chap. 2.

45. Michel Foucault, *Naissance de la Biopolitique* (Paris: Seuil/Gallimard, 2004), 93.

46. "The interlocutory process tying democratic governments and social movements is (by definition) always unfinished. . . . It is no longer a question of opposing reforms to revolution nor revolution to reforms but to make one act within the other, to transform the expressive capacity of the movement into forms of social *governance*." Antonio Negri and Giuseppe Cocco, *GlobAL: Luttes et Biopouvoir à l'Heure de la Mondialisation: Le Cas Exemplaire de l'Amerique Latine,* trans. J. Revel (Paris: Editions Amsterdam, 2007), 211 (my translation). While this passage expresses a position close to mine, critical constructivism has a different understanding of technology and technical struggles. See Matthew Greaves, "The Rethinking of Technology in Class Struggle: Communicative Affirmation and Foreclosure Politics," *Rethinking Marxism: A Journal of Economics, Culture & Society* 27, no. 2 (2015): 195–211.

2. Critical Constructivism

1. In the mid-1980s, when I first worked on the theme of this chapter, the phrase "Critical Theory" was associated with the critique of positivist and technocratic ideology in Marcuse, Habermas, and other members of the Frankfurt School. Today the phrase has no very specific referent, unless capitalized, in which case it still refers to the Frankfurt School. In miniscule it is loosely associated with the critique of these same ideologies and might refer to work derived from the writings of Deleuze and Foucault among others.

2. Should such an invitation be welcomed? One sociologist informed me that STS has no use for philosophy. Of course plenty of scientists and engineers say

the same thing about STS. I think it is time to forget the disciplinary boundary policing and get on with one of the most important conversations of our time.

3. Wiebe E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change,* Inside Technology (Cambridge, MA: MIT Press, 1995), 5.

4. Langdon Winner, "Upon Opening the Black Box and Finding It Empty: Social Constructivism and the Philosophy of Technology," *Science, Technology & Human Values* 18, no. 3 (July 1, 1993): 362–378, doi:10.1177/016224399301800306.

5. Andrew Feenberg, *Critical Theory of Technology* (New York: Oxford University Press, 1991).

6. For criticism within STS of attempts by STS scholars to theorize politics, see, for example, M. B. Brown, "Politicizing Science: Conceptions of Politics in Science and Technology Studies," *Social Studies of Science* 45, no. 1 (February 1, 2015): 3–30, doi:10.1177/0306312714556694; Linda Soneryd, "Technologies of Participation and the Making of Technologized Futures," in *Remaking Participation: Science, Environment and Emergent Publics,* ed. J. Chilvers and M. Kearnes (London: Routledge, 2015), 144–161.

7. Shiela Jasanoff, "The Idiom of Co-Production," in *States of Knowledge: The Co-Production of Science and the Social Order,* ed. S. Jasanoff (New York: Routledge, 2004); Bruno Latour and Peter Weibel, eds., *Making Things Public: Atmospheres of Democracy* (Cambridge, MA: MIT Press, 2005); Brian Wynne, *Rationality and Ritual: Participation and Exclusion in Nuclear Decision-Making* (London: Earthscan, 2011). Latour and Weibel's text is a massive collection of articles and graphics reconceptualizing the political in the light of STS. My contribution to this effort is found at 976–977.

8. Callon, Lascoumes, and Barthe, *Acting in an Uncertain World;* Chilvers and Kearnes, *Remaking Participation;* Jasanoff, "The Idiom of Co-Production."

9. Renato Dagnino, *Neutralidade da Ciência e Determinismo Tecnológico* (Campinas, Brazil: Editora Unicamp, 2008); Pablo Kreimer, Hernán Thomas, Patricia Rossini, and Alberto Lalouf, eds., *Producción y Uso Social de Conocimientos: Estudios Sociales de La Ciencia y la Tecnología en América Latina* (Bernal, Argentina: UNQ, 2004); R. Rajao, R. B. Duque, and R. De', "Introduction: Voices from within and outside the South—Defying STS Epistemologies, Boundaries, and Theories," *Science, Technology & Human Values* 39, no. 6 (November 1, 2014): 767–772, doi:10.1177/0162243914542161.

10. See, for example, Chilvers and Kearnes, *Remaking Participation.*

11. Lukács, *History and Class Consciousness;* see also Andrew Feenberg, *The Philosophy of Praxis: Marx, Lukács and the Frankfurt School* (London: Verso, 2014), chap. 4.

12. *One-Dimensional Man* sold 300,000 copies according to Ronald Aronson, "Marcuse Today," *Boston Review,* November 17, 2014, http://www.bostonreview.net/books-ideas/ronald-aronson-herbert-marcuse-one-dimensional-man-today.

13. Jennifer Karns Alexander, *The Mantra of Efficiency: From Waterwheel to Social Control* (Baltimore: The Johns Hopkins University Press, 2008).

14. Herbert Marcuse, *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society* (Boston: Beacon Press, 1964), 154.

15. Jürgen Habermas, *The Theory of Communicative Action,* 2 vols., trans. T. McCarthy (Boston: Beacon Press, 1984).

16. For my unsuccessful attempt to interest my Critical Theory colleagues in technology, see Feenberg, *Questioning Technology,* chap. 7. What accounts for its exclusion? An outdated limitation of humanistic scholarship? In conversation Habermas told me that he left technology out of *The Theory of Communicative Action* because he knew so little about it. Perhaps, given the intellectual context of the time, he also worried about lending antimodernism support. This is an excusable personal reason for the omission perhaps, but it is less easy to excuse the influential movement of thought he inspired for imitating his limitations. Widening the range of research would have made sense in a time of intense environmental struggle.

17. For an innovative approach to markets as social constructions, see Michel Callon, Madeleine Akrich, Sophie Dubuisson-Quellier, Catherine Grandclément, Antoine Hennion, Bruno Latour, Alexandre Mallard, Cécile Méadel, Fabian Muniesa, and Vololona Rabeharisoa, *Sociologie des Agencements Marchands* (Paris: Presses des Mines, 2013).

18. Trevor Pinch and Wiebe Bijker, "The Social Construction of Facts and Artefacts," in *The Social Construction of Technological Systems,* ed. W. Bijker, T. Hughes, and T. Pinch (Cambridge, MA: MIT Press, 1987), 17–50.

19. Ibid., 42.

20. Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1974); David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York: Knopf, 1977).

21. Theodor Adorno, *Introduction to Sociology,* trans. E. F. N. Jephcott (Cambridge: Polity, 2000), 161–162, n15.

22. For the early debate, see Andrew Pickering, ed., *Science as Practice and Culture* (Chicago: University of Chicago Press, 1992), chaps. 10–12.

23. Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (London: Oxford University Press, 2005), 208.

24. Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 1993).

25. Feenberg, *The Philosophy of Praxis,* chap. 3; Max Horkheimer, "On the Problem of Truth," in *Between Philosophy and Social Science: Selected Early Writings,* ed. and trans. G. F. Hunter, M. S. Kramer, and J. Torpey (Cambridge, MA: MIT Press, 1995).

