



PHILOSOPHY OF TECHNOLOGY

THE TECHNOLOGICAL CONDITION
AN ANTHOLOGY • SECOND EDITION

EDITED BY ROBERT C. SCHARFF AND VAL DUSEK

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Philosophy of Technology

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Philosophy of Technology

*The Technological Condition:
An Anthology*

Second Edition

Edited by

Robert C. Scharff
Val Dusek

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Introduction to the Second Edition

The first edition of this collection grew out of the editors' experienced needs as teachers of the philosophy of technology. Since its appearance, schools of thought and lines of research have started to differentiate themselves more clearly in this young field, new problems have been identified, and older ones reconceived. Our second edition takes many of these developments into account. Yet in certain basic ways, the original design of our anthology still seems right to us. Although the number of well-stocked anthologies has grown, we continue to believe that our collection best addresses two unfortunately common philosophical lacunae. First, most anthologies contain very little material from classical sources (e.g., Aristotle, Bacon, Kant, Comte, Marx) in terms of which technology, or basic concepts that contribute to our current ways of conceiving technological practices, are already discussed. Second, in many cases, the main focus is on specific technological issues and case studies, with the result – truth be told – that the selections are sometimes philosophically thin. In our view, especially when it comes to the philosophical consideration of technology, structuring an anthology after the familiar model of the applied ethics reader is likely to have unfortunate pedagogical consequences. In the typical application of this model, one starts with familiar, extra-philosophically identifiable “problems,” samples the variety of “values” or “criteria” in terms of which it has been claimed these problems can be handled, and then more or less leaves it up to the instructor to explain how philosophy somehow gets involved in testing the selection and “justification” of these values or criteria.

Regarding the philosophy of technology, however, we believe that this model gets things strategically back-

wards in important ways. One unintended consequence of its use is that it can leave students, especially those who have not had much previous exposure to philosophy, with the impression that philosophy mostly happens at the level of a “debate” among a smorgasbord of competing sets of values that themselves are somehow simply found, or “given” as logical or sociological options. This serves to confirm the popular non-philosophical conception of philosophy as a “belief system” that one already has or can pick out and thereafter “defend.” The whole idea of philosophy as a process of inquiry, or as critical self-discovery, or as involving a reflective struggle with inherited orientations, is thus muted or occluded. Moreover, as some of the authors below complain, the problems-model also has the effect of privileging one very familiar but perhaps not so innocent outlook regarding technological problems – namely, the idea that technology itself is not a problem, that it simply provides us with a collection of instrumental means, and that the main task is to decide what ends it should serve. To a significant number of philosophers of technology, this allegedly “neutral” interpretation of technology should itself be identified as a topic to be carefully questioned.

The second gap we have found in the available texts is a widespread failure to consider the question of the relation between contemporary technology and modern science. As pressing and immediate as the issues of, say, technology transfer, medical patients' rights, informatics, and biotechnology clearly are, debates that stay at the level of these issues often silently perpetuate long-standing, deeply held, but now hotly contested assumptions about the nature of science, about the technological applications of science, and even about the proper place of science and technology within the larger scope

of human affairs. For example, is knowledge essentially connected to a drive for power, as Bacon claimed and Foucault still insists? Is technology primarily to be understood as “applied modern science,” or is the ancient human concern for “making” already implicated in the very development of science itself, as (in very different ways) Comte, Marx, Heidegger, Mumford, Arendt, and various sorts of pragmatists maintain? And should we expect, or do we even have a choice about, technological practices increasingly coming to define the nature and axiological direction of human life? Such questions simply cannot be addressed adequately if they are permitted to arise only between the lines of selections focused primarily on issues of how to control, modify, or conceptually clarify this or that specific political, ethical, aesthetic, or engineering problem.

With these concerns in mind, then, we have structured our revised anthology as we did the original – in a way that, with or without sharing our reasoning above, instructors have the option of making historical, metaphysical, and epistemological issues just as prominent as ethical, political, aesthetic, and engineering problems. Because we envision this text as useful for anything from introductory undergraduate courses to graduate seminars, our selections vary considerably in length and difficulty, and we have elected to place most of our introductory material at the beginning of the sections rather than all together in one opening essay. Here, we confine ourselves to a brief explanation of the general plan of the six main parts of the text.

The purpose of Part I is to provide a forum for some familiar voices in the Western philosophical tradition whose views about the relation between knowledge and its applications have played an important role in setting up the inherited context within which contemporary philosophy of technology takes its bearings. Our selections were made in a way that is also designed to encourage consideration of the question of why – in comparison to other philosophical topics – a philosophy specifically of technology is so relatively recent in origin.

Part II contains contemporary readings that especially emphasize and critically assess the basic assumptions handed down to us from the nineteenth century about science, the relation between modern science and technology, and philosophy’s proper treatment of both. We have divided this part into two sections. The first section provides a kind of mini-history of the rise and decline of logical positivist, or Vienna Circle, philosophy of science, together with the emergence of various

postpositivist criticisms and alternatives. Our intention is to highlight the ways in which these alternatives all tend to stress the importance of precisely the social, cultural, and historical context of scientific practice that positivistic philosophy of science urges us to ignore. The readings in second section illustrate how stressing or ignoring this context directly affects how one conceives the nature of and the relation between the philosophies of science and of technology.

The readings in Part III illustrate what issues are at stake in trying to define technology, how unsettled and pluralistic are today’s attempts to do so, and the extent to which many recent efforts to define technology still tend, sometimes in spite of themselves, to reflect older, more traditional assumptions about what science is and how philosophy should approach it. In addition, these selections make it plain that, whether deliberately or unintentionally, efforts to define technology tend to take a stand on two controversial topics – namely, whether and how modern science has transformed “prescientific” technologies, and whether technology is essentially “applied science.”

Part IV reprints Martin Heidegger’s essay, “The Question Concerning Technology,” and a sampling of responses to it. Heidegger’s essay presents what is probably the single most influential – though by no means most popular – position in the field. Many of the issues discussed in the sections that follow, especially in Part VI, are framed in a way that reflects some species of agreement or disagreement with his views.

In Part V, the readings raise a cluster of general issues concerning technology’s proper role in mediating our relations with the natural world. One section considers the question of whether human beings are essentially just “tool-users” and thus most themselves when they are engaged in technological activities. A second section raises the issue of whether, as some writers have argued, the influence of technology in our lives is so strong and pervasive that it actually functions as a virtually autonomous force and makes all optimistic talk of “controlling” it seem naïve. The essays in the third section bring the issues of human nature and technological power together in relation to the widely debated ecological question of the legitimacy of the famous (or perhaps infamous and even male-gendered) Baconian imperative that encourages us to think of “knowledge” primarily as giving us the power to control our natural surroundings.

Part VI focuses on issues that arise when technology is viewed, not so much as an expression of human nature

or as an instrument for controlling nature, but rather as defining a specific and (at least in the so-called “developed” parts of the world) increasingly dominant kind of sociocultural practice. The essays in the first section all ask, in the words of one of the authors, what it is like to “be-with” technology, such that it mediates most of our relations not just with nature but also among ourselves. In “Technology and Cyberspace,” the second section, several authors consider the puzzling issue of whether the computer revolution promises to alter, like it or not, our basic notions of who we are, what a “mind” or “consciousness” is, and what it is to experience “reality.” A third section brings into focus a question implicit in numerous other readings, namely, what are the ramifications for the future of political democracy of our ever more predominantly technological forms of social practice?

Finally, we add a note of grateful acknowledgment. We would like to express our thanks to the publishers and other copyright holders who gave us reprint permission, and to the virtual army of persons who have encouraged and advised us in putting both the original and this revised text together. Among them are (with apologies to those we have inadvertently omitted) Thomas Achen, Babette Babich, Robert Crease, Fred Dallmayr, Jan Kyrre Berg

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Part I

The Historical Background

Introduction

At first glance, it may seem surprising that until recently, philosophers have not devoted much time to the question of technology. One might have thought that greater attention would at least have come to be paid to this phenomenon in the modern period when advances in natural and biological science increasingly and obviously made technology a central and dominant feature of society and culture. Yet the fact is that even today – in the North American and British mainstream of analytic philosophy and to a lesser extent among those influenced by late nineteenth- and twentieth-century postpositivist and Continental European sources – the philosophy of technology is still widely regarded as not much more than a small and not particularly prestigious area of specialization.

In part, the reasons for this secondary status for the philosophy of technology are reflected in the general features of modern intellectual history. In the Anglo-American empiricist, French Enlightenment, and European positivist traditions, technology is widely depicted as an unproblematically beneficial force for human progress. For these traditions, technology needs only the proper association with modern science to fulfill its promise; hence the genuinely philosophical issues lie primarily in the epistemology of science, which explains how genuine knowledge is to be obtained, and in ethics, which determines what that knowledge is for. With epistemology and ethics thus focused on the two central issues of what we can know and what we should do, technology falls through the cracks, understood as just the relatively neutral means for employing scientific

knowledge to bring about the ideal relations in the natural and social world that ethical decisions prescribe. It is true that for the Romantic and post-Hegelian “Continental” traditions, this judgment must be qualified slightly, for in these traditions there is less inclination to conceive all knowledge according to the model of science or to conceive of science as an essentially progressive force. Yet science itself (especially natural science) is just as often viewed by them also in strictly instrumentalist terms, and technology is widely understood as simply applied science – with the difference being that the cultural implications of all this are more likely to be conceived in critical and pessimistic terms, not in the progressive or even utopian terms characteristic of the empiricist and positivist traditions.

To fully understand the philosophical neglect of technology, however, one must go back to ancient Greek thought and to the manner in which figures like Plato and Aristotle drew their distinctions between theoretical and practical understanding. There is no question, of course, that the ancients took the distinction seriously. It is known, for instance, that Plato’s teacher, Socrates (c.470–399 BCE), often discussed this distinction. He insisted that the “craft” knowledge of farmers, shoemakers, and bakers, as well as physicians, is genuine knowledge. Socrates’ point, however, is one of criticism rather than defense. Craft knowledge consists primarily in a kind of technical understanding, limited to its concern with the pursuit of particular trades or practices. Unfortunately, those who possess such knowledge (and especially those

who achieve worldly success because of it) are often misled into thinking they possess wisdom about life in general. Socrates is thus at pains to argue that practically oriented craft knowledge is in fact quite different from the knowledge of the good life that has always been the concern of the religious seers and poets. Plato (c.429–c.347 BCE), too, employs this general Socratic distinction of craft knowledge vs. knowledge of life; moreover, his dialogues are full of images of actual technological devices. The water clock, the astronomical orrery, and the mechanical puppet show all figure prominently as metaphors and models for several of his myths – for example, of cosmic creation in the *Timaeus*, the last judgment in the *Republic*, the history of the cosmos in the *Statesman*, and the shadow play of puppet-objects in the myth of the cave in the *Republic*'s account of the triumph of reason over sensual experience in genuine philosophical learning.

What Plato also makes explicit, however, is that the Socratic distinction between technical or craft knowledge, on the one hand, and knowledge of the good life, on the other, is fundamentally a distinction between two unequal phenomena. Craft knowledge is ordinary, lower, sense-experientially based understanding focused on practical affairs. Knowledge of the good life and of the ultimate nature of things – that is, the “wisdom” that philosophers “love” – is a higher, theoretical, and genuinely rational knowledge to which the former kind of knowledge is rightfully and ultimately beholden. Thus, for example, in the *Republic*, Plato envisions the education of the philosopher king as involving extensive training in pure mathematics (including theoretical astronomy and music theory) as the proper background for further and still higher training in philosophical dialectics. And in the *Gorgias* he shows how technical understanding (e.g., of rhetoric) is useless, or worse, when cut off from the deeper knowledge of what rhetoric is truly “good” for.

It is this higher, genuinely rational understanding of the essential nature of things that Plato identifies as the concern of the philosophers; and it is this hierarchical conception of theoretical over practical understanding that he (and, in a somewhat differently interpreted way, Aristotle) bequeathed to the Western tradition. Moreover, in their enthusiastic preference for the rational and theoretical over the practical and sense-dependent, many later Platonists, Neoplatonists, and some say even Plato himself (in the controversial reports of his allegedly “unwritten” doctrines and “Lecture on the Good” given

at his Academy) came to identify numbers with the ideal, timeless form of philosophical knowledge. The distinction between mathematical knowledge and philosophical knowledge thereby came to be blurred, and it is perhaps not too much of a stretch to suggest that one can hear an echo of this ancient preference for mathematical metaphor in the later Western conceptions of technocracy, or rule by scientists and technologists. In any case, Plato did advocate the rule of the “wise,” by which he meant those trained in philosophy, where philosophy is understood as the love of a knowledge that is “like” that of the mathematical scientists but with an additional concern for cultivating a rational vision of the ultimate principles of all things.

Aristotle (384–322 BCE) makes just as strong a distinction between higher and lower understanding and is just as convinced as Plato that the highest kind of human life is one of rational contemplation of the “highest things.” Against Plato, however, Aristotle argues that the distinction between practical-technical-artistic understanding, on the one hand, and scientific-philosophical understanding, on the other, really cannot be a distinction involving possession of two kinds of “theories.” Plato’s Socrates appears to claim that moral virtue is a kind of knowledge; but this, counters Aristotle, must be wrong – if for no other reason than that this idea of moral virtue is unable to account for our familiar experience of the weakness of the will. Too obviously, it is possible to have knowledge of what to do but fail to do it. For Aristotle, moral virtue must therefore be conceived as a kind of practical reasoning (φρόνησις, *phronēsis*) achieved through exposure to experienced teachers, the building of good character, and the formation of the proper habits of activity.

Aristotle also objects to Plato’s tendency to overuse mathematical imagery in depicting not only philosophical and scientific knowledge but practical and political reasoning as well. In the *Republic*, for example, Plato presents abstract mathematical knowledge as a preliminary to political practice. His *Philebus* even entertains the notion of a “science of normative measure” (perhaps inspired by the mathematical theory of utility of the leading mathematician Eudoxus, who had joined the Academy). In contrast, Aristotle claims that different disciplines have different degrees of rigor that are appropriate to them. It is wrong to demand mathematical exactness in, say, ethics or politics. The largely implicit practical wisdom required of the citizen or politician, as well as the expertise of the artist and craftsman, is

concerned with generalizing about particular situations and individual things; and this sort of expertise must be carefully distinguished from the explicit theoretical knowledge of the scientist or philosopher, who is concerned with the truly universal and essential in all situations and all things.

For all their differences, however, Plato and Aristotle both developed hierarchical conceptions of knowledge that make philosophical or scientific understanding of the universal and essential superior. Evidence of this line of thinking can be seen in the fact that the ancients did not conceive of technological change and economic production in the modern terms of efficiency and progress. As Schadewaldt explains, our whole modern cluster of terms – nature, knowledge, technique, practical activity – have a very different ontological cast from that of the ancients. Above all, the Greeks did not understand their surroundings as what we call “nature” – that is, as a kind of external reality regarded as the object of our drive toward knowledge. For the Greeks, the cosmos is first of all *φύσις* (*physis*, from which our word “physics” comes) – the whole of things, with all of its motion, changes of shape and, size, and physical development and growth, and generation and degeneration – and we are part of it, placed in it, and the human spirit thus seeks to understand it as that with which we are in any case involved. Hence, it would make no sense to Plato or Aristotle to think of any kind of knowledge as something freely fashioned by us to give us control over something apart from us. Scientific understanding and practical techniques were both judged as analogous to the dynamic processes of the cosmos. The Roman aqueducts, for example, may seem “overbuilt” by modern standards, but that is because they are designed not just to carry water but to do so in perpetuity, to “be” as if things of the cosmos, like rivers and streams. Hence, where we might distinguish between “merely” aesthetic considerations and utility or efficiency in our crafts and practical productions, the ancients would consider both together as inseparable and as receiving their sanction from *φύσις* and our understanding of it. (We might note in passing that, in keeping with the supposed natural order of things, the “higher” arts of economic production as well as architecture and sculpture were regarded as best suited to men, whereas manual labor and hands-on crafts were widely considered to be lowly activities fit mostly for women and slaves.)

Through this Greek-pagan orientation, then, there runs a pervasive sense of our being destined to live in harmony with an awesomely comprehensive cosmos to which we

are never closer than when we strive to contemplate its first principles. In contrast, Christianity tends to encourage an outlook that fosters the idea of our separation from and superiority over nature. The Christian conception of the material universe as created from nothing by an all-knowing, rational God seems somehow to make that universe both less mysterious than Greek cosmology (see Mesthene’s “The Social Impact of Technological Change,” Chapter 56) and more remote from our true being. The theological interpretation of history as a progress toward our salvation paved the way for the later notions of linear scientific and technological progress. At the same time, the struggle for self-purification against the natural and material forces (introduced in the monastic orders) implicitly increased the dignity of the idea of work, and this imagery would later suggest the possibility of technological and scientific revolutions. All such developments, however, had to await the transfer of these views to a non-religious context (see Lynn White’s essay, Chapter 44). Only in the early modern period did the human control of nature and the essential beneficence of applying scientific knowledge to technology become ruling ideals. The remaining selections in Part I provide a sample of some of the major variations on these modern themes.