26. Nelly Oudshoorn and T. J. Pinch, eds., *How Users Matter: The Co-Construction of Users and Technologies* (Cambridge, MA: MIT Press, 2003); Gwen Ottinger and Benjamin R. Cohen, eds., *Technoscience and Environmental Justice: Expert Cultures in a Grassroots Movement* (Cambridge, MA: MIT Press, 2011).

27. In a debate in Maastricht in 2016, Sally Wyatt suggested that I give scientists too much credit for virtue. Having grown up among them, I may be prejudiced, but consider the difference between the impunity of nearly the entire banking community after 2008 and the severe punishment of the few scientists shown

to have faked results in recent years. Surely this signifies a difference in expectations. This is not to deny the erosion of the scientific ethos under the influence of neoliberal funding.

28. For a brief, clear illustration of the significance of the symmetry principle in this case, see Seymour Mauskopf, "A Tale of Two Chemists," *American Scientist* 94, no. 1 (2006): 76, http://www.americanscientist.org/bookshelf/pub/a-tale-of-two-chemists.

29. Feminists within STS were among the first to see the problem with symmetry. See Judy Wajcman, *TechnoFeminism* (Malden, MA: Polity, 2004), 126; See also David Michaels, *Doubt Is Their Product: How Industry's Assault on Science Threatens Your Health* (Oxford: Oxford University Press, 2008); Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury Press, 2010).

30. Harry M. Collins and Trevor J. Pinch, *The Golem: What Everyone Should Know about Science,* 2nd ed. (Cambridge: Cambridge University Press, 1998).

31. Ibid., 55.

32. I engaged in a debate over this claim. See Jeff Kochan, "Feenberg and STS: Counter-Reflections on Bridging the Gap," *Studies in History and Philosophy of Science* 37, no. 4 (December 2006): 702–720, doi:10.1016/j.shpsa.2006.06.001; Andrew Feenberg, "Symmetry, Asymmetry and the Real Possibility of Radical Change: Reply to Kochan," *Studies in History and Philosophy of Science* 37, no. 4 (December 2006): 721–727; Harry Collins and Trevor Pinch, "Who Is to Blame for the Challenger Explosion?," *Studies in History and Philosophy of Science* 38, no. 1 (March 2007): 254–255, doi:10.1016/j.shpsa.2006.12.006.

33. Hans Radder, *In and about the World: Philosophical Studies of Science and Technology* (Albany: State University of New York Press, 1996), 111–112. Latour eventually came to agree that he had gone too far toward a "Machiavellian" affirmation of success. Bruno Latour, *An Inquiry into Modes of Existence: An Anthropology of the Moderns* (Cambridge, MA: Harvard University Press, 2013), 64.

34. Frank Rich, "The Billionaires Bankrolling the Tea Party," *New York Times,* August 28, 2010, 20, http://www.nytimes.com/2010/08/29/opinion/29rich.html?_r=0. Is social constructivism better equipped than ANT to deal with such cases? Indeed, it would seem so since it emphasizes the role of interests and resources in decision making. But in this case, symmetry in the strong sense in which it was initially proposed might play an ambiguous role, equating such "resources" as real scientific knowledge with the well-rewarded pseudoscience of climate change denial. Or, more sensibly, symmetry would play no role at all since there are no serious rational resources on one side of the argument—just propaganda. In that case, it is difficult to see how the constructivist analysis would differ from a conventional political analysis.

35. Bruno Latour, "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts," in *Shaping Technology/Building Society: Studies in Sociotechnical Change,* ed. W. E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 251–252.

36. Feenberg, *Questioning Technology,* 116–119.

37. Alvin Ward Gouldner, *The Coming Crisis of Western Sociology* (New York: Basic Books, 1970), 218–224.

38. Herbert Marcuse, "The Individual in the Great Society," in *Towards a Critical Theory of Society: Collected Papers of Herbert Marcuse,* ed. D. Kellner, vol. 2 (London: Routledge, 2001), 69–74.

39. David J. Hess, *Alternative Pathways in Science and Industry: Activism, Innovation, and the Environment in an Era of Globalization* (Cambridge, MA: MIT Press, 2007), 80–84.

40. Because the concept of agency has been applied to things under the influence of ANT, a preliminary clarification of my use of the term is necessary. I do not intend by "agency" any and every activity, whether of persons or things, that has an impact on a network. I will stick to the usual meaning of political agency as the ability of persons to perform intentional acts of public consequence.

41. Janet Abbate, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999).

42. Callon, Lascoumes, and Barthe, *Acting in an Uncertain World;* Chilvers and Kearnes, *Remaking Participation;* Feenberg, *Questioning Technology,* chap. 5.

43. Harry M. Collins and Robert Evans, "The Third Wave of Science Studies: Studies of Expertise and Experience," *Social Studies of Science* 32, no. 2 (April 1, 2002): 235–296, doi:10.1177/0306312702032002003. Examples of the challenges of design at the interface between engineers and users can be found in Ulrike Felt, Rayvon Fouché, Clark A. Miller, and Laurel Smith-Doerr, eds., *Handbook of Science and Technology Studies* (Cambridge, MA: MIT Press, 2016), chaps. 31 and 17.

44. Bernadette Bensaude-Vincent, *L'Opinion Publique et la Science: à Chacun son Ignorance* (Paris: Éditions la Découverte, 2013); Jean-Baptiste Fressoz, *L'Apocalypse Joyeuse* (Paris: Éditions du Seuil, 2012).

45. Georg Simmel, *The Philosophy of Money,* trans. T. Bottomore and D. Frisby (London: Routledge & Kegan Paul, 1978), 331–354.

46. Commoner, *The Closing Circle.*

47. Ulrich Beck, *Risk Society: Towards a New Modernity,* trans. M. Ritter (Newbury Park, CA: Sage Publications, 1992).

48. Wynne, *Rationality and Ritual.*

49. This new public involvement is not an unmixed blessing. The public makes mistakes too—for example, in the case of the rejection of vaccinations for childhood diseases. But every advance of democracy grants new powers to the "unqualified." Only after the individuals have acquired citizenship are they in a position to engage the learning process that qualifies them to exercise it. Kant already recognized this principle as I explain in the Conclusion of this volume.

50. Andrew Feenberg, "Technoscience at the Fork," in *Continental Philosophy of Science,* ed. Jay Foster (London: Bloomsbury, 2017); Alfred Nordmann, Hans Radder, and Gregor Schiemann, eds., *Science Transformed? Debating Claims of an Epochal Break* (Pittsburgh, PA: University of Pittsburgh Press, 2011).

51. I have developed what I call the "instrumentalization theory" to explain these "double aspects" of technology. See Chapters 6 and 7.

52. For a contemporary example drawn from the field of education, see Edward Hamilton and Andrew Feenberg, "Alternative Rationalisations and Ambivalent Futures: A Critical History of Online Education," in *Reinventing the Internet,* ed. Andrew L. Feenberg and Norm Friesen (Rotterdam: Sense Publishers, 2012), 43–70; Edward Hamilton, *Technology and the Politics of University Reform: The Social Shaping of Online Education* (New York: Palgrave, 2016).

53. Alexander, *The Mantra of Efficiency,* 166–170.

54. Two critical constructivist studies exemplifying this method are Feenberg, *Between Reason and Experience*, chap. 6, and Darryl Cressman, *Building Musical Culture in Nineteenth-Century Amsterdam: The Concertgebouw* (Amsterdam: Amsterdam University Press, 2015).

55. Gilbert Simondon, *Du Mode d'Existence des Objets Techniques* (Paris: Aubier-Montaigne, 1958), chap. 1.

56. Pinch and Bijker, "The Social Construction of Facts and Artefacts," 17–50. This is a point also made in the field of design. See Batya Friedman, Peter H. Kahn, and Alan Borning, "Value Sensitive Design and Information Systems," in *The Handbook of Information and Computer Ethics,* ed. K. E. Himma and H. T. Tavani (Hoboken, NJ: Wiley, 2008), 69–101; Batya Friedman, "Value-Sensitive Design," *Interactions* 3, no. 6 (November–December 1996), https://cseweb.ucsd.edu/~goguen/courses/271/friedman96.pdf.

57. Tiago Moreira, "Health Care Standards and the Politics of Singularities: Shifting In and Out of Context," *Science, Technology & Human Values* 37, no. 4 (2012): 307–331.

58. For further discussion of the dichotomy of caring and curing, see Feenberg, *Alternative Modernity,* chap. 5.

59. For an example of this top-to-bottom approach from my work, see Feenberg, *Between Reason and Experience,* chap. 5.

60. Bensaude-Vincent, *L'Opinion Publique et la Science,* 190–191.

3. Concretizing Simondon and Constructivism

1. Gilbert Simondon, *Du Mode d'Existence des Objets Techniques* (Paris: Aubier-Montaigne, 1958). A collection of Simondon's essays has been translated and published. See Arne De Boever, Alex Murray, Jon Roffe, and Ashley Woodward, eds., *Gilbert Simondon: Being and Technology* (Edinburgh: Edinburgh University Press, 2012). An unpublished translation of MEOT is available as a PDF file at https://english.duke.edu/uploads/assets/Simondon_MEOT_part_1.pdf. *On the Mode of Existence of Technical Objects,* translated by Cécile Malaspina, is scheduled for publication by Univocal Press in 2017.

2. Marcuse, *One-Dimensional Man,* 232–234.

3. Gilbert Simondon, *L'Individuation Psychique et Collective* (Paris: Aubier, 1989), 277–278, my italics. My translations of Simondon's texts throughout.

4. Simondon, *Du Mode d'Existence des Objets Techniques,* 151. Cited in Marcuse, *One-Dimensional Man,* 232.

5. Gilbert Hottois, *Simondon et La Philosophie de La "Culture Technique"* (Brussels: Collection Le Point Philosophique, 1993), 78.

6. Herbert Marcuse, "Ecology and the Critique of Modern Society," in *Philosophy, Psychoanalysis and Emancipation: Collected Papers of Herbert Marcuse,* ed. D. Kellner, vol. 5 (London: Routledge, 2011), 206–213.

7. Bruno Latour, "A Door Must Be Either Open or Shut: A Little Philosophy of Techniques," in *Technology and the Politics of Knowledge,* ed. A. Feenberg and A. Hannay (Bloomington: Indiana University Press, 1995), 272–281.

8. Michael Lynch, *Scientific Practice and Ordinary Action: Ethnomethodology and Social Studies of Science* (Cambridge: Cambridge University Press, 1993).

9. Bruno Latour, *Politiques de La Nature* (Paris: Éditions la Découverte, 1999). I realize this claim is controversial but defending it would require another chapter. As an example of the sort of position I would take in the controversy, consider Yaron Ezrahi, "Nature as Dogma," *American Scientist* 93, no. 1 (January–February 2005), http://www.americanscientist.org/bookshelf/pub/nature-as-dogma.

10. Jason Chilvers and Matthew Kearnes, eds., *Remaking Participation: Science, Environment and Emergent Publics* (London: Routledge, 2015); Callon, Lascoumes, and Barthe, *Acting in an Uncertain World;* Jasanoff, "The Idiom of Co-Production," 1–12.

11. Jean-Hughes Barthelemy, "Sur L'architectonique de *Du Mode d'Existence de l'Objet Technique,*" *Cahiers Simondon,* no. 4 (2012): 106–107. The term épochè was introduced by Edmund Husserl in the context of phenomenology. He suspended the "natural attitude" in order to gain access to the structure of experience. Here I will use the term to refer to various "suspensions" aimed at highlighting aspects of technology that are usually overlooked.

12. Simondon, *Du Mode d'Existence des Objets Techniques,* chap. 1.

13. This term is confusing since Simondon does not mean to contrast the concrete with the conceptually abstract. His terminology, like Marx's, is loosely Hegelian. For Hegel the "concrete" is the synthetic unity of the whole. By contrast, a part interpreted as independent or taken as a synecdoche of the whole would be described as "abstract"; see Georg Wilhelm Friedrich Hegel, "Who Thinks Abstractly," http://www.marxists.org/reference/archive/hegel/works/se/abstract.htm. Simondon gives this distinction a dynamic interpretation to refer to the progress from less to more integrated technological designs.

14. Although Latour rarely refers to the specifics of Simondon's philosophy of technology, it is interesting to note a possible appropriation of the notion of concretization in his comments on a Gaston Lagaffe cartoon. A clever office boy reconciles the need to go in and out of a cat, a seagull, and his boss through successive modifications of a door. This is a "concretizing" strategy reconciling the functional requirements of all in the structure, the door. The door is analyzed as a "mediator" between the members of the office community; see Latour, "A Door Must Be Either Open or Shut," 278.

15. Jacob von Uexküll, *Theoretical Biology* (New York: Harcourt, Brace & Co., 1926).

16. Although he is critical of Shannon's theory of information as signal vs. noise, this example certainly seems to bear the imprint of that theory.

17. "Hylomorphism . . . is a philosophical theory developed by Aristotle, which conceives being (*ousia*) as a compound of matter and form. . . . Aristotle defines X's matter as 'that out of which' X is made. For example, letters are the matter of syllables. Thus, 'matter' is a relative term: an object counts as matter relative to something else. For example, clay is matter relative to a brick because a brick is made of clay, whereas bricks are matter relative to a brick house. Change is analyzed as a material transformation: matter is what undergoes a change of form. For example, consider a lump of bronze that's shaped into a statue. Bronze is the matter, and this matter loses one form (that of a lump) and gains a new form (that of a statue)." *Wikipedia* "Hylomorphism," https://en.wikipedia.org/wiki/Hylomorphism.

18. Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York: Routledge, 1991), chapter 8.

19. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987), 138.