Francis Bacon (1561–1626) famously claims that knowledge is power – that is, that through knowledge of nature and its technological applications, humans can achieve a purity of mind and behavior that was lost after the Fall in the Garden of Eden. Thus, in *The New Atlantis*, Bacon envisages a utopia in which the workers at “Saloman’s House” study the resources of the island and the world to improve the health and welfare of the inhabitants. Here, Plato’s philosopher kings have been transformed into proto-scientists and technologists who guide the nation. Further selections reveal Bacon’s colorful and (as discussed later by Carolyn Merchant, Chapter 40) sometimes disturbingly gendered ways of depicting the acquisition of scientific knowledge and what sort of power it is that such knowledge allegedly gives us. Perhaps most famous of all, there is his Myth of the Sphinx, in which Bacon likens science itself to a seeming monster (to those ignorant of its nature), with wings (for the rapid dissemination of its discoveries), sharp claws (which grip the mind with its clear axioms and telling arguments), mountaintop abode (as befits something so lofty), and apparent riddles (which, when solved, reward beyond measure in the power over ignorance conquered and technologies gained). It is worth

contrasting the image of “nature” that must lie behind this conception of knowledge and its acquisition with that of the ancients.

A sophisticated and nuanced version of the secularized doctrine of linear historical progress is found in “The Idea for a Universal History from a Cosmopolitan Point of View,” by Immanuel Kant (1724–1804). All “animals,” Kant suggests, are destined to fulfill their natural purposes, and in the case of human beings this means the development of scientific and ethical rationality. The idea of human progress toward world government and perpetual peace that Rousseau ridiculed is presented here as empowered by the “unsociable sociability” of humans. Though written in an admittedly somewhat speculative vein, Kant’s essay nevertheless expresses the modern outlook of many who suppose its truth even when they are silent about it. For Kant’s portrayal of rational progress seems to justify the Enlightenment doctrines about our elevation above and over against nature. At the same time, it points forward to the less qualified historical claims of Hegel, Comte, and Marx.

The theme of what would later be called technocracy truly came into its own in the early 1800s with the writings of Henri de Saint-Simon (1760–1825) and Auguste Comte (1798–1857). Comte began his career as Saint-Simon’s assistant, and he came to exert a powerful if often unacknowledged influence over a wide and diverse range of other thinkers by clarifying and extending Saint-Simon’s often sketchy and disorganized ideas into a “System of Positive Philosophy.” The first half of his system focuses on the epistemology of science (his *Cours de philosophie positive*); the last half develops his ideas on the social and political organization that Comte assumes successful science will make possible (his *Système de politique positive*). At the heart of his system lies Comte’s philosophy of history and its Law of Three Stages. This law depicts humanity as moving (first intellectually and then in action) through three phases of development, utilizing three “methods” of philosophizing – namely, the theological (or fictive), metaphysical (or abstractly speculative), and scientific (or “positive”). Comte founded and named sociology as the science of society, and his later work is quite explicit about the need to replace traditional religion with a “Religion of Humanity,” so that natural and social scientists and those who apply their knowledge, not the priests of the Catholic Church, would rule. A few positivist churches were actually founded, and some still exist in England and Latin America (Brazil’s flag contains Comte’s slogan,

“Order and Progress”). More importantly, however, Comte’s notion of the “priestly” role of scientists and technologists possesses – albeit in a less explicit form – a much greater worldwide significance in twenty-first-century industrial societies, East and West.

Karl Marx (1818–83) ridiculed the Saint-Simonian and Comtean blueprints for a technocratic utopia, calling them “recipes for the cookshops of the future.” Yet Marx’s collaborator, Engels, displayed much greater sympathy toward their doctrines, and through him, Saint-Simonian phrases – for example, “the administration of things, not of men,” “society as one vast factory,” and “artists as engineers of the soul” – found their way into the Soviet Marxism of both Lenin and Stalin. (Is it mere coincidence that the planners of Disney World are called “Imagineers”?)

In his *Discourse on the Sciences and the Arts*, Jean-Jacques Rousseau (1712–78) opposes the prevalent Enlightenment optimism concerning science and its applications. He shocked his contemporaries by challenging their complacent progressivism. Where they saw only scientific progress and the promise of what Comte called “social reorganization” leading to world peace and human happiness, Rousseau perceived progress of the sciences and the arts as leading instead to decline and decadence. Where *philosophes* such as Voltaire, d’Alembert, and Condorcet anticipated Saint-Simon and Comte in assuming that scientific progress of necessity leads to moral and political progress, Rousseau claims instead that the virtue and vigor of the barbarian nations is destroyed by the spread of civilization. Rousseau’s sensational anti-Baconian manifesto presaged and nourished the Romantic critique of the industrial revolution in subsequent generations in Germany and England.

Marx may have ridiculed the Saint-Simonian and Comtean conceptions of scientific and technological progress. Yet he was, after Bacon, the modern philosopher who made technology most central to his system. Marx’s vision of human history combines elements of the Baconians and Enlightenment *philosophes* with elements of the German and British Romantics. Like Bacon and the Enlightenment thinkers, Marx is optimistic concerning the development of science and technology as well as about their benefit for humanity in the long run, with the eventual establishment of communism. He shares, however, the pessimism of Rousseau and the Romantics concerning the oppression and alienation produced by science and technology, especially in relation to private property, in the present and short run.

Marx's account of the role of technology in social change varies from writing to writing. *The Poverty of Philosophy* contains his famous quip, "the hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist." His brief and highly influential "Preface to a Contribution to a Critique of Political Economy" identifies the "base" of society as constituted by technological forces and social power relations of production. Many orthodox Marxists have interpreted these passages as proposing a technological determinism. (Ironically, there are many technocrats today who are strongly anti-Marxist but espouse a conception of contemporary post-industrial society that is just as technologically deterministic. For contributions to the non-Marxist debate concerning technological determinism and autonomy, see the later selections by Ellul (Chapters 19 and 36), Heilbroner (Chapter 37), Wyatt (Chapter 39), and Winner (Chapter 55). In the much more detailed discussions of *Capital*, however, Marx claims that class structure and class struggle control what sort of technology is developed. In these passages, some readers have seen a social determinism that can be used to criticize of technological determinism. Many twentieth- and twenty-first-century non-Soviet Marxists – from Chinese Maoists to European Marxist humanists – have gone on to argue that the very idea of technological determinism is a product of a technocratic capitalist ideology (see, e.g., Marcuse, Chapter 38). One key issue in this dispute over whether technology determines social relations or social power determines technological developments is the question of the relative weight of the

technological division of labor (i.e., job roles determined by technology) vs. the social division of labor (i.e., job roles and technology determined by the desire of owners and managers to control workers). That Marx and Engels embrace the latter view can be seen, for example, in *The German Ideology*, where they describe a communist utopia in which one could be at once fisherman, hunter, and intellectual; or in Engels' later writings, where he rejects the anarchists' claim that labor discipline and hierarchy can be eliminated. Engels argues that technology by itself enforces certain types of labor discipline and hierarchy.

In any case, through all of these Marx-Engels selections there runs another theme that has also become a major topic of debate. According to Marx, human beings modify their environment with tools because this is our nature, and insofar as we do so, we exhibit our difference from other animals (see, e.g., *The German Ideology*). In his lifelong collaboration with Engels, Marx developed this conception of the human species into a full-blown account of human evolution from the apes (see "The Part Played by Labor in the Transition from Ape to Man.") This evolutionary conception of humans as essentially tool-making animals has been vigorously criticized by later philosophers of technology, including even humanistic Marxists (see Mumford and Arendt, Chapters 32 and 33). Arendt's argument is especially challenging, for it contains an immanent criticism, namely, that Marx's concept of labor displays a deep ambivalence between understanding technological labor as, on the one hand, involving creative world-construction and, on the other, as inseparably linked to degrading oppression.

On Dialectic and “Technē”

Plato

From the *Republic*

[...]

514 Next, I said, compare the effect of education and of the
 lack of it on our nature to an experience like this:
 Imagine human beings living in an underground, cave-
 like dwelling, with an entrance a long way up, which is
 both open to the light and as wide as the cave itself.
 They’ve been there since childhood, fixed in the same
 place, with their necks and legs fettered, able to see only
 in front of them, because their bonds prevent them from
 turning their heads around. Light is provided by a fire
 burning far above and behind them. Also behind them,
 b but on higher ground, there is a path stretching between
 them and the fire. Imagine that along this path a low wall
 has been built, like the screen in front of puppeteers
 above which they show their puppets.

I’m imagining it.

Then also imagine that there are people along the
 wall, carrying all kinds of artifacts that project above it –
 statues of people and other animals, made out of stone,
 c wood, and every material. And, as you’d expect, some of
 515 the carriers are talking, and some are silent.

It’s a strange image you’re describing, and strange
 prisoners.

They’re like us. Do you suppose, first of all, that these
 prisoners see anything of themselves and one another

besides the shadows that the fire casts on the wall in front
 of them?

How could they, if they have to keep their heads
 motionless throughout life? b

What about the things being carried along the wall?
 Isn’t the same true of them?

Of course.

And if they could talk to one another, don’t you think
 they’d suppose that the names they used applied to the
 things they see passing before them?¹

They’d have to.

And what if their prison also had an echo from the
 wall facing them? Don’t you think they’d believe that the
 shadows passing in front of them were talking whenever
 one of the carriers passing along the wall was doing so?

I certainly do.

Then the prisoners would in every way believe that
 the truth is nothing other than the shadows of those c
 artifacts.

They must surely believe that.

Consider, then, what being released from their bonds
 and cured of their ignorance would naturally be like.
 When one of them was freed and suddenly compelled to
 stand up, turn his head, walk, and look up toward the
 light, he’d be pained and dazzled and unable to see the
 things whose shadows he’d seen before. What do you
 think he’d say, if we told him that what he’d seen before d

Selections from Plato, *Republic*, VIII, trans. G.M.A. Grube and C.D.C. Reeve (Indianapolis: Hackett, 1992), pp. 186–206, 210–12. Reprinted by permission of Hackett Publishing Company Inc.

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was inconsequential, but that now – because he is a bit closer to the things that are and is turned towards things that are more – he sees more correctly? Or, to put it another way, if we pointed to each of the things passing by, asked him what each of them is, and compelled him to answer, don't you think he'd be at a loss and that he'd believe that the things he saw earlier were truer than the ones he was now being shown?

Much truer.

e And if someone compelled him to look at the light itself, wouldn't his eyes hurt, and wouldn't he turn around and flee towards the things he's able to see, believing that they're really clearer than the ones he's being shown?

He would.

And if someone dragged him away from there by force, up the rough, steep path, and didn't let him go until he had dragged him into the sunlight, wouldn't he be pained and irritated at being treated that way? And 516 when he came into the light, with the sun filling his eyes, wouldn't he be unable to see a single one of the things now said to be true?

He would be unable to see them, at least at first.

I suppose, then, that he'd need time to get adjusted before he could see things in the world above. At first, he'd see shadows most easily, then images of men and other things in water, then the things themselves. Of 517 the sky itself more easily at night, looking at the light of the stars and the moon, than during the day, looking at the sun and the light of the sun.

Of course.

Finally, I suppose, he'd be able to see the sun, not images of it in water or some alien place, but the sun itself, in its own place, and be able to study it.

Necessarily so.

And at this point he would infer and conclude that the sun provides the seasons and the years, governs everything in the visible world, and is in some way the cause 518 of all the things that he used to see.

It's clear that would be his next step.

What about when he reminds himself of his first dwelling place, his fellow prisoners, and what passed for wisdom there? Don't you think that he'd count himself happy for the change and pity the others?

Certainly.

And if there had been any honors, praises, or prizes among them for the one who was sharpest at identifying the shadows as they passed by and who best remembered

which usually came earlier, which later, and which simultaneously, and who could thus best divine the d future, do you think that our man would desire these rewards or envy those among the prisoners who were honored and held power? Instead, wouldn't he feel, with Homer, that he'd much prefer to "work the earth as a serf to another, one without possessions,"² and go through any sufferings, rather than share their opinions and live as they do?

I suppose he would rather suffer anything than live like that. e

Consider this too. If this man went down into the cave again and sat down in his same seat, wouldn't his eyes – coming suddenly out of the sun like that – be filled with darkness?

They certainly would.

And before his eyes had recovered – and the adjustment would not be quick – while his vision was still dim, if he had to compete again with the perpetual prisoners in recognizing the shadows, wouldn't he invite ridicule? Wouldn't it be said of him that he'd returned from his 517 upward journey with his eyesight ruined and that it isn't worthwhile even to try to travel upward? And, as for anyone who tried to free them and lead them upward, if they could somehow get their hands on him, wouldn't they kill him?

They certainly would.

This whole image, Glaucon, must be fitted together with what we said before. The visible realm should b be likened to the prison dwelling, and the light of the fire inside it to the power of the sun. And if you interpret the upward journey and the study of things above as the upward journey of the soul to the intelligible realm, you'll grasp what I hope to convey, since that is what you wanted to hear about. Whether it's true or not, only the god knows. But this is how I see it: In the knowable realm, the form of the good is the last thing to be seen, and it is reached only with difficulty. Once one has seen it, however, one must conclude that it is the cause of all that is correct and beautiful in anything, that it produces c both light and its source in the visible realm, and that in the intelligible realm it controls and provides truth and understanding, so that anyone who is to act sensibly in private or public must see it.

I have the same thought, at least as far as I'm able.

Come, then, share with me this thought also: It isn't surprising that the ones who get to this point are unwilling to occupy themselves with human affairs and that their souls are always pressing upwards, eager to spend

their time above, for, after all, this is surely what we’d expect, if indeed things fit the image I described before.

It is.

What about what happens when someone turns from divine study to the evils of human life? Do you think it’s surprising, since his sight is still dim, and he hasn’t yet become accustomed to the darkness around him, that he behaves awkwardly and appears completely ridiculous if he’s compelled, either in the courts or elsewhere, to contend about the shadows of justice or the statues of which they are the shadows and to dispute about the way these things are understood by people who have never seen justice itself?

That’s not surprising at all.

518 No, it isn’t. But anyone with any understanding would remember that the eyes may be confused in two ways and from two causes, namely, when they’ve come from the light into the darkness *and* when they’ve come from the darkness into the light. Realizing that the same applies to the soul, when someone sees a soul disturbed and unable to see something, he won’t laugh mindlessly, but he’ll take into consideration whether it has come from a brighter life and is dimmed through not having yet become accustomed to the dark or whether it has come from greater ignorance into greater light and is dazzled by the increased brilliance. Then he’ll declare the first soul happy in its experience and life, and he’ll pity the latter – but even if he chose to make fun of it, at least he’d be less ridiculous than if he laughed at a soul that has come from the light above.

What you say is very reasonable.

If that’s true, then here’s what we must think about these matters: Education isn’t what some people declare c it to be, namely, putting knowledge into souls that lack it, like putting sight into blind eyes.

They do say that.

But our present discussion, on the other hand, shows that the power to learn is present in everyone’s soul and that the instrument with which each learns is like an eye that cannot be turned around from darkness to light without turning the whole body. This instrument cannot be turned around from that which is coming into being without turning the whole soul until it is able to study that which is and the brightest thing that is, namely, d the one we call the good. Isn’t that right?

Yes.

Then education is the craft concerned with doing this very thing, this turning around, and with how the soul can most easily and effectively be made to do it. It isn’t

the craft of putting sight into the soul. Education takes for granted that sight is there but that it isn’t turned the right way or looking where it ought to look, and it tries to redirect it appropriately.

So it seems.

Now, it looks as though the other so-called virtues of the soul are akin to those of the body, for they really aren’t there beforehand but are added later by habit and e practice. However, the virtue of reason seems to belong above all to something more divine,³ which never loses its power but is either useful and beneficial or useless and harmful, depending on the way it is turned. Or have you never noticed this about people who are said to be 519 vicious but clever, how keen the vision of their little souls is and how sharply it distinguishes the things it is turned towards? This shows that its sight isn’t inferior but rather is forced to serve evil ends, so that the sharper it sees, the more evil it accomplishes.

Absolutely.

However, if a nature of this sort had been hammered at from childhood and freed from the bonds of kinship with becoming, which have been fastened to it by feasting, greed, and other such pleasures and which, like leaden weights, pull its vision downwards – if, being rid b of these, it turned to look at true things, then I say that the same soul of the same person would see these most sharply, just as it now does the things it is presently turned towards.

Probably so.

And what about the uneducated who have no experience of truth? Isn’t it likely – indeed, doesn’t it follow necessarily from what was said before – that they will never adequately govern a city? But neither would those who’ve been allowed to spend their whole lives being educated. The former would fail because they don’t have a single goal at which ail their actions, public and private, c inevitably aim; the latter would fail because they’d refuse to act, thinking that they had settled while still alive in the faraway Isles of the Blessed.⁴

That’s true.

It is our task as founders, then, to compel the best natures to reach the study we said before is the most important, namely, to make the ascent and see the good. But when they’ve made it and looked sufficiently, we mustn’t allow them to do what they’re allowed to do today. d

What’s that?

To stay there and refuse to go down again to the prisoners in the cave and share their labors and honors, whether they are of less worth or of greater.

Then are we to do them an injustice by making them live a worse life when they could live a better one?

e You are forgetting again that it isn't the law's concern
to make any one class in the city outstandingly happy but
to contrive to spread happiness throughout the city by
bringing the citizens into harmony with each other
through persuasion or compulsion and by making them
share with each other the benefits that each class can
520 confer on the community.⁵ The law produces such people
in the city, not in order to allow them to turn in
whatever direction they want, but to make use of them
to bind the city together.