20. Latour, "A Door Must Be Either Open or Shut," 278.

21. Simondon, *L'individuation Psychique et Collective,* 226.

22. Bruno Latour, *We Have Never Been Modern,* trans. C. Porter (Cambridge, MA: Harvard University Press, 1993), 77–78.

23. Herbert Marcuse, *Reason and Revolution: Hegel and the Rise of Social Theory* (Boston: Beacon Press, 1954), 146; Marcuse, "The Concept of Essence," in *Negations: Essays in Critical Theory,* trans. J. J. Shapiro (Boston: Beacon Press, 1968), 81–82.

24. See, for example, Sally Wyatt, "Technological Determinism Is Dead: Long Live Technological Determinism," in *The Handbook of Science and Technology Studies,* ed. E. J. Hackett, Olga Amsterdamska, Michael E. Lynch, and Judy Wajcman (Cambridge, MA: MIT Press, 2008), 165–180; A. Dafoe, "On Technological Determinism: A Typology, Scope Conditions, and a Mechanism," *Science, Technology & Human Values* 40, no. 6 (November 1, 2015): 147–176, doi:10.1177/0162243915579283. While arguing for more sympathetic attention to some forms of determinism, Wyatt notes that "we can no longer afford to be so obtuse in ignoring the justificatory technological determinism of so many actors" (176). This is precisely the strong point of Critical Theory, which has always focused on the ideological deployment of determinism.

25. Simondon, *Du Mode d'Existence des Objets Techniques,* 23–36.

26. Bernard Stiegler, "La Maïeutique de L'objet Comme Organisation de L'inorganique," in *Gilbert Simondon: Une pensée de l'individuation et de la technique,* Bibliothèque du Collège international de philosophie (Paris: Albin Michel, 1994), 249–250. Stiegler compares Simondon with Heidegger rather than STS; see Bernard Stiegler, *La technique et le temps: La faute d'Epiméthée* (Paris: Galilée/Cité des sciences et de l'industrie, 1994).

27. Simondon, *L'individuation Psychique et Collective,* 262–263.

28. Pascal Chabot, *La Philosophie de Simondon* (Paris: Vrin, 2003), 118.

29. Ibid., 73.

30. Barthelemy, "Sur L'architectonique de *Du Mode d'Existence de l'Objet Technique*," 120–126; Bernard Aspe, *Simondon, Politique du Transindividuel* (Paris: Dittmar, 2013), 154–156.

31. Gilbert Simondon, *L'invention Dans Les Techniques: Cours et Conférences* (Paris: Éditions du Seuil, 2005), 312.

32. Ibid., 284.

33. This camera, the Konica Auto Reflex, was reasonably priced and remarkably advanced. For more information, see "Konica Autoreflex," *Wikipedia,* https://en.wikipedia.org/wiki/Konica_Autoreflex.

34. Simondon, *L'invention Dans Les Techniques,* 286–287.

35. Simondon, *L'individuation Psychique et Collective,* 216.

36. Simondon, *Du Mode d'Existence des Objets Techniques,* 146.

37. Ibid., 53.

38. Simon Mills similarly proposes that human beings under specific conditions function as an "associated milieu" in "Concrete Software: Simondon's Mechanology and the Techno-Social," *The Fibreculture Journal,* no. 18 (2011): 206–231. He is critical of what he calls my "humanism" but I cannot see the difference between his approach and my own. More than twenty years ago I wrote, "Human beings are also an operating environment"; see Feenberg, *Critical Theory of Technology,* 194. This is precisely what Mills shows in an interesting analysis of Twitter.

39. Simondon, *L'invention Dans Les Techniques,* 295.

40. For earlier expositions of the theory, see Feenberg, *Transforming Technology,* chap. 7; Feenberg, *Between Reason and Experience,* chap. 1 and 4.

41. Feenberg, *Transforming Technology,* 77–78.

42. Nichole Dusyk, "Constructing and Contesting Clean Energy in British Columbia: The Role of Local Engagement" (unpublished doctoral dissertation, University of British Columbia, 2012), sec. 2.2.2; S. L. Star and J. R. Griesemer, "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39," *Social Studies of Science* 19, no. 3 (August 1, 1989): 387–420, doi:10.1177/030631289019003001. See also Geoffrey C. Bowker, Stefan Timmermans, Adele E. Clarke, and Ellen Balka, eds., *Boundary Objects and Beyond: Working with Leigh Star* (Cambridge, MA: MIT Press, 2016).

43. I realize that such claims are unimaginable at a meeting of the Society for Social Studies of Science, but one need only read a newspaper or listen to political debates on television to see that they are still hegemonic in society at large.

44. Adorno, *Negative Dialectics,* 85; Marcuse, *One-Dimensional Man,* chap. 8.

4. The Internet in Question

1. Christian Fuchs, "Labor in Informational Capitalism and on the Internet," *The Information Society* 26, no. 3 (April 30, 2010): 179–196, 190, doi:10.1080/01972241003712215.

2. Ibid., 192.

3. Christian Fuchs, *Foundations of Critical Media and Information Studies* (New York: Routledge, 2011), 311.

4. Christian Fuchs, "Critique of the Political Economy of Informational Capitalism and Social Media," in *Critique, Social Media and the Information Society,* ed. Christian Fuchs and M. Sandoval (New York: Routledge, 2014), 60–61. Of course politics are the exception on the Internet as they are just about everywhere else except at the meetings of political parties—and even there . . .

5. Fuchs has acknowledged the role of the Internet in social movements in other writings. See, for example, Christian Fuchs, "The Self-Organization of Social Movements," *Systemic Practice and Action Research* 19, no. 1 (2006): 101–137; Fuchs, *Occupy Media! The Occupy Movement and Social Media in Crisis Capitalism* (Winchester, UK: Zero Books, 2014). The unqualified condemnation I document above is thus puzzling. The point is not to attack Fuchs, who has made valuable contributions to the Marxist study of communication, but to consider critically a widely held view of the Internet he has formulated with particular clarity.

6. "Marx's Economic Manuscripts of 1861-63, Part 3) Relative Surplus Value: i) Formal and Real Subsumption of Labour under Capital. Transitional Forms" http://www.marxistsfr.org/archive/marx/works/1861/economic/ch37.htm.

7. Adam Arvidsson and Elanor Colleoni, "Value in Informational Capitalism and on the Internet," *The Information Society* 28, no. 3 (2012): 135–150.

8. Jodi Dean, "Communicative Capitalism: Circulation and the Foreclosure of Politics," *Cultural Politics: An International Journal* 1, no. 1 (2005): 51–74, doi:10.2752/174321905778054845; Dean, *Blog Theory: Feedback and Capture in the Circuits of Drive* (Cambridge: Polity, 2010).

9. Dean, *Blog Theory.*

10. Ibid., 114.

11. Malcolm Gladwell, "Small Change: Why the Revolution Will Not Be Tweeted," *The New Yorker,* October 4, 2010, http://www.newyorker.com/magazine/2010/10/04/small-change-3.

12. Gilles Deleuze, "Postscript on the Societies of Control," *October* 59 (1992): 3–7; Luc Boltanski and Eve Chiapello, *The New Spirit of Capitalism,* trans. G. Elliott (London: Verso, 2007); see also Alexander R. Galloway, *Protocol: How Control Exists after Decentralization* (Cambridge, MA: MIT Press, 2004).

13. For a detailed analysis of debates on several websites, see G. Glass, "Comment Space" (unpublished doctoral dissertation, Simon Fraser University, 2015), http://summit.sfu.ca/item/16120.

14. For examples of the varieties of resistance on the Internet, see Leah A. Lievrouw, *Alternative and Activist New Media* (Cambridge: Polity, 2011).

15. Andrew Feenberg and Maria Bakardjieva, "Virtual Community: No 'Killer Implication,'" *New Media & Society* 6, no. 1 (2004): 37–43, doi:10.1177/1461444804039904.

16. Quoted in Dean, *Blog Theory,* 114.

17. For examples, see Andrew Feenberg and Norm Friesen, eds., *(Re)inventing the Internet: Critical Case Studies* (Boston: Sense, 2012).

18. Christian Sandvig, "The Internet as the Anti-Television: Distribution Infrastructure as Culture and Power," in *Signal Traffic: Critical Studies of Media Infrastructures,* ed. L. Parks and N. Starosielski (Urbana: University of Illinois Press, 2015), 225–245.

19. Ibid., 234–236.

20. Feenberg and Bakardjieva, "Virtual Community."

21. Gilbert Simondon, *Du Mode d'Existence des Objets Techniques* (Paris: Aubier-Montaigne, 1958), chap. 1. As explained in Chapter 3, Simondon's term "concretization" is misleading since he does not mean to contrast the concrete with the conceptually abstract. He defines "concretization" as the merging of several functions in a single structure. This may have a progressive character where new actors are included but not all concretizations are progressive. The concretizations that support the commercial exploitation of the Internet are not progressive.

22. Feenberg, *Between Reason and Experience,* chap. 5.

23. See Jean-Marc Salmon, *29 Jours de Révolution. Histoire du soulèvement tunisien : 17 décembre 2010 – 14 janvier 2011* (Paris, éditions Les Petits matins, 2016). An extract is available at http://www.lenouveleconomiste.fr/a-las-une/29-jours-de-revolution-29388.

24. There are of course email lists but they have significant disadvantages compared to online community. One cannot imagine a social network such as Facebook based on email lists!

25. Dal Young Jin and Andrew Feenberg, "Commodity and Community in Social Networking: Marx and the Monetization of User-Generated Content," *The Information Society Journal,* 31: 52–60, 2015.

26. Andrew Ure, *The Philosophy of Manufactures* (London: Charles Knight, 1835), 18.

27. Jürgen Habermas, *The Structural Transformation of the Public Sphere,* trans. T. Burger (Cambridge, MA: MIT Press, 1991); Lee Salter, "Democracy, New Social Movements, and the Internet: A Habermasian Analysis," in *Cyberactivism: Online Activism in Theory and Practice,* ed. Martha McCaughey and Michael D. Ayers (New York: Routledge, 2003), 117–144.

28. See Robert Gehl and Maria Bakardjieva, eds., *Socialbots and Their Friends: Digital Media and the Automation of Sociality* (New York: Routledge, 2017).

29. Darin Barney, interview by Laureano Ralón, *Figure/Ground,* April 12, 2011, http://figureground.org/interview-with-darin-barney/.

30. Lincoln Dahlberg, "The Internet, Deliberative Democracy, and Power: Radicalizing the Public Sphere," *International Journal of Media and Cultural Politics* 1 (2003): 47–64; Peter Dahlgren, *Democracy in the Digital Age: Challenges to Political Life in Cyberspace* (London: Routledge, 2013).

31. For an early example, see Andrew Feenberg, with CNS staff, "The On-Line Patient Meeting," *Journal of Neurological Sciences* 139 (1996): 129–131.

32. Maria Bakardjieva, "Subactivism: Lifeworld and Politics in the Age of the Internet," in *(Re)Inventing the Internet,* 85–108.

33. Feenberg, *Questioning Technology,* 114–119.

5. Reason and Experience in the Age of the Technosystem

1. Don Ihde, *Technology and the Lifeworld: From Garden to Earth* (Bloomington: Indiana University Press, 1990), 200.

2. Robert B. Pippin, *Hegel's Practical Philosophy: Rational Agency as Ethical Life* (Cambridge: Cambridge University Press, 2008).

3. Georg Lukács, *History and Class Consciousness,* 78.

4. Ibid., 131.

5. Ibid., 131.

6. Adorno, *Negative Dialectics,* 3.

7. See, for example, Hilary Putnam, *The Collapse of the Fact/Value Dichotomy and Other Essays* (Cambridge, MA: Harvard University Press, 2004).

8. Max Horkheimer, *Eclipse of Reason* (New York: Oxford University Press, 1947).

9. Herbert Marcuse, "De l'Ontologie à la Technologie: Les Tendances de la Société Industrielle," *Arguments* 18 (1960): 54–59.

10. Herbert Marcuse, "From Ontology to Technology," in *Philosophy, Psychoanalysis and Emancipation,* 136–137.

11. Simondon, *Du Mode d'Existence des Objets Techniques*, 239.

12. Marcuse, *One-Dimensional Man,* 153.

13. Quoted in Marcuse, *One-Dimensional Man,* 153–154.

14. Ibid., 108.

15. Ibid., 231–232.

16. Theodor Adorno, "The Actuality of Philosophy," in *The Adorno Reader,* ed. Brian O'Connor (Oxford: Blackwell, 2000), 37. I follow here Shierry Weber Nicholsen's translation of *exacte Phantasie* in *Exact Imagination, Late Work: On Adorno's Aesthetics* (Cambridge, MA: MIT Press, 1997), 4n9.

17. Nikolas Kompridis, *Critique and Disclosure: Critical Theory between Past and Future* (Cambridge, MA: MIT Press, 2006), 203; see also Andrew Feenberg, "Lukács's Theory of Reification and Contemporary Social Movements," *Rethinking Marxism* 27, no. 4 (October 2015): 490–507.

18. Herbert Marcuse, *An Essay on Liberation* (Boston: Beacon Press, 1969).

19. Herbert Marcuse, "Beyond One-Dimensional Man," in *Towards a Critical Theory of Society,* 117–118.

20. Ian H. Angus, *Technique and Enlightenment: Limits of Instrumental Reason* (Lanham, MD: University Press of America, 1984).

21. Ibid., 11.

22. Ibid., 54.

23. Ibid., 13.

24. For the relation of Arendt to Critical Theory, see Lars Rensmann and Samir Gandesha, eds., *Arendt and Adorno: Political and Philosophical Investigations* (Stanford, CA: Stanford University Press, 2012), especially chap. 1.