That's true, I had forgotten.

Observe, then, Glaucon, that we won't be doing an
injustice to those who've become philosophers in our city
and that what we'll say to them, when we compel them to
guard and care for the others, will be just. We'll say: "When
b people like you come to be in other cities, they're justified
in not sharing in their city's labors, for they've grown
there spontaneously, against the will of the constitution.
And what grows of its own accord and owes no debt for
its upbringing has justice on its side when it isn't keen to
pay anyone for that upbringing. But we've made you
kings in our city and leaders of the swarm, as it were,
both for yourselves and for the rest of the city. You're
c better and more completely educated than the others and
are better able to share in both types of life.⁶ Therefore
each of you in turn must go down to live in the common
dwelling place of the others and grow accustomed to
seeing in the dark. When you are used to it, you'll see
vastly better than the people there. And because you've
seen the truth about fine, just, and good things, you'll
know each image for what it is and also that of which it
is the image. Thus, for you and for us, the city will be
governed, not like the majority of *cities* nowadays, by
people who fight over shadows and struggle against one
another in order to rule – as if that were a great good –
d but by people who are awake rather than dreaming,⁷ for
the truth is surely this: A city whose prospective rulers
are least eager to rule must of necessity be most free from
civil war, whereas a city with the opposite kind of rulers
is governed in the opposite way."

Absolutely.

Then do you think that those we've nurtured will
disobey us and refuse to share the labors of the city, each
in turn, while living the greater part of their time with
one another in the pure realm?

It isn't possible, for we'll be giving just orders to just
people. Each of them will certainly go to rule as to

something compulsory, however, which is exactly the
opposite of what's done by those who now rule in each
city. This is how it is. If you can find a way of life that's
better than ruling for the prospective rulers, your well-
governed city will become a possibility, for only in it will
the truly rich rule – not those who are rich in gold but
those who are rich in the wealth that the happy must
521 have, namely, a good and rational life. But if beggars hun-
gry for private goods go into public life, thinking that
the good is there for the seizing, then the well-governed
city is impossible, for then ruling is something fought
over, and this civil and domestic war destroys these
people and the rest of the city as well.

That's very true.

Can you name any life that despises political rule
besides that of the true philosopher? b

No, by god, I can't.

But surely it is those who are not lovers of ruling who
must rule, for if they don't, the lovers of it, who are rivals,
will fight over it.

Of course.

Then who will you compel to become guardians of
the city, if not those who have the best understanding of
what matters for good government and who have other
honors than political ones, and a better life as well?

No one.

Do you want us to consider now how such people
will come to be in our city and how – just as some are
said to have gone up from Hades to the gods – we'll lead c
them up to the light?

[...]

Then it would be appropriate, Glaucon, to legislate this 525
subject for those who are going to share in the highest
offices in the city and to persuade them to turn to calcula-
tion and take it up, not as laymen do, but staying with it
until they reach the study of the natures of the numbers c
by means of understanding itself, nor like tradesmen and
retailers, for the sake of buying and selling, but for the
sake of war and for ease in turning the soul around, away
from becoming and towards truth and being.

Well put.

Moreover, it strikes me, now that it has been
mentioned, how sophisticated the subject of calculation
is and in how many ways it is useful for our purposes, d
provided that one practices it for the sake of knowing
rather than trading.

How is it useful?

In the very way we were talking about. It leads the
soul forcibly upward and compels it to discuss the

numbers themselves, never permitting anyone to propose for discussion numbers attached to visible or tangible bodies. You know what those who are clever in these matters are like: If, in the course of the argument, someone tries to divide the one itself, they laugh and won't permit it. If you divide it, they multiply it, taking care that one thing never be found to be many parts rather than one.

That's very true.

Then what do you think would happen, Glaucon, if someone were to ask them: “What kind of numbers are you talking about, in which the one is as you assume it to be, each one equal to every other, without the least difference and containing no internal parts?”

I think they'd answer that they are talking about those numbers that can be grasped only in thought and can't be dealt with in any other way.

Then do you see that it's likely that this subject really is compulsory for us, since it apparently compels the soul to use understanding itself on the truth itself?

Indeed, it most certainly does do that.

And what about those who are naturally good at calculation or reasoning? Have you already noticed that they're naturally sharp, so to speak, in all subjects, and that those who are slow at it, if they're educated and exercised in it, even if they're benefited in no other way, nonetheless improve and become generally sharper than they were?

That's true.

Moreover, I don't think you'll easily find subjects that are harder to learn or practice than this.

No, indeed.

Then, for all these reasons, this subject isn't to be neglected, and the best natures must be educated in it.

I agree.

Let that, then, be one of our subjects. Second, let's consider whether the subject that comes next is also appropriate for our purposes.

What subject is that? Do you mean geometry?

That's the very one I had in mind.

Insofar as it pertains to war, it's obviously appropriate, for when it comes to setting up camp, occupying a region, concentrating troops, deploying them, or with regard to any of the other formations an army adopts in battle or on the march, it makes all the difference whether someone is a geometer or not.

But, for things like that, even a little geometry – or calculation for that matter – would suffice. What we need to consider is whether the greater and more

advanced part of it tends to make it easier to see the form of the good. And we say that anything has that tendency if it compels the soul to turn itself around towards the region in which lies the happiest of the things that are, the one the soul must see at any cost.

You're right.

Therefore, if geometry compels the soul to study being, it's appropriate, but if it compels it to study becoming, it's inappropriate.

So we've said, at any rate.

Now, no one with even a little experience of geometry will dispute that this science is entirely the opposite of what is said about it in the accounts of its practitioners.

How do you mean?

They give ridiculous accounts of it, though they can't help it, for they speak like practical men, and all their accounts refer to doing things. They talk of “squaring,” “applying,” “adding,” and the like, whereas the entire subject is pursued for the sake of knowledge.

Absolutely.

And mustn't we also agree on a further point?

What is that?

That it is knowledge of what always is, not of what comes into being and passes away.

That's easy to agree to, for geometry *is* knowledge of what always is.

Then it draws the soul towards truth and produces philosophic thought by directing upwards what we now wrongly direct downwards.

As far as anything possibly can.

Then as far as *we* possibly can, we must require those in your fine city not to neglect geometry in any way, for even its by-products are not insignificant.

What are they?

The ones concerned with war that you mentioned. But we also surely know that, when it comes to better understanding any subject, there is a world of difference between someone who has grasped geometry and someone who hasn't.

Yes, by god, a world of difference.

Then shall we set this down as a second subject for the young?

Let's do so, he said.

And what about astronomy? Shall we make it the third? Or do you disagree?

That's fine with me, for a better awareness of the seasons, months, and years is no less appropriate for a general than for a farmer or navigator.

You amuse me: You're like someone who's afraid that the majority will think he is prescribing useless subjects. It's no easy task – indeed it's very difficult – to realize that in every soul there is an instrument that is purified and rekindled by such subjects when it has been blinded and destroyed by other ways of life, an instrument that it is more important to preserve than ten thousand eyes, since only with it can the truth be seen. Those who share your belief that this is so will think you're speaking incredibly well, while those who've never been aware of it will probably think you're talking nonsense, since they see benefit worth mentioning in these subjects. So decide right now which group you're addressing. Or are your arguments for neither of them but mostly for your own sake – though you won't begrudge anyone else whatever benefit he's able to get from them?

The latter: I want to speak, question, and answer mostly for my own sake.

Then let's fall back to our earlier position, for we were wrong just now about the subject that comes after geometry.

What was our error?

After plane surfaces, we went on to revolving solids before dealing with solids by themselves. But the right thing to do is to take up the third dimension right after the second. And this, I suppose, consists of cubes and of whatever shares in depth.

You're right, Socrates, but this subject hasn't been developed yet.

There are two reasons for that: First, because no city values it, this difficult subject is little researched. Second, the researchers need a director, for, without one, they won't discover anything. To begin with, such a director is hard to find, and, then, even if he could be found, those who currently do research in this field would be too arrogant to follow him. If an entire city helped him to supervise it, however, and took the lead in valuing it, then he would be followed. And, if the subject was consistently and vigorously pursued, it would soon be developed. Even now, when it isn't valued and is held in contempt by the majority and is pursued by researchers who are unable to give an account of its usefulness, nevertheless, in spite of all these handicaps, the force of its charm has caused it to develop somewhat, so that it wouldn't be surprising if it were further developed even as things stand.

The subject *has* outstanding charm. But explain more clearly what you were saying just now. The subject that deals with plane surfaces you took to be geometry.

Yes.

And at first you put astronomy after it, but later you went back on that.

In my haste to go through them all, I've only progressed more slowly. The subject dealing with the dimension of depth was next. But because it is in a ridiculous state, I passed it by and spoke of astronomy (which deals with the motion of things having depth) after geometry.

That's right.

Let's then put astronomy as the fourth subject, on the assumption that solid geometry will be available if a city takes it up.

That seems reasonable. And since you reproached me before for praising astronomy in a vulgar manner, I'll now praise it your way, for I think it's clear to everyone that astronomy compels the soul to look upward and leads it from things here to things there.

It may be obvious to everyone except me, but that's not my view about it.

Then what *is* your view?

As it's practiced today by those who teach philosophy, it makes the soul look very much downward.

How do you mean?

In my opinion, your conception of "higher studies" is a good deal too generous, for if someone were to study something by leaning his head back and studying ornaments on a ceiling, it looks as though you'd say he's studying not with his eyes but with his understanding. Perhaps you're right, and I'm foolish, but I can't conceive of any subject making the soul look upward except one concerned with that which is, and that which is invisible. If anyone attempts to learn something about sensible things, whether by gaping upward or squinting downward, I'd claim – since there's no knowledge of such things – that he never learns anything and that, even if he studies lying on his back on the ground or floating on it in the sea, his soul is looking not up but down.

You're right to reproach me, and I've been justly punished, but what did you mean when you said that astronomy must be learned in a different way from the way in which it is learned at present if it is to be a useful subject for our purposes?

It's like this: We should consider the ornaments that brighten the sky to be the most beautiful and most exact of visible things, seeing that they're embroidered on a visible surface. But we should consider their motions to fall far short of the true ones – motions that are really fast or slow as measured in true numbers, that trace out true

geometrical figures, that are all in relation to one another, and that are the true motions of the things carried along in them. And these, of course, must be grasped by reason and thought, not by sight. Or do you think otherwise?

Not at all.

Therefore, we should use the embroidery in the sky as a model in the study of these other things.⁸ If someone experienced in geometry were to come upon plans very carefully drawn and worked out by Daedalus or some other craftsman or artist, he'd consider them to be very finely executed, but he'd think it ridiculous to examine them seriously in order to find the truth in them about the equal, the double, or any other ratio.

How could it be anything other than ridiculous?

Then don't you think that a real astronomer will feel the same when he looks at the motions of the stars? He'll believe that the craftsman of the heavens arranged them and all that's in them in the finest way possible for such things. But as for the ratio of night to day, of days to a month, of a month to a year, or of the motions of the stars to any of them or to each other, don't you think he'll consider it strange to believe that they're always the same and never deviate anywhere at all or to try in any sort of way to grasp the truth about them, since they're connected to bodies and visible?

That's my opinion anyway, now that I hear it from you.

Then if, by really taking part in astronomy, we're to make the naturally intelligent part of the soul useful instead of useless, let's study astronomy by means of problems, as we do geometry, and leave the things in the sky alone.

The task you're prescribing is a lot harder than anything now attempted in astronomy.

And I suppose that, if we are to be of any benefit as lawgivers, our prescriptions for the other subjects will be of the same kind. But have you any other appropriate subject to suggest?

Not offhand.

“Well, there isn't just one form of motion but several.

Perhaps a wise person could list them all, but there are two that are evident even to us.

What are they?

Besides the one we've discussed, there is also its counterpart.

What's that?

It's likely that, as the eyes fasten on astronomical motions, so the ears fasten on harmonic ones, and that the sciences of astronomy and harmonics are closely akin. This is what the Pythagoreans⁹ say, Glaucon, and we agree, don't we?

We do.

Therefore, since the subject is so huge, shouldn't we ask them what they have to say about harmonic motions and whether there is anything else besides them, all the while keeping our own goal squarely in view?

What's that?

That those whom we are rearing should never try to learn anything incomplete, anything that doesn't reach the end that everything should reach – the end we mentioned just now in the case of astronomy. Or don't you know that people do something similar in harmonics? Measuring audible consonances and sounds against one another, they labor in vain, just like present-day astronomers.

Yes, by the gods, and pretty ridiculous they are too. They talk about something they call a “dense interval” or quartertone¹⁰ – putting their ears to their instruments like someone trying to overhear what the neighbors are saying. And some say that they hear a tone in between and that *it* is the shortest interval by which they must measure, while others argue that this tone sounds the same as a quarter tone. Both put ears before understanding.

You mean those excellent fellows who torment their strings, torturing them, and stretching them on pegs. I won't draw out the analogy by speaking of blows with the plectrum or the accusations or denials and boastings on the part of the strings; instead I'll cut it short by saying that these aren't the people I'm talking about. The ones I mean are the ones we just said we were going to question about harmonics, for they do the same as the astronomers. They seek out the numbers that are to be found in these audible harmonies, but they do not make the ascent to problems. They don't investigate, for example, which numbers are in harmony and which aren't or what the explanation is of each.

But that would be a superhuman task.

Yet it's useful in the search for the beautiful and the good. But pursued for any other purpose, it's useless.

Probably so.

Moreover, I take it that, if inquiry into all the subjects we've mentioned brings out their association and relationship with one another and draws conclusions about their kinship, it does contribute something to our goal and isn't labor in vain, but that otherwise it is in vain.

I, too, divine that this is true. But you're still talking about a very big task, Socrates.

Do you mean the prelude, or what? Or don't you know that all these subjects are merely preludes to the song itself that must also be learned? Surely you don't

e think that people who are clever in these matters are dialecticians.

No, by god, I don't. Although I have met a few exceptions.

But did it ever seem to you that those who can neither give nor follow an account know anything at all of the things we say they must know?⁷

My answer to that is also no.

532 Then isn't this at last, Glaucon, the song that dialectic sings? It is intelligible, but it is imitated by the power of sight. We said that sight tries at last to look at the animals themselves, the stars themselves, and, in the end, at the sun itself.¹¹ In the same way, whenever someone tries through argument and apart from all sense perceptions to find the being itself of each thing and doesn't give up
b until he grasps the good itself with understanding itself, he reaches the end of the intelligible, just as the other reached the end of the visible.

Absolutely.

And what about this journey? Don't you call it dialectic?

I do.

Then the release from bonds and the turning around from shadows to statues and the light of the fire and, then, the way up out of the cave to the sunlight and, there, the continuing inability to look at the animals, the
c plants, and the light of the sun, but the newly acquired ability to look at divine images in water and shadows of the things that are, rather than, as before, merely at shadows of statues thrown by another source of light that is itself a shadow in relation to the sun – all this business of the crafts we've mentioned has the power to awaken the best part of the soul and lead it upward to the study of the best among the things that are, just as, before, the
d clearest thing in the body was led to the brightest thing in the bodily and visible realm.

I accept that this is so, even though it seems very hard to accept in one way and hard not to accept in another. All the same, since we'll have to return to these things often in the future, rather than having to hear them just once now, let's assume that what you've said is so and turn to the song itself, discussing it in the same way as we did the prelude. So tell us the way in which the power of
e dialectic works, what forms it is divided into, and what paths it follows, for these lead at last, it seems, towards that place which is a rest from the road, so to speak, and an end of journeying for the one who reaches it.

533 You won't be able to follow me any longer, Glaucon, even though there is no lack of eagerness on my part to

lead you, for you would no longer be seeing an image of what we're describing, but the truth itself. At any rate, that's how it seems to me. That it is really so is not worth insisting on any further. But that there is some such thing to be seen, *that* is something we must insist on. Isn't that so?

Of course.

And mustn't we also insist that the power of dialectic could reveal it only to someone experienced in the subjects we've described and that it cannot reveal it in any other way?

That too is worth insisting on.

At any rate, no one will dispute it when we say that there is no other inquiry that systematically attempts to
b grasp with respect to each thing itself what the being of it is, for all the other crafts are concerned with human opinions and desires, with growing or construction, or with the care of growing or constructed things. And as for the rest, I mean geometry and the subjects that follow it, we described them as to some extent grasping what is, for we saw that, while they do dream about what is, they are unable to command a waking view of it as long as they make use of hypotheses that they leave untouched
c and that they cannot give any account of. What mechanism could possibly turn any agreement into knowledge when it begins with something unknown and puts together the conclusion and the steps in between from what is unknown?

None.

Therefore, dialectic is the only inquiry that travels this road, doing away with hypotheses and proceeding to the first principle itself, so as to be secure. And when the eye of the soul is really buried in a sort of barbaric bog,¹²
d dialectic gently pulls it out and leads it upwards, using the crafts we described to help it and cooperate with it in turning the soul around. From force of habit, we've often called these crafts sciences or kinds of knowledge, but they need another name, clearer than opinion, darker than knowledge. We called them thought somewhere before.¹³ But I presume that we won't dispute about a name when we have so many more important matters to
e investigate.

Of course not.