25. Angus, *Technique and Enlightenment,* 100.

26. Ibid., 120.

27. Ibid., 121.

28. Ibid., 139.

29. To be perfectly clear, this is a sociological concept of rationality, not an epistemological concept. Weber, not Frege. Judgments of rationality and irrationality are socially situated. "A thing is never irrational in itself, but only from a particular rational point of view." Max Weber, *The Protestant Ethic and the Spirit of Capitalism,* trans. T. Parsons (New York: Scribners, 1958), 194n9.

30. It is beyond the scope of this book to elaborate a theory of the moral foundations of such progressive changes in the technosystem, and in any case despite all efforts to avoid it, theories of justice suffer the same fate as the many worldviews that compete for hegemony in the public sphere. Experience shows that there is no "inviolate level" of "rights" transcending all disagreement at the level of the "good."

6. The Concept of Function in Critical Constructivism

1. "ICE" refers to a combination of intentional, causal, and evolutionary function theories. Wybo Houkes and Pieter E. Vermaas, *Technical Functions: On the Use and Design of Artefacts,* Philosophy of Engineering and Technology, vol. 1 (New York: Springer, 2010); M. Franssen, P. Vermaas, P. Kroes, and A. W. M. Meijers, eds., *Philosophy of Technology: After the Empirical Turn* (Berlin: Springer Verlag, 2016). For another important synthesis of a wide range of literature on function, see Beth Preston, "Why Is a Wing Like a Spoon? A Pluralist Theory of Function," *Journal of Philosophy* 95, no. 5 (1998): 215–254.

2. Houkes and Vermaas, *Technical Functions,* 11–12.

3. Andrew Feenberg, "Transition or Convergence: Communism and the Paradox of Development," in *Technology and Communist Culture: The Socio-Cultural Impact of Technology under Socialism,* ed. F. Fleron (New York: Praeger, 1977), 114.

4. Feenberg, *Critical Theory of Technology,* 78, 83; Feenberg, "Subversive Rationalization: Technology, Power, and Democracy," *Inquiry* 35, nos. 3/4 (1992): 311.

5. Ted Cavanagh worked out a useful example of the application of the theory to building construction. The terms of the theory at that time were somewhat different. I called *causality* and *culture* "primary" and "secondary" instrumentalization in earlier versions. This led to confusion between secondary instrumentalization and processes of reinvention or creative appropriation which occur after the technical artifact is released on the public, whereas my intent was to describe complementary aspects of all designing. See Ted Cavanagh, "Diverse Designing: Sorting Out Function and Intention in Artifacts," in *Philosophy and Design: From Engineering to Architecture,* ed. P. E. Vermaas, Peter Kroes, Andrew Light, and Steven Moore (Dordrecht, Netherlands: Springer, 2009), 301–315.

6. Here, as with Simondon, the influence of Uexküll is apparent.

7. The principal discussion of tools is in Martin Heidegger, *Being and Time,* trans. J. MacQuarrie and E. Robinson (New York: Harper & Row, 1962), pt. 1, sec. III. The distinction in world relations is developed at length in Martin

Heidegger, *The Fundamental Concepts of Metaphysics: World, Finitude, Solitude,* trans. W. A. MacNeill and N. Walker (Bloomington: Indiana University Press, 1995), pt. 2, chap. 3.

8. Heidegger, *The Fundamental Concepts of Metaphysics,* 215.

9. Ibid., 199.

10. Heidegger, *Being and Time,* 98.

11. Steven Galt Crowell, *Normativity and Phenomenology in Husserl and Heidegger* (Cambridge: Cambridge University Press, 2013), 28–30.

12. Heidegger, *Being and Time,* 100–101.

13. Martin Heidegger, *Aristotle's Metaphysics 1–3: On the Essence and Actuality of Force,* trans. W. Brogan and P. Warnek (Bloomington: Indiana University Press, 1995).

14. Ibid., 74.

15. Martin Heidegger, *The Question Concerning Technology, and Other Essays,* trans. H. B. Lovitt (New York: Harper & Row, 1977).

16. Michael E. Zimmerman, *Heidegger's Confrontation with Modernity: Technology, Politics, Art* (Bloomington: Indiana University Press, 1990), 212.

17. Martin Heidegger, *Hölderlin's Hymn 'The Ister,'* trans. W. McNeill and J. Davis (Bloomington: Indiana University Press, 1996), 4.

18. Heidegger, *The Question Concerning Technology, and Other Essays,* 136.

19. Ibid., 16.

20. Albert Borgmann, *Technology and the Character of Contemporary Life* (Chicago: University of Chicago Press, 1984), 105.

21. Gernot Böhme, *Invasive Technification: Critical Essays in the Philosophy of Technology,* trans. C. Shingleton (London: Bloomsbury Press, 2012), 194.

22. Maurice Merleau-Ponty, *Les Aventures de La Dialectique* (Paris: Gallimard, 1955). For a comparison of Heidegger and Lukács, see Franck Fischbach, *La privation de monde: Temps, espace et capital* (Paris: Vrin, 2011), chap. 3.

23. Lukács, *History and Class Consciousness,* 97, 236.

24. Ibid., 131.

25. But don't scientists engage in technical manipulations as experimenters in the discovery of the laws of nature? Of course, but their activity does not freely create the laws they discover, but on the contrary aims to constrain their choices. Even admitting that the kind of object science takes for nature is determined in part by theory and experimental design, that is a quasi-transcendental determination quite different from the empirically verifiable effect of specific activities human beings can voluntarily take up or abandon in the pursuit of their individual or collective interests.

26. Feenberg, *The Philosophy of Praxis*, Chapter 4.

27. Francis Bacon, "Aphorisms Concerning the Interpretation of Nature and the Kingdom of Man," in *The English Philosophers from Bacon to Mill,* ed. E. A. Burtt (New York: Modern Library, 1939), 28.

28. Lukács, *History and Class Consciousness,* 83, 98.

29. Ibid., 6.

30. Ibid., 99–100; see also Richard Westerman, "The Reification of Consciousness: Husserl's Phenomenology in Lukács's Identical Subject-Object," *New German Critique* 37, no. 3 (Fall 2010): 119.

31. Heidegger, *Being and Time,* 345.

32. Herbert Marcuse, "Contributions to a Phenomenology of Historical Materialism," in *Heideggerian Marxism,* ed. R. Wolin and J. Abromeit, trans. E. Oberle (Lincoln: University of Nebraska Press, 2005), 31–32; Marcuse, *One-Dimensional Man,* 228, 239–240; Andrew Feenberg, *Heidegger and Marcuse: The Catastrophe and Redemption of History* (New York: Routledge, 2005), chap. 5.

33. For an early exposition, see Feenberg, *Transforming Technology,* chap. 7. For a more recent short exposition with examples, see Sara M. Grimes and Andrew Feenberg, "Critical Theory of Technology," in *The Sage Handbook of Digital Technology Research,* ed. Sara Price, Carey Jewitt, and Barry Brown (London: Sage, 2013), 121–129.

34. Gilbert Simondon has written an important article on the technical mentality, but he mistakes the cultural level of the technical artifact for a distraction from an imagined pure technique. See Gilbert Simondon, "Technical Mentality," trans. Arne De Boever, *Parrhesia* 7 (2009): 7–27.

35. This is the theme of Bernard Stiegler's important work on technology and time. See *La technique et le temps: La faute d'Epiméthée* (Paris: Galilée/Cité des Sciences et de l'Industrie, 1994).

36. I respond here to Paul Thompson suggestive paper, "Commodification and Secondary Rationalization" in *Democratizing Technology: Andrew Feenberg's Critical Theory of Technology*, ed. T. Veak. (Albany: SUNY Press, 2006).

7. The Logic of Protest

1. Jürgen Habermas, "Technology and Science as Ideology," in *Toward a Rational Society: Student Protest, Science, and Politics,* trans. J. J. Shapiro (Boston: Beacon Press, 1970).

2. Kant refers to those who exercise public reason as "scholars" but in my usage it will refer to everyone engaged in public debate. This usage it should be noted is different from Rawls's rather restrictive definition of the same term. Immanuel Kant, "What Is Enlightenment?," *Kant on History,* ed. L. W. Beck, trans. L. W. Beck, R. Anchor, and E. Fackenheim (Indianapolis, IN: Bobbs-Merrill, 1963), 5.

3. Aristotle, *The Art of Rhetoric,* trans. H. C. Lawson-Tancred (New York: Penguin Books, 1991), 74.

4. Ibid., 79.

5. Albena Azmanova, *The Scandal of Reason: A Critical Theory of Political Judgment* (New York: Columbia University Press, 2012); see also Ronald Beiner, *Political Judgment* (Chicago: University of Chicago Press, 1983), 141–143. In earlier work on online education, Cindy Xin and I introduced a similar concept of "common ground," the tacit assumptions and beliefs shared by adversaries in discussion which make communication between them possible. Cindy

Xin and Andrew Feenberg, "Pedagogy in Cyberspace: The Dynamics of Online Discourse," *Journal of Distance Education* 21, no. 2 (2007): 1–25, doi:10.2304/elea.2007.4.4.415.

6. Immanuel Kant, *Critique of Judgment,* trans. W. Pluhar (Indianapolis, IN: Hackett, 1987), 18–19.

7. Steve Woolgar and Daniel Neyland, *Mundane Governance: Ontology and Accountability* (Oxford: Oxford University Press, 2013).

8. Azmanova, *The Scandal of Reason,* 9.

9. Hannah Arendt, *Lectures on Kant's Political Philosophy* (Chicago: University of Chicago Press, 1982); see also Beiner, *Political Judgment;* Ronald Beiner and Jennifer Nedelsky, *Judgment, Imagination, and Politics* (Lanham, MD: Rowman and Littlefield, 2001); Alessandro Ferrara, *The Force of the Example: Explorations in the Paradigm of Judgment* (New York: Columbia University Press, 2008).

10. Alessandro Ferrara, *Justice and Judgment: The Rise and Prospect of the Judgment Model in Contemporary Political Philosophy* (London: Sage Publications, 1999), 7.

11. Hannah Arendt, *The Human Condition* (Chicago: The University of Chicago Press, 1958), 52.

12. Ferrara, *The Force of the Example,* 72–75.

13. Azmanova, *The Scandal of Reason,* 167. In a private communication, Alessandro Ferrara suggests an alternative interpretation in terms of his concept of "oriented reflective judgment" (Ferrara, *Force of the Example,* 75). His elaboration of this concept refers to normative principles such as equal rights which can orient without determining reflective judgments. Perhaps the concept can be generalized to cover less morally charged categories such as those to which I refer here.

14. For examples from environmental justice struggles, see Gwen Ottinger and Benjamin R. Cohen, eds., *Technoscience and Environmental Justice: Expert Cultures in a Grassroots Movement* (Cambridge, MA: MIT Press, 2011).

15. For the relation of logical categories such as consistency to actions, see Roy Edgley, *Reason in Theory and Practice* (London: Hutchinson University Library, 1969), 112–113.

16. Jacques Rancière, *Aux Bords du Politique* (Paris: Gallimard, 1998), 84–95.

17. Article 1 reads, "Les Français sont égaux devant la loi, quels que soient d'ailleurs leurs titres et leurs rangs." http://www.conseil-constitutionnel.fr/conseil-constitutionnel/francais/la-constitution/les-constitutions-de-la-france/charte-constitutionnelle-du-14-aout-1830.5104.html.

18. Albena Azmanova, "Social Harm, Political Judgment, and the Pragmatics of Justification," in *Philosophical Dimensions of Human Rights,* ed. C. Corradetti (Dordrecht, Netherlands: Springer, 2012), 117. I realize these are contested propositions and of course Azmanova defends them at length in her article and book. However, regardless of the outcome of the debate she has initiated, her stance is useful for my purpose. Once again, I am *not* trying to establish a theory of justice. Under the given historical circumstances, it is methodologically

important to validate protest from below in the face of technocratic dogmatism. This could change should antiscientific notions become so widespread as to contaminate most public interventions, but this is not the case at this time.

19. Ibid., 116.

20. Antonio Gramsci, *The Modern Prince,* trans. L. Marks (New York: International Publishers, 1959), 40.

21. Lily Hoffman, *The Politics of Knowledge: Activist Movements in Medicine and Planning* (Albany: State University of New York Press, 1989).

22. Cited in Andrew Feenberg and Jim Freedman, *When Poetry Ruled the Streets: The French May Events of 1968* (Albany: State University of New York Press, 2001), 96–97, my translation. For the original consult http://edocs.lib.sfu.ca/cgi-bin/Mai68?Display=971, image 13-14.

23. Bijker, *Of Bicycles, Bakelites, and Bulbs,* 4–5. For a discussion of the earlier tradition of science protest, see David King and Les Levidow, "Introduction: Contesting Science and Technology, from the 1970s to the Present," *Science as Culture* 25, no. 3 (2016): 367–372.

24. Azmanova, *The Scandal of Reason,* 184–185.

25. Ibid., 168. This is what I call "culture" in this book, in contrast with the communitarian definition.

26. John Kaag, "Continuity and Inheritance: Kant's *Critique of Judgment* and the Work of C. S. Peirce," *Transactions of the Charles S. Peirce Society* 41, no. 3 (2005): 515–540.

27. Charles Sanders Peirce, *The Collected Papers of Charles Sanders Peirce,* ed. C. Hartshorne, P. Weiss, and A. Burks (Cambridge, MA: Harvard University Press, 1931), 5, 189.

28. Charles Spinosa, Fernando Flores, and Hubert L Dreyfus, *Disclosing New Worlds: Entrepreneurship, Democratic Action, and the Cultivation of Solidarity* (Cambridge, MA: MIT Press, 1997), chap. 1. For more on this interesting book see Feenberg, *Between Reason and Experience,* 148–149.