It will therefore be enough to call the first section knowledge, the second thought, the third belief, and the fourth imaging, just as we did before. The last two together we call opinion, the other two, intellect.¹⁴
534 Opinion is concerned with becoming, intellect with being. And as being is to becoming, so intellect is to opinion, and as intellect is to opinion, so knowledge is to

belief and thought to imaging. But as for the ratios between the things these are set over and the division of either the opinable or the intelligible section into two, let's pass them by, Glaucon, lest they involve us in arguments many times longer than the ones we've already gone through.

I agree with you about the others in any case, insofar as I'm able to follow.

Then, do you call someone who is able to give an account of the being of each thing dialectical? But insofar as he's unable to give an account of something, either to himself or to another, do you deny that he has any understanding of it?

How could I do anything else?

Then the same applies to the good. Unless someone can distinguish in an account the form of the good from everything else, can survive all refutation, as if in a battle, striving to judge things not in accordance with opinion but in accordance with being, and can come through all this with his account still intact, you'll say that he doesn't know the good itself or any other good. And if he gets hold of some image of it, you'll say that it's through opinion, not knowledge, for he is dreaming and asleep throughout his present life, and, before he wakes up here, he will arrive in Hades and go to sleep forever.

Yes, by god, I'll certainly say all of that.

Then, as for those children of yours whom you're rearing and educating in theory, if you ever reared them in fact, I don't think that you'd allow them to rule in your city or be responsible for the most important things while they are as irrational as incommensurable lines.

Certainly not.

Then you'll legislate that they are to give most attention to the education that will enable them to ask and answer questions most knowledgeably?

I'll legislate it along with you.

Then do you think that we've placed dialectic at the top of the other subjects like a coping stone and that no other subject can rightly be placed above it, but that our account of the subjects that a future ruler must learn has come to an end?

Probably so.

[...]

We hold from childhood certain convictions about just and fine things; we're brought up with them as with our parents, we obey and honor them.

Indeed, we do.

There are other ways of living, however, opposite to these and full of pleasures, that flatter the soul and attract

it to themselves but which don't persuade sensible people, who continue to honor and obey the convictions of their fathers.

That's right.

And then a questioner comes along and asks someone of this sort, "What is the fine?" And, when he answers what he has heard from the traditional lawgiver, the argument refutes him, and by refuting him often and in many places shakes him from his convictions, and makes him believe that the fine is no more fine than shameful, and the same with the just, the good, and the things he honored most. What do you think his attitude will be then to honoring and obeying his earlier convictions?

Of necessity he won't honor or obey them in the same way.

Then, when he no longer honors and obeys those convictions and can't discover the true ones, will he be likely to adopt any other way of life than that which flatters him?

No, he won't.

And so, I suppose, from being law-abiding he becomes lawless.

Inevitably.

Then, as I asked before, isn't it only to be expected that this is what happens to those who take up arguments in this way, and don't they therefore deserve a lot of sympathy?

Yes, and they deserve pity too.

Then, if you don't want your thirty-year-olds to be objects of such pity, you'll have to be extremely careful about how you introduce them to arguments.

That's right.

And isn't it one lasting precaution not to let them taste arguments while they're young? I don't suppose that it has escaped your notice that, when young people get their first taste of arguments, they misuse it by treating it as a kind of game of contradiction. They imitate those who've refuted them by refuting others themselves, and, like puppies, they enjoy dragging and tearing those around them with their arguments.

They're excessively fond of it.

Then, when they've refuted many and been refuted by them in turn, they forcefully and quickly fall into disbelieving what they believed before. And, as a result, they themselves and the whole of philosophy are discredited in the eyes of others.

That's very true.

But an older person won't want to take part in such madness. He'll imitate someone who is willing to engage

in discussion in order to look for the truth, rather than someone who plays at contradiction for sport. He'll be more sensible himself and will bring honor rather than discredit to the philosophical way of life.

That's right.

And when we said before that those allowed to take part in arguments should be orderly and steady by nature, not as nowadays, when even the unfit are allowed to engage in them – wasn't all that also said as a precaution?

Of course.

Then if someone continuously, strenuously, and exclusively devotes himself to participation in arguments, exercising himself in them just as he did in the bodily physical training, which is their counterpart, would that be enough?

Do you mean six years or four?

It doesn't matter. Make it five. And after that, you must make them go down into the cave again, and compel them to take command in matters of war and occupy the other offices suitable for young people, so that they won't be inferior to the others in experience. But in these, too, they must be tested to see whether they'll remain steadfast when they're pulled this way and that or shift their ground.

How much time do you allow for that?

Fifteen years. Then, at the age of fifty, those who've survived the tests and been successful both in practical matters and in the sciences must be led to the goal and compelled to lift up the radiant light of their souls to what itself provides light for everything. And once they've seen the good itself, they must each in turn put the city, its citizens, and themselves in order, using it as their model. Each of them will spend most of his time with philosophy, but, when his turn comes, he must labor in politics and rule for the city's sake, not as if he were doing something fine, but rather something that has to be done. Then, having educated others like himself to take his place as guardians of the city, he will depart for the Isles of the Blessed and dwell there. And, if the Pythia agrees, the city will publicly establish memorials and sacrifices to him as a daimon, but if not, then as a happy and divine human being.

Like a sculptor,¹⁵ Socrates, you've produced ruling men that are completely fine.

And ruling women, too, Glaucon, for you mustn't think that what I've said applies any more to men than it does to women who are born with the appropriate natures.

That's right, if indeed they are to share everything equally with the men, as we said they should.

[...]

Notes

- 1 Reading *parionta autous nomizein onomazein*. E.g. they would think that the name "human being" applied to the shadow of a statue of a human being.
- 2 *Odyssey* 11.489–90. The shade of the dead Achilles speaks these words to Odysseus, who is visiting Hades. Plato is, therefore, likening the cave dwellers to the dead.
- 3 See *Republic* 589d, 590d, 611b ff.
- 4 A place where good people are said to live in eternal happiness, normally after death.
- 5 See *Republic* 420b–421c, 462a–466c.
- 6 I.e. the practical life of ruling the city and the theoretical life of studying the good itself.
- 7 See *Republic* 476c–d.
- 8 See *Republic* 510d–511a.
- 9 Pythagoras of Samos (sixth century) taught a way of life (see *Republic* 600b) in which natural science became a religion. He is credited with discovering the mathematical ratios determining the principal intervals of the musical scale. He seems to have been led by this to believe that all natural phenomena are explicable in terms of numbers. He may have

discovered some version of the theorem about right triangles that bears his name.

- 10 A dense interval is evidently the smallest difference in pitch recognized in ancient music.
- 11 See *Republic* 516a–b.
- 12 See *Republic* 519a–b.
- 13 See *Republic* 511d–e.
- 14 The reference is to *Republic* 511d–e, but there the first section is called understanding (*noēsis*) rather than knowledge (*epistēmē*). However, since we've just been told that thought (*dianoia*) is not a kind of knowledge, understanding and knowing have in effect become identified. It is harder to explain why knowledge and thought are now referred to jointly as *noēsis*. But presumably it is because that whole section of the line is earlier referred to as the intelligible (*noēton*). See *Republic* 509d–e. To prevent misunderstanding, therefore, I have translated *noēsis* as "intellect" here.
- 15 See *Republic* 361d.

On “Technē” and “Epistēmē”

Aristotle

From *Nicomachean Ethics*

6.15 The particular virtues of thought Then let us begin over again, and discuss these states of the soul.

vi 3 Let us say, then, that there are five states in which the
15 soul grasps the truth in its affirmations or denials. These are craft, scientific knowledge, intelligence, wisdom and understanding; for belief and supposition admit of being false.

6.2 Scientific knowledge (Epistēmē)

6.21 It is concerned with what is necessary What science is evident from the following, if we must speak exactly and not be guided by [mere] similarities.

20 For we all suppose that what we know scientifically does not even admit of being otherwise; and whenever what admits of being otherwise escapes observation, we do not notice whether it is or is not, [and hence we do not know about it]. Hence what is known scientifically is by necessity. Hence it is eternal; for the things that are by unconditional necessity are all eternal, and eternal things are ingenerable and indestructible.

6.22 Its first principles cannot be scientifically known Further, every science seems to be teachable, and what is scientifically knowable is learnable. But all

teaching is from what is already known, as we also say in 25 the *Analytics*; for some teaching is through induction, some by deductive inference, [which both require previous knowledge].

Induction [reaches] the origin, i.e. the universal, while deductive inference proceeds from the universal. Hence deductive inference has origins from which it proceeds, 30 but which are not themselves [reached] by deductive inference. Hence they are [reached] by induction.

6.23 Hence scientific knowledge requires demonstration from indemonstrable premises

Scientific knowledge, then, is a demonstrative state, and has all the other features that in the *Analytics* we add to the definition. For someone has scientific knowledge when he has the appropriate sort of confidence, and the origins are known to him; for if they are not better known to him 35 than the conclusion, he will have scientific knowledge only coincidentally.

So much for a definition of scientific knowledge.

6.3 Craft-knowledge (Technē)

6.31 Production contrasted with action What vi4 admits of being otherwise includes what is produced and 1140a what is done in action. Production and action are different; about them we rely also on [our] popular discussions.

Selections from Aristotle, *Nicomachean Ethics*, VI, trans. Terence Irwin (Indianapolis: Hackett, 1985), pp. 151–159. Reprinted by permission of Hackett Publishing Company Inc., and from *Metaphysics* I, 1, trans. W. D. Ross, in *The Basic Works of Aristotle*, ed. Richard McKeon (New York: Random House, 1941), pp. 689–693. Copyright © Oxford University Press. Reprinted by permission of Oxford University Press.

Hence the state involving reason and concerned with
5 action is different from the state involving reason and con-
cerned with production. Nor is one included in the other;
for action is not production, and production is not action.

6.32 Crafts are concerned with production, not with action

Now building, e.g., is a craft, and is essen-
tially a certain state involving reason concerned with
production; there is no craft that is not a state involving
reason concerned with production, and no such state
that is not a craft. Hence a craft is the same as a state
10 involving true reason concerned with production.

Every craft is concerned with coming to be; and the
exercise of the craft is the study of how something that
admits of being and not being comes to be, something
whose origin is in the producer and not in the product.
For a craft is not concerned with things that are or come
to be by necessity; or with things that are by nature, since
15 these have their origin in themselves.

And since production and action are different, craft
must be concerned with production, not with action.

In a way craft and fortune are concerned with the
same things, as Agathon says: "Craft was fond of fortune,
20 and fortune of craft."

A craft, then, as we have said, is a state involving true
reason concerned with production. Lack of craft is the
contrary state involving false reason and concerned with
production. Both are concerned with what admits of
being otherwise.

6.4 Intelligence (Phronesis)

6.41 An intelligent person deliberates about living

vi 5 **well** To grasp what intelligence is we should first study
25 the sort of people we call intelligent.

It seems proper, then, to an intelligent person to be
able to deliberate finely about what is good and benefi-
cial for himself, not about some restricted area – e.g.
about what promotes health or strength – but about
what promotes living well in general.

A sign of this is the fact that we call people intelligent
about some [restricted area] whenever they calculate well
30 to promote some excellent end, in an area where there is
no craft. Hence where [living well] as a whole is con-
cerned, the deliberative person will also be intelligent.

6.42 The scope of intelligence distinguishes it from scientific knowledge and from craft-knowledge

Now no one deliberates about what cannot be otherwise
or about what cannot be achieved by his action. Hence, if

science involves demonstration, but there is no demonstra-
tion of anything whose origins admit of being otherwise,
since every such thing itself admits of being otherwise; 35
and if we cannot deliberate about what is by necessity; 1140b
it follows that intelligence is not science nor yet craft-
knowledge. It is not science, because what is done in action
admits of being otherwise; and it is not craft-knowledge,
because action and production belong to different kinds.

6.43 Definition of intelligence The remaining pos-
sibility, then, is that intelligence is a state grasping the
truth, involving reason, concerned with action about
what is good or bad for a human being.

It must be concerned with action, not with production For pro-
duction has its end beyond it; but action does not, since
its end is doing well itself, [and doing well is the concern
of intelligence].

6.44 The definition is confirmed by commonly recognized features of intelligence

Commonly recognized intelligent people Hence Pericles and
such people are the ones whom we regard as intelligent,
because they are able to study what is good for them-
selves and for human beings; and we think that house- 10
hold managers and politicians are such people.

*The recognized connection between temperance and intelli-
gence* This is also how we come to give temperance
(*sōphrosunē*) its name, because we think that it preserves
intelligence, (*sōzousan tēn phronēsin*). This is the sort of
supposition that it preserves. For the sort of supposition
that is corrupted and perverted by what is pleasant or
painful is not every sort – not, e.g., the supposition that
the triangle does or does not have two right angles – but 15
suppositions about what is done in action.

For the origin of what is done in action is the goal it
aims at; and if pleasure or pain has corrupted someone, it
follows that the origin will not appear to him. Hence it
will not be apparent that this must be the goal and cause
of all his choice and action; for vice corrupts the origin. 20

Hence [since intelligence is what temperance
preserves, and what temperance preserves is a true sup-
position about action], intelligence must be a state grasp-
ing the truth, involving reason, and concerned with
action about human goods.

We recognize that intelligence cannot be misused ... Moreover,
there is virtue [or vice in the use] of craft, but not [in the
use] of intelligence. Further, in a craft, someone who

makes errors voluntarily is more choiceworthy; but with intelligence, as with the virtues, the reverse is true. Clearly, 25 then, intelligence is a virtue, not craft-knowledge.

There are two parts of the soul that have reason. Intelligence is a virtue of one of them, of the part that has belief; for belief is concerned, as intelligence is, with what admits of being otherwise.

... *And that it cannot be forgotten* Moreover, it is not only a state involving reason. A sign of this is the fact that such a state can be forgotten, but intelligence cannot.

6.5 Understanding (Nous)

vi 6 **6.51 There must be a virtue of thought concerned**
30 **with first principles** Scientific knowledge is supposition about universals, things that are by necessity. Further, everything demonstrable and every science have *origins*, since scientific knowledge involves reason.

Hence there can be neither scientific knowledge nor craft-knowledge nor intelligence about the origins of 35 what is scientifically known. For what is scientifically known is demonstrable, [but the origins are not]; and craft and intelligence are about what admits of being otherwise. Nor is wisdom [exclusively] about origins; for it is 1141a proper to the wise person to have a demonstration of some things.

6.52 Since no other virtue of thought grasps first principles, understanding must grasp them [The states of the soul] by which we always grasp the 5 truth and never make mistakes, about what can or cannot be otherwise, are scientific knowledge, intelligence, wisdom and understanding. But none of the first three – intelligence, scientific knowledge, wisdom – is possible about origins. The remaining possibility, then, is that we have understanding about origins.

6.6 Wisdom (Sophia)

vi 7 **6.61 It is concerned with scientific knowledge and**
10 **with understanding, not with action** We ascribe wisdom in crafts to the people who have the most exact expertise in the crafts, e.g. we call Pheidias a wise stoneworker and Polycleitus a wise bronze-worker, signifying nothing else by wisdom than excellence in a craft. But we also think some people are wise in general, not wise in some [restricted] area, or in some other [specific] way, as Homer says in the *Margites*: “The gods did not make 15 him a digger or a plough-man or wise in anything else.”

Clearly, then, wisdom is the most exact [form] of scientific knowledge.

Hence the wise person must not only know what is derived from the origins of a science, but also grasp the truth about the origins. Therefore wisdom is understanding plus scientific knowledge; it is scientific knowledge of the most honourable things that has received [understanding as] its coping-stone.

6.62 It must be distinguished from intelligence and political science For it would be absurd for some- 20 one to think that political science or intelligence is the most excellent science, when the best thing in the universe is not a human being [and the most excellent science must be of the best things].

Moreover, what is good and healthy for human beings and for fish is not the same, but what is white or straight is always the same. Hence everyone would say that the content of wisdom is always the same, but 25 the content of intelligence is not. For the agent they would call intelligent is the one who studies well each question about his own [good], and he is the one to whom they would entrust such questions. Hence 25 intelligence is also ascribed to some of the beasts, the ones that are evidently capable of forethought about their own life.

It is also evident that wisdom is not the same as political science. For if people are to say that science 30 about what is beneficial to themselves [as human beings] counts as wisdom, there will be many types of wisdom [corresponding to the different species of animals]. For if there is no one medical science about all beings, there is no one science about the good of all animals, but a different science about each specific good. [Hence there will be many types of wisdom, 30 contrary to our assumption that it has always the same content].

And it does not matter if human beings are the best among the animals. For there are other beings of a far 1141b more divine nature than human beings; e.g., most evidently, the beings composing the universe.

What we have said makes it clear that wisdom is both scientific knowledge and understanding about what is by nature most honourable. That is why people say that Anaxagoras or Thales or that sort of person is 5 wise, but not intelligent, when they see that he is ignorant of what benefits himself. And so they say that what he knows is extraordinary, amazing, difficult and divine, but useless, because it is not human goods that he looks for.

6.7 Intelligence compared with the other virtues of thought

6.71 It is concerned with action, and hence with particulars

10 Intelligence, by contrast, is about human concerns, about what is open to deliberation. For we say that deliberating well is the function of the intelligent person more than anyone else; but no one deliberates about what cannot be otherwise, or about what lacks a goal that is a good achievable in action. The unconditionally good deliberator is the one whose aim expresses rational calculation in pursuit of the best good for a human being that is achievable in action.

15 Nor is intelligence about universals only. It must also come to know particulars, since it is concerned with action and action is about particulars. Hence in other areas also some people who lack knowledge but have experience are better in action than others who have knowledge. For someone who knows that light meats are digestible and healthy, but not which sorts of meats are light, will not produce health; the one who knows that bird meats are healthy will be better at producing health. And since intelligence is concerned with action, it must possess both [the universal and the particular knowledge] or the [particular] more [than the universal]. Here too, however, [as in medicine] there is a ruling [science].

From *Metaphysics*

Book A (I)

1 All men by nature desire to know. An indication of this is the delight we take in our senses; for even apart from their usefulness they are loved for themselves; and above all others the sense of sight. For not only with a view to action, but even when we are not going to do anything, we prefer seeing (one might say) to everything else. The reason is that this, most of all the senses, makes us know and brings to light many differences between things.

980^b By nature animals are born with the faculty of sensation, and from sensation memory is produced in some of them, though not in others. And therefore the former are more intelligent and apt at learning than those which cannot remember; those which are incapable of hearing sounds are intelligent though they cannot be taught, e.g. the bee, and any other race of animals that may be like it; and those which besides memory have this sense of hearing can be taught.

The animals other than man live by appearances and memories, and have but little of connected experience; 25 but the human race lives also by art and reasonings. Now from memory experience is produced in men; for the several memories of the same thing produce finally the capacity for a single experience. And experience seems 981^a pretty much like science and art (*technē*), but really science and art come to men *through* experience; for “experience made art”, as Polus says,¹ “but inexperience 5 luck”. Now art arises when from many notions gained by experience one universal judgement about a class of objects is produced. For to have a judgement that when Callias was ill of this disease this did him good, and similarly in the case of Socrates and in many individual cases, is a matter of experience; but to judge that it has done good to all persons of a certain constitution, marked off 10 in one class, when they were ill of this disease, e.g. to phlegmatic or bilious people when burning with fever – this is a matter of art.

With a view to action experience seems in no respect inferior to art, and men of experience succeed even better than those who have theory without experience. 15 (The reason is that experience is knowledge of individuals, art of universals, and actions and productions are all concerned with the individual; for the physician does not cure *man*, except in an incidental way, but Callias or Socrates or some other called by some such individual name, who happens to be a man. If, then, a man has the 20 theory without the experience, and recognizes the universal but does not know the individual included in this, he will often fail to cure; for it is the individual that is to be cured.) But yet we think that *knowledge* and *understanding* belong to art rather than to experience, and we suppose artists to be wiser than men of experience 25 (which implies that Wisdom depends in all cases rather on knowledge); and this because the former know the cause, but the latter do not. For men of experience know that the thing is so, but do not know why, while the 30 others know the “why” and the cause. Hence we think also that the master-workers in each craft are more honourable and know in a truer sense and are wiser than the manual workers, because they know the causes of the 981^b things that are done (we think the manual workers are like certain lifeless things which act indeed, but act without knowing what they do, as fire burns – but while the lifeless things perform each of their functions by a 5 natural tendency, the labourers perform them through habit); thus we view them as being wiser not in virtue of being able to act, but of having the theory for themselves

and knowing the causes. And in general it is a sign of the man who knows and of the man who does not know, that the former can teach, and therefore we think art more truly knowledge than experience is; for artists can teach, and men of mere experience cannot.

10 Again, we do not regard any of the senses as Wisdom; yet surely these give the most authoritative knowledge of particulars. But they do not tell us the "why" of anything – e.g. why fire is hot; they only say *that* it is hot.

At first he who invented any art whatever that went beyond the common perceptions of man was naturally 15 admired by men, not only because there was something useful in the inventions, but because he was thought wise and superior to the rest. But as more arts were invented, and some were directed to the necessities of life, others to recreation, the inventors of the latter were naturally always regarded as wiser than the inventors of the former, because their branches of knowledge did not aim at 20 utility. Hence when all such inventions were already established, the sciences which do not aim at giving pleasure or at the necessities of life were discovered, and first in the places where men first began to have leisure. This is why the mathematical arts were founded in Egypt; for there the priestly caste was allowed to be at leisure.

We have said in the *Ethics*² what the difference is 25 between art and science and the other kindred faculties; but the point of our present discussion is this, that all men suppose what is called Wisdom to deal with the first causes and the principles of things; so that, as has been 30 said before, the man of experience is thought to be wiser than the possessors of any sense-perception whatever, the artist wiser than the men of experience, the master-worker than the mechanic, and the theoretical kinds of knowledge to be more of the nature of Wisdom than the productive. Clearly then Wisdom is knowledge about 982^a certain principles and causes.

2 Since we are seeking this knowledge, we must inquire 5 of what kind are the causes and the principles, the knowledge of which is Wisdom. If one were to take the notions we have about the wise man, this might perhaps make the answer more evident. We suppose first, then, that the wise man knows all things, as far as possible, although he has not knowledge of each of them in detail; 10 secondly, that he who can learn things that are difficult, and not easy for man to know, is wise (sense-perception is common to all, and therefore easy and no mark of Wisdom); again, that he who is more exact and more capable of teaching the causes is wiser, in every branch of

15 knowledge; and that of the sciences, also, that which is desirable on its own account and for the sake of knowing it is more of the nature of Wisdom than that which is desirable on account of its results, and the superior science is more of the nature of Wisdom than the ancillary; for the wise man must not be ordered but must order, and he must not obey another, but the less wise must obey *him*.

Such and so many are the notions, then, which we have about Wisdom and the wise. Now of these charac- 20 teristics that of knowing all things must belong to him who has in the highest degree universal knowledge; for he knows in a sense all the instances that fall under the universal. And these things, the most universal, are on the whole the hardest for men to know; for they are farthest from the senses. And the most exact of the sciences are those which deal most with first principles; for those 25 which involve fewer principles are more exact than those which involve additional principles, e.g. arithmetic than geometry. But the science which investigates causes is also *instructive*, in a higher degree, for the people who instruct us are those who tell the causes of each thing. And understanding and knowledge pursued for their 30 own sake are found most in the knowledge of that which is most knowable (for he who chooses to know for the sake of knowing will choose most readily that which is most truly knowledge, and such is the knowledge of that 982^b which is most knowable); and the first principles and the causes are most knowable; for by reason of these, and from these, all other things come to be known, and not these by means of the things subordinate to them. And the science which knows to what end each thing must be done is the most authoritative of the sciences, and 5 more authoritative than any ancillary science; and this end is the good of that thing, and in general the supreme good in the whole of nature. Judged by all the tests we have mentioned, then, the name in question falls to the same science; this must be a science that investigates the first principles and causes; for the good, i.e. the end, is 10 one of the causes.

That it is not a science of production is clear even from the history of the earliest philosophers. For it is owing to their wonder that men both now begin and at first began to philosophize; they wondered originally at the obvious difficulties, then advanced little by little and 15 stated difficulties about the greater matters, e.g. about the phenomena of the moon and those of the sun and of the stars, and about the genesis of the universe. And a man who is puzzled and wonders thinks himself ignorant

(whence even the lover of myth is in a sense a lover of Wisdom, for the myth is composed of wonders); therefore since they philosophized in order to escape from ignorance, evidently they were pursuing science in order to know, and not for any utilitarian end. And this is confirmed by the facts; for it was when almost all the necessities of life and the things that make for comfort and recreation had been secured, that such knowledge began to be sought. Evidently then we do not seek it for the sake of any other advantage; but as the man is free, we say, who exists for his own sake and not for another's so we pursue this as the only free science, for it alone exists for its own sake.

Hence also the possession of it might be justly regarded as beyond human power; for in many ways human nature is in bondage, so that according to Simonides "God alone can have this privilege", and it is unfitting that man should not be content to seek the knowledge that is suited to him. If, then, there is something in what the poets say, and jealousy is natural to the divine power, it would probably occur in this case above all, and all who excelled in this knowledge would be unfortunate. But the divine power cannot be jealous (nay, according to the proverb, "bards tell many a lie"), nor should any other science be thought more honourable than one of this sort. For the most divine science is also most honourable;

and this science alone must be, in two ways, most divine. For the science which it would be most meet for God to have is a divine science, and so is any science that deals with divine objects; and this science alone has both these qualities; for (1) God is thought to be among the causes of all things and to be a first principle, and (2) such a science either God alone can have, or God above all others. All the sciences, indeed, are more necessary than this, but none is better.

Yet the acquisition of it must in a sense end in something which is the opposite of our original inquiries. For all men begin, as we said, by wondering that things are as they are, as they do about self-moving marionettes, or about the solstices or the incommensurability of the diagonal of a square with the side; for it seems wonderful to all who have not yet seen the reason, that there is a thing which cannot be measured even by the smallest unit. But we must end in the contrary and, according to the proverb, the better state, as is the case in these instances too when men learn the cause; for there is nothing which would surprise a geometer so much as if the diagonal turned out to be commensurable.

We have stated, then, what is the nature of the science we are searching for, and what is the mark which our search and our whole investigation must reach.

Notes

1 Cf. PL. *Gorg.* 448 c, 462 BC.

2 1130^b 14–1141^b 8.

The Greek Concepts of “Nature” and “Technique”

Wolfgang Schadewaldt

The two concepts “nature” and “technique” – whether taken separately or as mutually interrelated – present themselves to public consciousness with a particular urgency at the the present time. During the past generation it seemed that the overwhelming discoveries of science would lead to a totally new conception of nature, while industrial technique or technology, building upon the discoveries of science at the same time that it makes them possible, is in the process of bringing about a far-reaching transformation of the whole of human existence. Thus both concepts, nature and technique, are becoming crucial issues for the thinking of our age. Yet both have their origins in ancient Greece, and like all ancient Greek concepts, are not merely words but forms of thought, categories, schemes, and ways of looking at what is, by which the Greeks two and a half millenia ago sought to explain the oncoming reality and to master it by thought. Perhaps in this matter it would be worthwhile to use philological studies to go to the root of the ideas of “nature” and “technique,” and from their origins to illuminate things which have become commonplace, in fact only too commonplace, in our everyday existence.

The Concept of “Nature” among the Greeks

1

The word “nature,” by which we generally designate the totality of all things existing around us (sometimes including man, at other times excluding him) is the Latin word which practically all European languages have adopted. But the conception is Greek and lies in the word *phýsis*, which the Romans rendered by their word *natura*. The fact that the European nations and (so far as I know) other languages hardly had any word of their own to rival it, is of some significance; it witnesses the uniqueness of the Greek conception of the world involved in *natura-phýsis*, as well as the effectiveness of this view of the world.

In Latin *natura* (derived from *nasci*, “to be born”) originally belonged to the language of the farmer and the breeder who used *natura* in a concrete way to designate the uterine orifice of a female quadruped.¹ Designating the place through which birth happens and from which the succession of births proceeds, *natura* was

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used quite early to translate the Greek *phýsis*, so that its original concrete meaning was expanded to include a new general content. As such it designated the creative origin of everything which is and, in another sense, the inborn character, because it also determines the constitution of the thing brought forth.

2

When we turn to the root word *phýsis*, it must first be pointed out that the Greek term is never used, as “nature” now is in common speech and scientific terminology, to designate a realm of objects. *Phýsis* is never that “nature” out there where people make Sunday excursions, “in” which this and that occurs or this and that is such and such. *Phýsis* comes from the Greek verb *phýo*, which means something like “bring-forth,” “put forth,” “make to grow,” chiefly in the botanical realm where the tree puts forth leaves, blossoms, branches, and then in the zoological realm in respect to hair, wool, wings, horns. Moreover, the noun *phýsis*, like all Greek constructions with *-sis* [similar to English gerunds], does not mean some object or material thing, but a coming-to-pass, an event, a directing activity, a *Wesen* [being or essence] – if we understand this word in its original active meaning, which is preserved in *venwesen* [to administer, manage].

Thus in the most general sense *phýsis* means a process of coming-to-be or originating – *génésis* as the Greeks expressed it, something which was the object of inquiry for those who first thought about nature – but an originating process and a coming-to-be as is to be found exhibited in the phenomena of growing and putting forth. The characteristic of growth is that it always comes about *from* something else. That is, all growing is a growing-forth, and in the last analysis presupposes a common origin – the uterine orifice of *phýsis-natura*. Again it is characteristic of the coming-to-be process of growth that out of something already formed it always tends toward some new form and shape. This entire coming-to-be and directing activity of *phýsis* comes about by its own agency, so that the source of that movement which *is* this coming-to-be lies in the thing itself which comes-to-be.

Aristotle also deliberated over *phýsis* with that extraordinary clarity which was his great strength. On the basis of previous linguistic usage he advanced, in his famous definition of *phýsis*,² the following three closely connected meanings of nature.

Phýsis for Aristotle first meant broadly the coming-to-be and being or essence [*Wesen*] of all things which are, which as such bear within themselves the source of motion – whereas the processes of coming-to-be and production in technique do not proceed by their own agency, but are initiated at some point by man. Accordingly, not only the realm of life (i.e. plant and animal organisms) belongs to *phýsis*, but also that of chemical, physical, and atomic changes on earth as well as in the farthest reaches of the cosmos, all of which, like the cosmos in its entirety, are self-moved – or, possibly, originate from a “first mover,” which Aristotle assumes in his theology and which for him is the deity.

Secondly, *phýsis-natura* is for Aristotle the primary, as yet undifferentiated material ground of all coming-to-be, out of which genesis and growth come about, hence the elements understood as the primal matter (*próte hýle*) which persists in all the particularizations of the things which emerge out of it. This meaning takes account of the fact that the directing activity and the being or essence of *phýsis* always comes about from a material substrate, which we must not, however, understand as inert matter.

But this meaning points toward another. To complement the notion of a material ground from which the growth and coming-to-be of *phýsis* comes about, the concepts of form and shape (*éidos* and *morphē*) enter in. These are the end and purpose, the *télos*, of all coming-to-be in nature. For Aristotle and the Greeks, the whole self-movement of nature is not simply effected in the sense of being caused, but ordered or directed in a purposeful manner. At one point Aristotle remarks unequivocally that there are these two kinds of causality in nature, and that when one speaks of nature one must at least try to take account of both, whereas all who fail to do this have actually said nothing about nature.³

In accordance with this general view the individual natural object also has of itself its own *phýsis* or nature in that it has its specific growth – that is, by virtue of the above mentioned self-movement it has proceeded from the elemental material ground which also persists in the specific character of the individual natural object; and it actualizes itself in final form, for instance, in the fully-grown mature state of a plant or animal. And this final form, the *entelechy*, is so decisive for the organism that a natural object can only be said “to have its nature” when it attains to this final form. Henceforward, in Greek, “nature” can go on to designate the established, permanent, essential form and fundamental character of any thing which is.

3

It is not possible in these few pages to pursue the entire history of the concept and the idea of *phýsis* in all its diverse ramifications. But at least let it be stressed that, in the venerable place where we first meet the word it designates, in a remarkably characteristic fashion, the living growth-form or growth of a plant. In the Tenth Book of the *Odyssey*,⁴ the god Hermes plucks the magic herb *mōly* from the ground to give it to Odysseus. “And he showed him its *phýsis*” the poet says. “It was black at the root, and like milk were its blossoms.” The root and blossoms, the bottom and top of the plant, stand for its entire build; and this “build,” the living structure, the growth-form is precisely the *phýsis* which the god shows to the hero in a perfectly matter-of-fact way.

Conceiving *phýsis* to be a living as well as formed growth the Greeks further perceived it as a mysterious, living, directive order in particular things which have of themselves come into being – something which becomes a standard for anyone who, like Heraclitus, seeks to analyze and explain each particular thing according to its nature (*katá phýsin*). Heraclitus who in the fluent reciprocity of opposites finds proportionality, *lógos*, as that which rules and endures, can accordingly arrive at the proposition that “*Phýsis* loves to conceal herself.”⁵ That is, its lawlike, living order is always “behind” everything, no matter how much we may strip it down. Its directing activity can be exhibited yet not fathomed; *phýsis* is an “open mystery.”

For the rest, it is the Greek physicians particularly who, on the basis of their experience with the human organism, have contributed to the elaboration of the concept of *phýsis*. For instance, one of them denies that a certain illness, epilepsy, is of a particularly divine origin. “Illnesses,” he says, “are all divine as much as human, but each nevertheless has its own living laws, *phýsis*, and thus may also be conquered by the physician’s art.”⁶ A renowned physician, in agreement with this, expressed his conviction “that one cannot acquire a more exact knowledge concerning nature from anywhere else than from medicine.”⁷ Later, *phýsis* is extended to the totality of what is, the entire visible *kosmos* which, is *phýsis* in its totality (*hóle phýsis*) or *phýsis* of existing things (*phýsis tón ónton*), now emerges not only as *kósmos*, order, but precisely as living growth, striving from form to form. The Pythagoreans, guided by observations of musical phenomena, established number and symmetry as the ultimate ground of this ontological growth, and then upon this foundation Plato, in the dialogue of his old age,

Timaeus, derived the structure of the “world-soul” which penetrates and embraces the cosmos as well as the structure of the four elements from fundamental mathematical forms and symmetries. He thus founded that mathematical view of nature which, in scientifically rendered form, has proven so extraordinarily successful in contemporary science and technology.