29. Heidegger's notion of authentic action as liberation from the tyranny of *das Man* would have had a similar aspect if he had applied it to the technical world of *Being and Time* instead of mythologizing historical action. Marcuse's early *Heidegger-Marxismus* and his later writings go some way toward a technical conception of authenticity, although he would not have used that term after 1933. See Feenberg, *Heidegger and Marcuse,* Chapter 7.

30. Michel de Certeau, *The Practice of Everyday Life,* trans. S. Rendall (Berkeley: University of California Press, 1984), xx.

31. In 1980, de Certeau and I organized two conferences on "The Rhetorics of Technology" at the University of Wisconsin–Milwaukee and the University of Urbino.

32. Aristotle, *Rhetoric,* chap. 2.22.

33. Ibid., chap. 2.23.

34. Karl Marx, "The Critique of Hegel's Philosophy of Right," in *Early Writings,* ed. and trans. T. B. Bottomore (London: C. A. Watts and Co., 1963), 43, 52.

35. de Certeau, *The Practice of Everyday Life,* 26.

Conclusion

1. For an example of such translation, see Adam Branch and Zachariah Mampilly, *Africa Uprising: Popular Protest and Political Change* (London: Zed Books, 2015).

2. Dean Nicholas, "Zhou Enlai's Famous Saying Debunked," *History Today,* June 15, 2011, http://www.historytoday.com/blog/news-blog/dean-nicholas/zhou-enlais-famous-saying-debunked. The article explains that in fact the reference may have been to the May Events of 1968, but the story as originally told is too good to dismiss.

3. Jean François Lyotard, *The Postmodern Condition: A Report on Knowledge,* trans. G. Bennington and B. Massumi (Minneapolis: University of Minnesota Press, 1991).

4. Adorno, *Negative Dialectics,* 85.

5. Amy Allen, *The End of Progress* (New York: Columbia University Press, 2016), 131.

6. Foucault, "Truth and Power," 131.

7. Allen, *The End of Progress*, 10–11.

8. Latour, *We Have Never Been Modern.*

9. David Ingram, *Habermas: Introduction and Analysis* (Ithaca, NY: Cornell University Press, 2010), 262–264.

10. I do not aim here at an evaluation of the adequacy of Allen's criticisms of these philosophers but rather work through her argument in terms of my own approach to related issues. In a private communication David Ingram suggests a different interpretation according to which Habermas and Honneth, at least in recent years, argue for a "positive hermeneutical cycle of critical reflection that can expose some of these effects [of power] so that theory is in a continual process of self-correction without ever achieving a status of pure rationality. So they emphatically do not hold norm and fact separate." On these terms Honneth grounds norms on a critical relation to *Sittlichkeit* and his understanding "could easily be fleshed out in terms of a techno-systemic account of embedded practical reason."

11. Allen, *The End of Progress,* 106. Allen admits that Honneth invokes a genealogy of the circumstances under which reconstruction of the norms occurs, but she says he views this approach as exclusively negative, relevant only to practical failures to realize the norms. So the norms themselves still seem independent of the social context.

12. The importance of the issue is not in question; however, I do not believe discourse ethics has the resources to get to the bottom of it. Decentering worldviews that justify discrimination is important, but the psychic mechanisms of scapegoating that underlie hatred of homosexuals and others who are "different" are not explained by simple adherence to regressive beliefs.

13. Allen, *The End of Progress,* 88.

14. Ibid., 150.

15. Azmanova, *The Scandal of Reason,* 224. Critical constructivism makes a similar argument in relation to the organizations of the technosystem such as cor-

porations. "If the self-understanding of groups articulates their actions, we can show the normative role of technique by reversing the terms of delegation theory and introducing it into the account of organizational consensus. . . . Once a device is successfully installed, the prescriptions it bears can be raised to consciousness as the concrete content of the normative consensus underlying the organization" (Feenberg, *Alternative Modernity,* 91).

16. For a confrontation of a similar viewpoint with Hegel and Heidegger's theories of modernity, see David Kolb, *The Critique of Pure Modernity: Hegel, Heidegger, and After* (Chicago: University of Chicago Press, 1986), especially chap. 12.

17. This was Barry Commoner's argument in *The Closing Circle* (New York: Bantam, 1971). Surprisingly, his contribution appears to be largely forgotten, although today his once controversial position is now common sense. See Feenberg, *Questioning Technology,* chap. 3.

18. Commenting on the theory of Jacques Ellul, Langdon Winner called this "reverse adaptation." See Langdon Winner, *Autonomous Technology: Technics-Out-of-Control as a Theme in Political Thought* (Cambridge, MA: MIT Press, 1977), 233–234.

19. See, e.g., Ana Paula de Moura Varanda and Pedro Claudio Cunca Bocayuva, *Tecnologia Social, Autogestão e Economia Solidária* (Rio de Janeiro: FASE, 2009); Ron Eglash, Jennifer Croissant, Giovanna de Chiro, and Rayvon Fouché, eds., *Appropriating Technology* (Minneapolis: University of Minnesota Press, 2004), pt. 3.

20. Feenberg, *Between Reason and Experience,* chap. 6; Feenberg, *Alternative Modernity,* chaps. 8–9.

21. This is also the case with Seyla Benhabib, *Critique, Norm, and Utopia: A Study of the Foundations of Critical Theory* (New York: Columbia University Press, 1986).

22. Ingram, *Habermas*, 324. For a thorough critique of several aspects of Habermas's formalism, see 175–191, 253–265.

23. Andrew Feenberg, "Why Students of the Frankfurt School Will Have to Read Lukács," in *Handbook for Critical Theory,* ed. M. Thompson (New York: Palgrave, 2016).

24. Marcuse, *One-Dimensional Man,* 233–234.

25. The concept of "complementarity" of interpretation and explanation proposed by Carl Otto Apel can be given social content to cover this notion of multiple rationalities. See Feenberg, *Between Reason and Experience,* 211–214.

26. Herbert Marcuse, "The Problem of Social Change in the Technological Society," in *Herbert Marcuse—Towards a Critical Theory of Society: Collected Papers of Herbert Marcuse,* ed. D. Kellner, vol. 2 (London: Routledge, 2001), 55.

27. Kant, "What Is Enlightenment?," 1.

28. Quoted in Hannah Arendt, *Lectures on Kant's Political Philosophy* (Chicago: University of Chicago Press, 1982), 48. The source is Immanual Kant, *Religion within the Limits of Reason Alone,* trans. T. M. Greene and H. H. Hudson (New York: Harper Torchbooks, 1960), 176–177 (note).

29. For a persuasive argument for the relation between contemporary existence and technology, see Albert Borgmann, *Technology and the Character of Contemporary Life* (Chicago: University of Chicago Press, 1984).

30. Perhaps this is an adequate response to the claim that what Lyotard calls "post-modernity" and Allen calls "the end of progress" is just another grand narrative and so contradicts their own premises.

31. Might such a change be called "socialist"? I have formulated some ideas about what that would mean from a critical constructivist standpoint. See Feenberg, *Transforming Technology*, chap. 6.

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