For the Greeks *phýsis* in its “necessity” emerges as divine and superior to all human laws;⁸ one even speaks of a “law of *phýsis*”⁹ Aristotle also observes that *phýsis* gives evidence of divine causation,¹⁰ and says that “everything which is by nature, bears in itself something divine.”¹¹ And in what was for the Greeks a very characteristic as well as instructive union of empirical observation of natural phenomena with the contemplation of their rational activity, this soberly observant thinker, especially in his writings on natural science, pursues the “activity” of nature when he remarks that it “is architectonic;” that it creates, orders, designs;¹² that it teaches, and especially gives instruction to technique; that there is nothing unordered in its domain;¹³ that it shuns the unlimited;¹⁴ that it predominates as the creative power in each individual thing, plant and living creature;¹⁵ that it is provident,¹⁶ and always fashions “for the sake of” something;¹⁷ that it fashions by correct reasoning (*eulógos*);¹⁸ that “like god” it makes nothing at random,¹⁹ nor creates anything accidentally, superfluously, purposelessly;²⁰ that it does not proceed by episodes like bad tragedy;²¹ but strives in everything for what is beneficial²² and has the best in view.²³ It is an activity of directing which as a comprehensive and purposeful directing that creates from form to form is, Aristotle says, ultimately “dependent upon god as its prime mover.”²⁴

Man is placed into the totality of this directing activity of *phýsis*. Thus the conception of *phýsis* as a self-moved process of creating from form to form also influences the domains of ethics and aesthetics, and Aristotle can say that nothing which is contrary to nature can be good (“right”).²⁵ Heraclitus can put forth the significant proposition that “Sound thinking is man’s greatest power, and his highest aptitude consists in the fact that he has the capacity to say what is, and that he can fashion creatively by hearkening to nature.”²⁶ As we know, Heraclitus strongly influenced later Stoic philosophy which regarded all of nature as penetrated by the divine *lógos*, and established as a guideline for the upright and blessed life the dictum that one must live “in harmony with nature,” a principle which has influenced the most diverse kinds of naturalistic ethics in the modern period.

4

The Greek view of nature which has been generally described became the foundation of our modern conception of nature when in the Renaissance people turned anew to antiquity and to its cosmological thought. But a few things had happened in the meantime. And so it came about that our modern conception of nature more and more abandoned the comprehensive wholeness of the ancient Greek *phýsis*, the wholeness and unity of form and motion, law and life, causality and purpose; and that chiefly in developing the modern dualism between thought and extension we have separated nature and spirit, nature and freedom, the I and the world, subject and object, from one another. We have taken man out of nature, placed him over and against it, and reduced the consequently profaned nature to a mere object of human knowledge. Goethe, who with his notion of the “imprinted From which unfolds itself through living,” understood the ancient *phýsis* better than anyone else, and was thinking of this modern reduction when in his later years he once lamented the fact “that Nature, who makes us to create, is no longer Nature at all, but a being completely different from that with which the Greeks were occupied.”²⁷

This reduction of nature to what is calculable has, as is plain to see, proven to be extraordinarily successful. It has brought us the most astounding discoveries, and placed in our hands the greatest means of power – although at the cost of an impoverishment that is hard to estimate. Today, however, we are experiencing how our most advanced science, following its own rigorous development of problems is in the process of overcoming this dualism of subject and object and is necessarily drawing man, as the observing subject, back into the act of nature’s transition into appearance and knowledge.²⁸ And thus it almost seems as if we have attained to a point higher on the spiral approaching the Greeks’ view of *phýsis*, from which even the things set forth here may take on some new actuality.

The Concept of “Technique” among the Greeks

1

By its very etymology the concept of *technique* points more directly than that of *nature* to its origin in the language, thought, and world-view of the Greeks.

To begin with etymology, we find at the very beginning an Indo-European stem that was pronounced approximately *tekp*, and meant “woodwork” or “carpentry.” It appears in Latin in the word for weave, *texo* (hence our “textile”); while Old High German *dehsala*, “hatchet,” and Middle High German *dehsen*, “to break flax,” go back to the same stem. In ancient Greek the stem appears early in *téktōn*, the “master builder” and “carpenter,” whom Homer already knows and honors in his poetry.²⁹ This *téktōn* survives in our “architect” and “tectonic.” But to *téktōn* belongs the important *téchnē*, which designates the art or skill of the carpenter and master builder, and more generally the art of every kind of production. The word then comes to mean on the one hand a concrete sense of “craftsmanship” and “trade” of every kind, and on the other hand the ability to devise strategems and hatch plots, and in general a “clever, crafty machination.”

From *téchnē* the adjective *technikón* is formed in Greek, which in addition to aptitude for the art of production also designates the general aggregate of what is in accord with and suited to art or skill. By the way of the Latin “*technica ars*,” the art of skilled production, the word passed to the French who, in a period of extraordinary technical activity during the 17th century, developed the term *technique*, which in the early 18th century was taken over into German as *Technik*, to designate the entire domain of all those procedures and actions related to skill production of every kind. Finally, for us today *Technik* means in a still more general sense the sum and substance of all means and modes of procedure whose mastery is the condition for what is in the highest sense the competent practice of an art or skill. And so we speak of “masterly technique” in the case of the athlete and the musician as well as the poet.³⁰

We may note at this point that “machine,” which is closely bound up with “technique,” likewise is ultimately Greek in origin. At the beginning, already in Homeric Greek, we find *mêchos*, which means something like “expedient or remedy in a difficult situation.” A further construction from *mêchos* is *mēhané*, which likewise has the primary meaning of a “remedy,” “clever expedient,” or “cleverly contrived means” by which one gets anything. But this word signifying “means by which one gets” is already used in classical fifth century Greece for the concrete “machine,” the stage machine and the war machine. The Romans, accordingly, adopted it on loan in the word *machina*, which by way of the French *machine* has passed into German with its French pronunciation.

Another direct descendent from the ancient *mēchanē* persists in “mechanics,” “mechanical,” “mechanistic.” In our “mechanistic” world-view which was established by Newton this term has attained great importance, while the expression “merely mechanical,” on the other hand, disparagingly means an unconscious, indifferent, purely routine activity; and as designating the precise but lifeless course of mechanical processes, it came to mean the opposite of “organic.” In Greek the word *órganon* originally meant a mere instrument or tool. But because from Plato on it was applied especially to the organs of the body, chiefly to those of perception, the word rose to mean the parts of the living organism, whereupon “organic” has come to mean the natural living functional system as opposed to the “mechanical.”

So much then for the general survey of the concept of *technique* and some related concepts in ancient Greek and in their remarkably diverse history up to their present usage.

2

In order to discuss more closely now the central concept *téchnē*, let us first say something about how Greek thinkers and philosophers, especially Aristotle, conceptually refined the long familiar notion of *téchnē* and assigned it a special place among other concepts of action and production.

At first sight *téchnē* presents itself to us as a particular kind of knowledge, as opposed to other kinds of knowledge. *Téchnē* is that knowledge and ability which is directed to producing and constructing, and thus occupies a sort of intermediate place between mere experience or know-how, *emperiría*, and theoretical knowledge, *epistēmē*. *Téchnē* differs from theoretical knowledge, *epistēmē*, in that the latter has to do with what is immutable, purely existent and primary, in all its relations and implications (i.e., mathematics), whereas *téchnē*, as “productive knowledge,” bears upon the domain of what is mutable, in the process of becoming, and comes to be. *Téchnē*, builds upon *emperiría*, experience. But whereas mere experience, which rests upon what is retained and associated in memory, regards only the particular instances and their connection, *téchnē* proceeds from many particular cases to a universal concept.³¹ Thus the medical practitioner with mere experience only knows that chicken is good for a weak stomach. But the physician, who is in possession of *téchnē*, knows furthermore that chicken is a light food and why it is

light and why the stomach is weak.³² Whereas experience knows only the “that,” *téchnē* knows also the “why,” the reasons, and in this respect approaches theoretical knowledge, *epistēmē*.³³ Thus *téchnē* is expressly defined as a knowledge and ability which has come about by habit, i.e. has passed into flesh and blood, and which is directed to a producing, but in connection with a clear course of reasoning concerning the thing itself, which the man of mere experience does not have in view.³⁴ A knowledge that is likewise productive but which, however rich and diverse it may be, has a false idea of the thing itself remains simply *atechnía*, blunder.³⁵

3

In a second respect *téchnē*, as the process of production by which something comes to be, belongs in the large, diversely activated domain of the mutable with its various processes of coming-to-be. Here too *téchnē* assumes a kind of intermediate position between those processes which merely result because this and that coincide in such and such a fashion – which the Greeks conceived as *týchē*, mere coincidence or “chance” – and the regular, vital processes of nature, *phýsis*, which we have treated in the first section. As every technician and all those who practice a skill know, happy coincidence still plays a considerable role in our methodical technique, or technology. And so Aristotle too approves the words of the tragic poet: “*Téchnē* loves happy chance, as happy chance loves *téchnē*.”³⁶

But the directing activity of *téchnē* actually comes much nearer to the directing activity of nature than to chance; indeed, both *téchnē* and nature proceed in a fundamentally identical manner. Both the manner by which nature generates and that by which technique produces are alike in that by the agency of something and out of something a something is realized.³⁷ They differ in the fact that in nature the agent’s source of motion lies in the natural object itself, whereas in *téchnē* it has its source in the thinking soul of him who initiates the technical process; i.e., the production. In the cases of both nature and *téchnē* we are concerned with the realization in matter of a figure or form, which is the end. In nature the origin and development toward this end, the form or configuration (the *eídos*,) takes place by itself. In technique the end-form is principally conceived and constructed in man’s act of thinking. We speak of the plan, the design, the construction. The way of constructive thinking then proceeds from the end-form; whether house,

station, hospital, or school; step by step forward through the different means of realization, finally to the matter, the ultimate building material. The procedure of technical actualization then goes back the same way, from the procurement and preparation of the material, through its compounding according to the stipulations of the design first conceived and elaborated in thought, to the realized structure, which then stands there as hospital, station, or school.³⁸

Because in *téchnē* man intervenes as the one who must, from the needs of his condition, first conceive in thought an object to be made, then determine its design and carry out its construction, the process of production in *téchnē* is more complicated than that of generation in nature. But the production process itself takes place in a manner directly analogous to the processes of generation and coming-to-be in *phýsis*. Thus the Greeks arrived at the principle that *téchnē* imitates nature,³⁹ which when correctly understood amounts to saying that *téchnē* in its process of production proceeds analogously to the natural processes of generation. At the same time, however, the Greeks observed that *téchnē* perfects that which nature by itself was unable to achieve.⁴⁰ This “perfecting” is clearly conceived in terms of what is useful to man. For nature when left to itself pursues its own way in simple, unvarying fashion. But what is useful to man is as variable as man himself. Therefore, when it is a matter of bending the simple directing activity of nature out of its own way to the uses of man which it resists, difficulties arise; and this is where technique intervenes, by inventing expedients, “machines,” which with the means of nature bend nature to serve human purposes. Thus a tragic poet has already said the same thing – “by *téchnē* we master that to which we are subject by nature.”⁴¹ Example: the lever, which enables us to move great loads with little expenditure of force.⁴² This is the way in which *téchnē*, by proceeding analogously to nature on the one hand, brings nature to perfection – in terms of human needs – on the other.

4

From what has been said so far, the Greek concept of technique is characterized by the twofold relationship of technique first to theoretical knowledge and then to the processes of nature. Because the Greeks understood both relationships together in the notion of *téchnē*, it could never happen for them that technique would seek to set itself up independently over against theoretical

knowledge, or that it would totally lose nature from view and see it merely as a furnisher of energy and raw materials to be “mastered.” Because the Greeks included a relationship to theoretical knowledge in their concept of technique, it came about that for the Greeks – and only for the Greeks – the old handicraft, operating on the foundation of a strictly empirical and traditional knowledge, became an integrated part of technique as a science.

In technique as thus understood the Greeks came to see a very lofty kind of knowledge and at the same time a quite definite humanism. Thus Socrates in his search for the genuinely knowledgeable man is disappointed when he approaches politicians and poets, but among the handicraftsmen [*Techniker*, men of technique] he finds genuine knowledge of their business, as he himself says. Only the handicraftsmen, too, spoil this knowledge when they presume, on the basis of their sound specialized knowledge, to know and judge of everything⁴³ – or, in modern terms, to set up their technical knowledge as absolute. As for the human dignity of technique, for the Greeks this is attested to from Homer onwards by the lively, even good-humored interest which poets as well as prose writers take in all aspects of making and producing.

Generally speaking, the chief concern with which the Greeks enter the world, in contrast with the older civilizations of the Orient, is the interest in man as “man in his world.” Also involved in this interest is their interest in all occurrences of production and making, whether it be the way in which Homer depicts how Hephaestus forges the shield for Achilles⁴⁴ and Odysseus builds his ship;⁴⁵ or Herodotus with joy and wonder describes such astonishing technical feats as the Athos canal,⁴⁶ the Hellespont bridge,⁴⁷ an aqueduct tunnel on Samos;⁴⁸ or Aeschylus in his plays depicts the fire signal which in the shortest time brings the news of victory from Troy to Argos,⁴⁹ and in his *Prometheus* explains the fundamental human mission of technique, which with the aid of fire has not only led man out of a primitive cave existence into civilization but has also made him into a free being as well.⁵⁰ To be sure, Aeschylus also points to the demonic which lurks in technique, as when Prometheus brought fire to men only by a misdeed – theft from the hearth of the gods.

Sophocles also gives valid testimony to the perilous mongrelism of technique, in the famous choral ode of the *Antigone*.⁵¹ He speaks of the *deinótēs* of man which has led to technique. *Dei-nótēs*, literally “terribleness,” comprises at once the “ability” and the “monstrous”

(uncanny) power which technique has placed into man's hand. It has made him master of land and sea, enabled him to set up state and culture and even to take up arms against death. But since man “with the inventiveness of techniques holds in his hand something clever beyond expectation,” he stands where the path forks toward good and evil.⁵² This expresses with great exactness the perilous problematic of technique which engages us even today. This problematic too,

along with the twofold relation to theoretical knowledge and the directing activity of nature, belongs to the Greek notion of technique, which in this context proves to be singularly instructive. By the simplest pattern, as it were, this notion brings into view the possibilities and the limitations of technique, and discloses that perspective from which, as a great power of man, it becomes effective in the totality of things human through its correctly conceived use.⁵³

Notes

This essay includes two lectures originally delivered over the North German Radio Network, June 25 and July 10, 1959. It is translated here by permission of the publisher from Wolfgang Schadewaldt, *Natur, Technik, Kunst: drei Beiträge zum Selbstverständnis der Technik in unserer Zeit* (Göttingen: Musterschmidt, 1960), pp. 35–53. Translation copyright by Carl Mitcham and Robert Mackey. Wolfgang Schadewaldt's *Hellas und Hesperien*, 2 vols. (Zurich and Stuttgart: Artemis Verlag, 1970), includes the following related works: “Das Welt-Modell der Griechen” (vol. 1, pp. 601–625), “Die Anforderungen der Technik an die Geisteswissenschaften” (vol. 2, pp. 461–484), “Die Welt der modernen Technik und die altgriechische Kulturidee” (vol. 2, pp. 485–497), “Natur – Technik – Kunst” (vol. 2, pp. 497–512), and “Zu Werner Heisenbergs Darstellung der Entwicklung der modernen Atomphysik” (vol. 2, pp. 525–527).

- 1 For this important fact I am indebted to the erudition of my friend Ernst Zinn.
- 2 *Physics* II, 1–2, 192b8–194b5; *Metaphysics* V, 4, 1014b 16 ff.
- 3 *Parts of Animals* I, 1, 642a14 ff.
- 4 *Odyssey* X, 302 ff.
- 5 Fragment 123, Diels-Kranz.
- 6 *The Sacred Disease*, 329.
- 7 Hippocrates, *De Prisca Mediana*, 20.
- 8 Cf. for instance the tragedian Euripides, *Trojan Women*, 866 f.
- 9 Plato, *Gorgias* 483e–f; Aristotle, *De Caelo* I, 1, 268a14.
- 10 *Nicomachean Ethics* X, 9, 1179b21.
- 11 *Nicomachean Ethics* VII, 13, 1153b32.
- 12 *Parts of Animals* I, 5, 645a9; II, 14, 658a23 and 32; II, 16, 659b35; and *Eudemian Ethics* VII, 14, 1247a10.
- 13 *Generation of Animals* III, 10, 760a31.
- 14 *Generation of Animals* I, 1, 715b14.
- 15 *Generation of Animals* II, 4, 741a1.
- 16 *De Caelo* II, 9, 291a24.
- 17 *On Sleeping and Waking* 2, 455b17.
- 18 *Parts of Animals* II, 9, 654b31; *Generation of Animals* II, 6, 742b23 and 4, 740a28.
- 19 *De Caelo* I, 4, 271a33.
- 20 *De Caelo* II, 8, 290a31 and 11, 291b13; and *On the Soul* III, 9, 432b21 *et passim*.

- 21 *Metaphysics* XIV, 3, 1090b19.
- 22 *On Generation and Corruption* II, 10, 336b28.
- 23 *Parts of Animals* II, 14, 658a23.
- 24 *Metaphysics* XII, 7, 1072b13.
- 25 *Politics* VII, 3, 1325b10.
- 26 Fragment 112.
- 27 See Ernst Grumach, ed., *Goethe und die Antike, eine Sammlung* (Berlin, 1949), “Maximen und Reflexionen,” Nos. 1364–66, p. 230.
- 28 [This no doubt refers to some theories of Heisenberg and Heidegger. For Heidegger's discussion of *physis* see *An Introduction to Metaphysics* (New York: Doubleday Anchor, 1961), p. 11 ff. and “On the Being and Conception of $\Phi\upsilon\sigma\iota\varsigma$ in Aristotle's *Physics* B, 1,” *Man and World* 9, no. 3 (August 1976): 219–270 – Editors.]
- 29 *Odyssey* XVII, 382 ff.
- 30 [The English “technology” has a somewhat different history. It is ultimately derived from the Greek *technologia*, meaning “a systematic treatment” – especially of grammar. In fact, its first Greek occurrence is in Aristotle's *Rhetoric* (1354b17, 1354b26, and 1356a11). However, its Latin form with basically the same meaning, does not occur till very late, after 1500. And as late as 1683 it is still used in Twells' *Examination Grammar* in this sense. But by the beginning of the seventeenth century it already has been extended to include the systematic study of the practical or industrial arts. For some reason similar constructions in other European languages – cf. German *Technologie*. French *technologic* – have never achieved the same currency as the English. – Editors.]
- 31 *Metaphysics* I, 1, 981a1 ff.
- 32 *Nicomachean Ethics* VI, 7, 1141b18.
- 33 *Metaphysics* I, 1, 981a24–b9.
- 34 *Nicomachean Ethics* VI, 4, 1140a10 ff.
- 35 *Nicomachean Ethics* VI, 4, 1140a20 ff.
- 36 *Nicomachean Ethics* VI, 4, 1140a18 ff. [Aristotle is quoting Agathon. – Editors.]
- 37 *Metaphysics* VI, 7, 1032a11 ff.
- 38 *Metaphysics* VI, 7, 1032b1 ff.

- 39 E.g., *Physics* II, 2, 194a21.
 40 *Physics* II, 8, 199a15 f.
 41 [Antiphon, as quoted by pseudo-Aristotle, *Mechanical Problems* 847a21.]
 42 *Mechanics* I, 847a13 ff.
 43 Plato, *Apology of Socrates*. 22c–d.
 44 *Iliad* XVIII, 478 ff.
 45 *Odyssey* V, 243 f.
 46 Herodotus, *Histories* VII, 22 f.
 47 *Histories* VII, 36.
 48 *Histories* III, 60.
 49 Aeschylus, *Agamemnon*, 281 ff.
 50 *Prometheus Bound*, 248 ff. and 443 ff.
 51 Sophocles, *Antigone*, 332 ff.
 52 [Schadewaldt's German translation of *Antigone* 365–6, when literally rendered into English, reads “with the inventiveness of technology, holds in his hands an intellectual means never anticipated.” The Greek text of A. C. Pearson (Oxford):

σοφον τι το μαχαωοεω
 τεχνας υπερ ελπια

Literal translation: “having, in the inventiveness of *téchnē*, something cunning beyond expectation.” – Editors.]

- 53 Some bibliographical references on the notion of *phýsis* and *téchnē* among the Greeks: Edmund Hardy, *Der Begriff der Phýsis in der griechischen Philosophie* (Berlin: Weidmann, 1884); H. Siebeck, “Über die Entstehung der Termini natura naturans und natura naturata,” *Archiv für Geschichte der Philosophie* 3 (1890): 370–378; John Walter Beardslee, *The Use of Φύσις in 5th Century Greek Literature* (Chicago: University of Chicago Press, 1918) [PhD dissertation]; A. N. Whitehead, *The Concept of Nature* (Cambridge: Cambridge Univ. Press, 1920); John Dewey, *Experience and Nature* (Chicago: Open Court, 1925); Morris R. Cohen, *Reason and Nature: An Essay on the Meaning of Scientific Method* (New York: Harcourt Brace, 1931); Frederick J. E. Woodbridge, *Nature and Mind* (New York: Columbia Univ. Press, 1937); Hans Diller, “Der griechische Naturbegriff,” *Neue Jahrbücher* 114 (1939): 241–257; R. G. Collingwood, *The Idea of Nature* (Oxford: Clarendon Press, 1945); H. Bartz and W. Rüegg, eds., *Natur und Geist* (Zurich, 1946); P. Weiser, *Nature and Man* (Oxford, 1947). – Hermann Diels, *Antike Technik; sieben Vorträge*, 2nd ed. (Leipzig and Berlin: B. G. Teubner, 1920); Albert Rehm and Kurt Vogel, “Exakte Wissenschaft,” in *Einleitung in die Altertums-wissenschaft*, ed. A. Gercke and E. Nordern, vol. II, part 5, 4th ed. (Leipzig and Berlin: B. G. Teubner, 1933), esp. pp. 55 f., 71 ff.

On the Idols, the Scientific Study of Nature, and the Reformation of Education

Francis Bacon

Thoughts and Conclusions on the Interpretation of Nature as a Science Productive of Works

15. The need for a philosophy of invention

But it is not only the methods of demonstration that are at fault. The methods of discovery, or invention, if indeed there be any, are just as much in need of examination. And here Bacon¹ found evidence not so much of wandering from the true path, but simply of solitude and emptiness. He was indeed dumbfounded at it. To think that no man among men should ever have had it in his heart or on his mind to direct the resources of human wit and intellect towards the arts and sciences and to pave a path towards that goal! To think that this whole endeavour should have been, should still be, left to the obscurity of tradition, the dizzy round of argument, the eddies and whirlpools of chance and mere experience! He felt driven to condone the strange practice of the Egyptians. Like other ancient peoples

they deified their inventors; and if they set up images even of brute beasts in their temples, well, they had the excuse that the irrational animals have discovered almost as many of nature's operations as men have done. Men indeed have failed to use their prerogative of reason to this end. However, we must not neglect to look into such discoveries as are made.

We may consider first the simple artless mode of discovery habitual to men. All this amounts to is that everyone who makes the attempt first seeks out and peruses what others have said on the subject and then adds his own quota of thought. But it is a baseless procedure either to entrust oneself to the authority of others or to solicit, to invoke, one's own spirit to deliver oracles. Next comes the kind of discovery or research in favour with the dialecticians. It shares no more than the name with what we have in mind. The dialecticians are not concerned to seek out the principles and axioms on which arts depend; they look only for logical consistency. When exceptionally keen and persistent researchers come to bother them with their questions, the dialecticians' practice is to urge them to put their trust in, nay, to take an oath of blind loyalty to,

Francis Bacon, "Thoughts and Conclusions on the Interpretation of Nature as a Science Productive of Works," trans. B. Farrington in *The Philosophy of Francis Bacon* (Liverpool: Liverpool University Press, 1964), pp. 90–96 abridged; reprinted by permission of Liverpool University Press. "The Plan of the Work 6" and "Aphorisms Concerning the Interpretation of Nature and the Kingdom of Man," from *Novum Organum*, trans. and ed. Peter Urbach and John Gibson (Chicago and LaSalle: Open Court Publishing, 1994), pp. 29, 43, 53–56, 202; © 1994, reprinted by permission of Open Court Publishing Company, a division of Carus Publishing Company, Chicago, IL. "On the Idols and on the Scientific Study of Nature," from *The New Atlantis*, ed. Jerry Weinberge (Wheeling, IL: Harlan Davidson, Inc., rev. edn. 1989), pp. 71–74, 77, 79–83 abridged; copyright ©1980, 1989, reprinted by permission of John Wiley & Sons, USA. "Sphinx; or Science" and "On the Reformation of Education" from "Translation of the 'De Augmentis,'" in *The Works of Francis Bacon*, ed. J. Spedding, R.L. Ellis, and D.D. Heath (London: Longman, 1980), pp. 159–162 and 284–291, abridged.

the existent art, such as it is. Finally, there are inventions due to experience pure and simple. If it just happens, it is called chance; if it has been sought after, it is called experiment. But these are only examples of what the proverb calls the broom that has come untied.

Those who try to discover the nature or mode of operation of anything by the repetition of random experiments are never at one stay. They alternate between puzzled inaction or giddy activity; hot on the trail one moment, covered with confusion the next; their one discovery being the need for further investigation. How could it be otherwise? To imagine that the nature of anything can be found by examining that thing in isolation, is a notion born of ignorance and inexperience. The nature one seeks may be latent in some things, but manifest and palpable in others; in some things a matter for astonishment, in others too common to notice. There is, for example, a property in bodies which makes them hold together. Water-bubbles seem to shut themselves up in little hemispherical membranes; the force by which they do this strikes us as something mysterious and ingenious. The force which holds wood or stone together we take for granted, and give them the name of solid.

Bacon's conclusion was that men should perhaps be called rather unlucky than ignorant. It is not that they have not exerted themselves; but ill-luck or fond illusions have deflected them from their course.

16. The time has come for a fresh start

It is time an end were put to this desperation, or at least to these laments. We must decide once for all whether it would be better to abandon the endeavour and rest content with what we have, or make a serious exertion to improve our lot. The first step to this end is to set up in view the worthiness and excellence of the aim proposed, and so kindle greater enthusiasm for hard work on an exacting business. In this connection Bacon recalled how in antiquity extravagant enthusiasm led men to accord divine honours to inventors; while on those who deserved well of their fellows in civil affairs, on founders of cities and empires, Lawmakers, Liberators of their country from long-standing evils, over-throwers of tyrants, and others of this ilk, the style of Heroes only was conferred. Not for nothing, Bacon reflected, was this distinction observed in ancient times; for the benefits inventors confer extend to the whole human race, while those of civil heroes are confined to particular regions and narrower circles of human settlement. And there is this too. Inventions come without force or disturbance to bless the life of mankind,

while civil changes rarely proceed without uproar and violence. If then the utility of some one particular invention so impresses men that they exalt to superhuman rank the man who is responsible for it, how much more noble would that discovery be which should contain within itself the potentiality of all particular inventions, and open up to the human spirit a path of direct and easy access to new remoter powers. Take an example from history. In olden days, when men directed their course at sea by observation of the stars, they merely skirted the shores of the old continent or ventured to traverse small land-locked seas. They had to await the discovery of a more reliable guide, the needle, before they crossed the ocean and opened up the regions of the New World. Similarly, men's discoveries in the arts and sciences up till now are such as could be made by intuition, experience, observation, thought; they concerned only things accessible to the senses. But, before men can voyage to remote and hidden regions of nature, they must first be provided with some better use and management of the human mind. Such a discovery would, without a doubt, be the noblest, the truly masculine birth of time.

Again Bacon noted that, in the Scriptures, King Solomon, though blessed with empire, gold, splendour of architecture, satellites, servants, ministers and slaves of every kind and degree, with a fleet to boot, and a glorious name and with the flattering admiration of the world, yet prided himself on none of these things. Instead he declared that *It was the glory of God to conceal a thing, the glory of a King to find it out*; as if the divine nature enjoyed the kindly innocence of such hide-and-seek, hiding only in order to be found, and with characteristic indulgence desired the human mind to join Him in this sport. And indeed it is this glory of discovery that is the true ornament of mankind. In contrast with civil business it never harmed any man, never burdened a conscience with remorse. Its blessing and reward is without ruin, wrong or wretchedness to any. For light is in itself pure and innocent; it may be wrongly used, but cannot in its nature be defiled.

Bacon next considered the nature of human ambition and found it to be of three kinds, one perhaps not worthy of the name. The first is of those men who with restless striving seek to augment their personal power in their own country. This is the vulgar and degenerate sort. The second is of those who seek to advance the position of their own country in the world; and this may be allowed to have more worth in it and less selfishness. The third is of those whose endeavour is to restore and exalt the power and dominion of man himself, of the human race, over the universe. Surely this is nobler and holier than the former

two. Now the dominion of man over nature rests only on knowledge. His power of action is limited to what he knows. No force avails to break the chain of natural causation. Nature cannot be conquered but by obeying her.

This put Bacon upon thinking of examples to illustrate not simply the force of inventions but how such force is accompanied by rewards and blessings. This force is most plainly seen in those three inventions unknown to antiquity, and whose origins are still to us obscure and inglorious, to wit, Printing, Gunpowder and the Nautical Needle. These three, few in number, and not lying much out of the way, have changed the face and status of the world of men, first in learning, next in warfare, and finally in navigation. On them have followed countless changes, as a close scrutiny reveals. In fact, no empire, no school, no star seems to have exerted a greater influence on human affairs than these mechanical inventions. As for their value, the soonest way to grasp it is this. Consider the abyss which separates the life of men in some highly civilised region of Europe from that of some savage, barbarous tract of New India. So great is it that the one man might appear a god to the other, not only in respect of any service rendered but on a comparison of their ways of life. And this is the effect not of soil, not of climate, not of physique, but of the arts. Thus, in the geographical world, the old is much more civilised than the new. In the scientific world this is not so. On the contrary, recent acquisitions must be held the more important. They do not, like the old, merely exert a gentle guidance over nature's course; they have the power to conquer and subdue her, to shake her to her foundations. For the rule is that what discoveries lie on the surface exert but little force. The roots of things, where strength resides, are buried deep.

It may be that there are some on whose ear my frequent and honourable mention of practical activities makes a harsh and unpleasing sound because they are wholly given over in love and reverence to contemplation. Let them bethink themselves that they are the enemies of their own desires. For in nature practical results are not only the means to improve well-being but the guarantee of truth. The rule of religion, that a man should show his faith by his works, holds good in natural philosophy too. Science also must be known by works. It is by the witness of works, rather than by logic or even observation, that truth is revealed and established. Whence it follows that the improvement of man's mind and the improvement of his lot are one and the same thing.

Bacon drew the conclusion that all he has said about the worthiness of the end which he has marked out and measured in his mind is not exaggerated but falls short of the truth.

17. Omens favourable to research

But, since what has been said about the excellence of the end may be regarded as a dream, let us consider with full care what hopeful prospect there is and in what quarter it shows itself. We must not suffer ourselves to become prisoners of a vision of supreme goodness and beauty and so abandon, or impair, the strictness of our judgment. Rather we should apply the rule current in civil affairs and be suspicious on principle and look on the dark side of human prospects. Let us cast aside all slighter hopes and vigorously canvass even those that seem most firm. In this determination Bacon consulted the auspices with all due care; and here the first thing that struck him was that the business in hand, being eminently good, was manifestly of God, and in the works of His hand small beginnings draw after them great ends. Then the omens from the nature of Time were also good. All concur that truth is the daughter of Time. How pusillanimous, then, to grovel before authors but to allow to Time, the author of authors and of all authority, less than his due! Nor were his hopes drawn only from the universal character of time, but from the special prerogative of our own age. The opinion men cherish about Antiquity is ill-considered and ill-suited to the word. The term should mean the ripe age, the fullness of years, of the whole world. Now among men we expect greater knowledge of affairs and more maturity of judgment from an old man in proportion to his experience and the multitude of things he has seen, heard and pondered; so from our modern age, if it but realised its powers and would put them boldly to the trial, far greater things are to be expected than from those distant days; for the world has grown older and immeasurably increased its store of experience and observation. It ought not to go for nothing that through the long voyages and travels which are the mark of our age many things in nature have been revealed which might throw new light on natural philosophy. Nay, it would be a disgrace for mankind if the expanse of the material globe, the lands, the seas, the stars, was opened up and brought to light, while, in contrast with this enormous expansion, the bounds of the intellectual globe should be restricted to what was known to the ancients.

It is worth bearing in mind, too, that the political conditions of Europe in this age are favourable. England is stronger, France is restored to peace, Spain is exhausted, Italy and Germany are undisturbed. The balance of power is restored and, in this tranquil state of the most famous nations, there is a turning towards peace; and peace is fair weather for the sciences to flourish.² Nor is the state of letters unfavourable. Rather, it has many auspicious aspects.

By the Art of Printing, a thing unknown to antiquity, the discoveries and thoughts of individuals are now spread abroad like a flash of lightning. Religious controversies have become a weariness of the spirit, and men are perhaps more ready to contemplate the power, wisdom, and goodness of God in His works. Still, let us assume we have to do with a man who is overwhelmed by the unanimity and duration of the world's acquiescence in the opinions of former days. If such a man considers closely he cannot fail to see that leaders of opinion are but few and that all the rest, their followers, are but ciphers. They have never given a valid assent to the general opinion, for this results from an act of independent judgment. All they have managed to do is to make the step from ignorance to prejudice. If, then, the unanimity of these opinions is an illusion, so is their duration. On examination it shrinks to very narrow bounds. Suppose we allow twenty-five centuries to the recorded history of mankind. Of these scarce five can be set apart as propitious towards, and fruitful in, scientific progress, and the kind of sciences they cultivated were as far as possible removed from that natural philosophy we have in mind. Three periods only can be counted when the wheel of knowledge really turned: one among the Greeks, the second with the Romans, the last among the nations of Western Europe. All other ages have been given over to wars or other pursuits. So far as any scientific harvest is concerned they were barren wastes.

Another favourable omen is found in an understanding of the power and true nature of Chance. Chance, operating in suitable circumstances, has prompted many discoveries. This explains why, in the discovery of fire, the Prometheus of New India followed a different course from the European Prometheus. Flint is scarce in New India. Clearly in inventions which depend on the availability of suitable materials chance plays a large part; in inventions remote from daily experience, a smaller one; yet, be its role big or little, in every age it is the fertile parent of discoveries, nor have we any reason to suppose it has grown old and past bearing. Bacon accordingly opined that, since discoveries occur even when men are not looking for them and are thinking of something else, it is reasonable to expect that when men *are* thought determined and intelligent experimentalists. But, whichever group

they belong to, these pretensions are only evidence of their wish to have a reputation above their fellows. In fact the divorce between the two activities, speculation and experiment, has always obtained. But if the two could be joined in a closer and holier union the prospects of a numerous and happy issue are bright indeed.

There is also this further ground for comfort. When he reviewed the infinite expenditure of brains, time, and money on objects and pursuits which, fairly judged, are useless, Bacon was certain that a small portion of this expenditure devoted to sane and solid purposes could triumph over every obstacle. Men shrink back from the multiplicity of particular facts. Yet the phenomena of the arts are easily grasped in comparison with the fictions of the mind once they break free from the control of factual evidence. Thus all the arguments adduced above urge us on to adopt a hopeful view. But the surest ground of hope is in the mistakes of the past. When the affairs of a commonwealth had been mismanaged, there was comfort in the remark: The blacker the past, the brighter the hope for the future. In philosophy, too, if the old errors are abandoned (and to be made aware of them is the first step to amendment), things will take a turn for the better. But if men had been on the right path all those ages past and yet had got no further, what hope could there be? Then it would have been clear that the difficulty lay in the material to be investigated (which is out of our control), not in the instrument, that is to say, the human mind and its management, which is ours to improve. As things are, it is plain that there are no insuperable or immovable objects in the way; simply it lies in a direction untrodden by the feet of men. It may frighten us a little by its loneliness; it offers no other threat. A new world beckons. Even if the breezes that reach us from it were of far less promise and hope, Bacon was resolved that the trial should be made. Not to try is a greater hazard than to fail. If we fail, it is the loss but of a trifling effort. Not to try is to forgo the prospect of measureless good.

The conclusion of this meditation, of what has been said and left unsaid, is that there is no lack of hope. There is hope enough both to launch the man of enterprise on the venture and to convince the deep and sober mind of the likelihood of success.

Notes

1 [The following four pages were written by Bacon himself in the third person, translated here by B. Farrington, Editors.]

2 Bacon's optimism here is facile. The Thirty Years War and the English Revolution were at hand.

From *Novum Organum*

The plan of the work

I have made a beginning that, I hope, is not to be despised; the fortune of mankind will give the outcome, such as men in the present state of things and of minds may perhaps be unable to grasp or measure. For the matter in hand is not just a pleasant speculation, but in truth concerns the affairs and fortunes of mankind and all the power of its works. For man is only the servant and interpreter of Nature and he only does and understands so much as he shall have observed, in fact or in thought, of the course of Nature; more than this he neither knows, nor can do. No force whatever can unfasten or break the chain of causes, and Nature is only overcome by obeying her. So it is that those two objects of mankind, *Knowledge* and *Power*, come in fact to the same thing; and the failure of works derives mostly from ignorance of causes.

[...]

Aphorisms concerning the interpretation of nature and the kingdom of man

3

Human knowledge and human power come to the same thing, for where the cause is not known the effect cannot be produced. We can only command Nature by obeying her, and what in contemplation represents the cause, in operation stands as the rule.

[...]

38

The idols and false notions that have hitherto occupied the human understanding, and lie deep-seated there, have not only so beset men's minds that their approach to the truth becomes difficult; but even when access to it is given and conceded, they will present themselves and interfere in that very restoration (*instauratio*) of the sciences, unless men are forewarned and protect themselves against them as far as possible.

39

There are four kinds of idols besetting human minds. To help in my teaching, I have given them names. I call the first, *Idols of the Tribe*; the second, *Idols of the Cave*; the third, *Idols of the Market-place*; and the fourth, *Idols of the Theatre*.

40

The formation of notions and axioms by true *induction* is of course the proper remedy for warding off and clearing away these idols, but just to point them out is very useful. For the doctrine concerning idols is to the *Interpretation of Nature* as the doctrine of Sophistical Refutations¹ is to ordinary dialectic.

41

The *Idols of the Tribe* lie deep in human nature itself and in the very tribe or race of mankind. For it is wrongly asserted that the human sense is the measure of things.² It is rather the case that all our perceptions, both of our sense and of our minds, are reflections of man, not of the universe, and the human understanding is like an uneven mirror that cannot reflect truly the rays from objects, but distorts and corrupts the nature of things by mingling its own nature with it.

42

The *Idols of the Cave* are those specific to individual men.³ For besides the errors common to human nature in general, each of us has his own private cave or den, which breaks up and falsifies the light of Nature; either because of his own distinct and individual nature, or because of what he has been taught or gained in conversation with others, or from his reading, and the authority of those whom he respects and admires; or from the different impressions [he gains from things], according as they present themselves to a mind prejudiced and already committed, or to one impartial and moderate, or the like. So that the human spirit (according to how it is distributed in individual men) is variable and always in commotion, and as it were, subject to chance. Whence Heraclitus⁴ has well said that men seek knowledge in lesser worlds, and not in the greater or common world.

43

There are also idols arising from the dealings and association of men with one another, which I call *Idols of the Market-place*, because of the commerce and meeting of men there. For speech is the means of association among men; but words are applied according to common understanding. And in consequence, a wrong and inappropriate application of words obstructs the mind to a remarkable extent. Nor do the definitions or explanations with which learned men have sometimes been

accustomed to defend and vindicate themselves in any way remedy the situation. Indeed, words plainly do violence to the understanding and throw everything into confusion, and lead men into innumerable empty controversies and fictions.

44

Finally, there are idols which have crept into human minds from the various dogmas of philosophies, and also from faulty laws of demonstrations. These I call *Idols of the Theatre*, because I regard all the philosophies that have been received or invented as so many stage plays creating fictitious and imaginary worlds. Nor am I only speaking of present philosophies, nor indeed only of the ancient philosophies and their sects, for numerous other plays of the same kind may yet be composed and contrived, since the most diverse errors spring sometimes from similar causes. Nor again do I mean this only in regard to

universal philosophies, but also to many principles and axioms of the sciences, which have become established through tradition, credulity and neglect.
[...]

And from this an improvement of the estate of man is sure to follow, and an enlargement of his power over Nature. For man by the Fall fell both from his state of innocence and his dominion over creation. Both of these, however, can even in this life be to some extent made good; the former by religion and faith, the latter by arts and sciences. For the curse did not make creation entirely and for ever rebellious; but in virtue of that ordinance “in the sweat of thy face shalt thou eat thy bread”,⁵ by every kind of effort (certainly not by disputations and empty magic ceremonies), it will at length in some measure be subdued so as to provide man with his bread, that is, with the necessities of human life.

Notes

- 1 This is a reference to Aristotle’s work *De Sophisticis Elenchis* (*On Sophistical Refutations*), in which he expounds and attempts to solve various sophistical puzzles that arise from verbal ambiguities and equivocations. Sophistical refutations were “arguments which appear to be refutations but are really fallacious and not refutations” (164a20). And in this work, Aristotle characterised dialectical arguments as ones “which, starting from generally accepted opinions, reason to establish a contradiction” (165b3).
- 2 This presumably alludes to Protagoras of Abdera (fifth century BC), the first and most notable of the Greek sophists, whose famous contention was “Man is the measure of all things, of things that are that they are, and of things that are not that they are not”. This seems to have been intended as an expression of scepticism and relativism, though Bacon is evidently reading it in the opposite sense.

We have noted before that Bacon did not regard sophist teachings as sceptical.

- 3 Bacon is alluding here to Plato’s Myth of the Cave, from the seventh book of the *Republic*, which depicts mankind as trapped in a cave, mistaking the shadows passing across the walls of the cave for realities.
- 4 In the *Advancement of Learning*, I, (*Works*, III, p. 292) Bacon makes his meaning much clearer: “Heraclitus gave a just censure, saying, *Men sought truth in their own little worlds, and not in the great and common world*; for they disdain to spell and so by degrees to read in the volume of God’s works; and contrariwise by continual meditation and agitation of wit do urge and as it were invoke their own spirits to divine and give oracles unto them, whereby they are deservedly deluded”, (Heraclitus of Ephesus was a Greek philosopher who was born around 500 BC.)
- 5 Genesis iii, 19.

On the Idols and on the Scientific Study of Nature

For I will impart unto thee, for the love of God and men, a relation of the true state of Salomon’s House. Son, to make you know the true state of Salomon’s House, I will keep this order. First, I will set forth unto you the end of our foundation. Secondly, the preparations and instruments we have for our works. Thirdly, the several employments and functions whereto our

fellows are assigned. And fourthly, the ordinances and rites which we observe.

“The End of our Foundation is the knowledge of Causes, and secret motions of things; and the enlarging of the bounds of Human Empire, to the effecting of all things possible.

“The Preparations and Instruments are these. We have large and deep caves of several depths: the deepest are sunk six hundred fathom; and some of them are digged

and made under great hills and mountains: so that if you reckon together the depth of the hill and the depth of the cave, they are (some of them) above three miles deep. For we find that the depth of a hill, and the depth of a cave from the flat, is the same thing; both remote alike from the sun and heaven's beams, and from the open air.¹ These caves we call the Lower Region. And we use them for all coagulations, indurations,² refrigerations, and conservations of bodies. We use them likewise for the imitation of natural mines;³ and the producing also of new artificial metals, by compositions and materials which we use, and lay there for many years. We use them⁴ also sometimes, (which may seem strange,) for curing of some diseases, and for prolongation of life in some hermits that choose to live there, well accommodated of⁵ all things necessary; and indeed live very long; by whom also we learn many things.

"We have burials in several earths, where we put divers cements, as the Chinese do their porcellain. But we have them in greater variety, and some of them more fine. We have also great variety of composts, and soils, for the making of the earth fruitful.

"We have high towers; the highest about half a mile in height; and some of them likewise set upon high mountains; so that the vantage⁶ of the hill with the tower is in the highest of them three miles at least. And these places we call the Upper Region: accounting the air between the high places and the low, as a Middle Region. We use these towers, according to their several heights and situations, for insolation,⁷ refrigeration, conservation; and for the view of divers meteors;⁸ as winds, rain, snow, hail; and some of the fiery meteors⁹ also. And upon them, in some places, are dwellings of hermits, whom we visit sometimes, and instruct what to observe.

[...]

"We have also great and spacious houses, where we imitate and demonstrate meteors; as snow, hail, rain, some artificial rains of bodies and not of water, thunders, lightnings; also generations of bodies in air; as frogs, flies, and divers others.

"We have also certain chambers, which we call Chambers of Health, where we qualify¹⁰ the air as we think good and proper for the cure of divers diseases, and preservation of health.

"We have also fair and large baths, of several mixtures, for the cure of diseases, and the restoring of man's body from arefaction:¹¹ and others for the confirming¹² of it in strength of sinews, vital parts, and the very juice and substance of the body

[...]

"We have also divers mechanical arts, which you have not; and stuffs made by them; as papers, linen, silks, tissues; dainty works of feathers of wonderful lustre; excellent dyes, and many others; and shops likewise, as well for such as are not brought into vulgar use amongst us as for those that are. For you must know that of the things before recited, many of them are grown into use throughout the kingdom; but yet if they did flow from our invention, we have of them also for patterns and principals.¹³

"We have also furnaces of great diversities, and that keep great diversity of heats; fierce and quick; strong and constant; soft and mild; blown, quiet; dry, moist; and the like. But above all, we have heats in imitation of the sun's and heavenly bodies' heats, that pass divers inequalities¹⁴ and (as it were) orbs,¹⁵ progresses,¹⁶ and returns,¹⁷ whereby we produce admirable effects. Besides, we have heats of dung, and of bellies and maws of living creatures, and of their bloods and bodies; and of hays and herbs laid up moist; of lime unquenched;¹⁸ and such like. Instruments also which generate heat only by motion. And farther, places for strong insulations; and again, places under the earth, which by nature or art yield heat. These divers heats we use, as the nature of the operation which we intend requireth.

[...]

"We have also engine-houses, where are prepared engines and instruments for all sorts of motions. There we imitate and practise to make swifter motions than any you have, either out of your muskets or any engine that you have; and to make them and multiply them more easily, and with small force, by wheels and other means: and to make them stronger, and more violent than yours are; exceeding your greatest cannons and basilisks.¹⁹ We represent also ordnance and instruments of war, and engines of all kinds: and likewise new mixtures and compositions of gun-powder, wildfires burning in water, and unquenchable. Also fire-works of all variety both for pleasure and use. We imitate also flights of birds; we have some degrees²⁰ of flying in the air; we have ships and boats for going under water, and brooking of seas; also swimming-girdles²¹ and supporters. We have divers curious²² clocks, and other like motions of return,²³ and some perpetual motions. We imitate also motions of living creatures, by images²⁴ of men, beasts, birds, fishes, and serpents. We have also a great number of other various motions, strange for equality, fineness, and subtilty.²⁵

“We have also a mathematical house, where are represented all instruments, as well of geometry as astronomy, exquisitely made.

“We have also houses of deceits of the senses; where we represent all manner of feats of juggling, false apparitions, impostures, and illusions; and their fallacies.²⁶ And surely you will easily believe that we that have so many things truly natural which induce admiration, could in a world of particulars²⁷ deceive the senses, if we would disguise those things and labour to make them seem more miraculous. But we do hate all impostures and lies: inso-much as²⁸ we have severely forbidden it to all our fellows, under pain of ignominy and fines, that they do not²⁹ shew any natural work or thing, adorned or swelling;³⁰ but only pure as it is, and without all affectation of strangeness.

“These are (my son) the riches of Salomon’s House.

“For the several employments and offices of our fellows; we have twelve that sail into foreign countries, under the names of other nations, (for our own we conceal;) who bring us the books, and abstracts,³¹ and patterns of experiments of all other parts. These we call Merchants of Light.

“We have three that collect the experiments which are in all books. These we call Depredators.³²

“We have three that collect the experiments of all mechanical arts; and also of liberal sciences;³³ and also of practices which are not brought into arts.³⁴ These we call Mystery-men.

“We have three that try new experiments, such as themselves think good. These we call Pioners [*sic*] or Miners.

“We have three that draw the experiments of the former four into titles and tables,³⁵ to give the better light³⁶ for the drawing of observations and axioms out of them. These we call Compilers.

“We have three that bend themselves,³⁷ looking into the experiments of their fellows, and cast about³⁸ how to draw out of them things of use and practice for man’s life, and knowledge as well for works as for plain demonstration³⁹ of causes, means of natural divinations,⁴⁰ and the easy and clear discovery of the virtues⁴¹ and parts of bodies. These we call Dowry-men or Benefactors.

“Then after divers meetings and consults⁴² of our whole number, to consider of the former labours and collections, we have three that take care, out of them, to direct new experiments, of a higher light,⁴³ more penetrating into nature than the former. These we call Lamps.

“We have three others that do execute the experiments so directed, and report them. These we call Inoculators.⁴⁴

“Lastly, we have three that raise the former discoveries by experiments into greater observations, axioms, and aphorisms. These we call Interpreters of Nature.

“We have also, as you must think, novices and apprentices, that the succession of the former employed men do not fail; besides a great number of servants and attendants, men and women. And this we do also: we have consultations, which of the inventions and experiences which we have discovered shall be published, and which not: and take all an oath of secrecy, for the concealing of those which we think fit to keep secret: though some of those we do reveal sometimes to the state, and some not.

“For our ordinances and rites: we have two very long and fair galleries: in one of these we place patterns and samples of all manner of the more rare and excellent inventions: in the other we place the statua’s⁴⁵ of all principal inventors. There we have the statua of your Columbus, that discovered the West Indies: also the inventor of ships: your monk⁴⁶ that was the inventor of ordnance and of gunpowder: the inventor of music: the inventor of letters: the inventor of printing: the inventor of observations of astronomy: the inventor of works in metal: the inventor of glass: the inventor of silk of the worm: the inventor of wine: the inventor of corn and bread: the inventor of sugars: and all these by more certain⁴⁷ tradition than you have. Then have we divers inventors of our own, of excellent works; which since you have not seen, it were too long to make descriptions of them; and besides, in the right understanding of those descriptions you might easily err. For upon every invention of value, we erect a statua to the inventor, and give him a liberal and honourable reward. These statua’s are some of brass; some of marble and touch-stone;⁴⁸ some of cedar and other special woods gilt and adorned: some of iron; some of silver; some of gold.

“We have certain hymns and services, which we say daily, of laud,⁴⁹ and thanks to God for his marvellous works: and forms of prayers, imploring his aid and blessing for the illumination of our labours, and the turning of them into good and holy uses.

“Lastly, we have circuits or visits of divers principal cities of the kingdom; where, as it cometh to pass, we do publish such new profitable inventions as we think good. And we do also declare natural divinations of diseases, plagues, swarms of hurtful creatures, scarcity, tempests, earthquakes, great inundations, comets, temperature⁵⁰ of the year, and divers other things; and we give counsel thereupon what the people shall do for the prevention and remedy of them.”

And when he had said this, he stood up; and I, as I had been taught, kneeled down; and he laid his right hand upon my head, and said; "God bless thee, my son, and God bless this relation which I have made. I give thee leave to publish it for the good of other nations;

for we here are in God's bosom, a land unknown." And so he left me; having assigned a value of about two thousand ducats,⁵¹ for a bounty⁵² to me and my fellows. For they give great largesses⁵³ where they come upon all occasions.

Notes

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| <p>1 <i>Thus</i>, caves dug downward under hills are especially deep.</p> <p>2 <i>Hardenings</i>.</p> <p>3 <i>Mineral veins</i>.</p> <p>4 <i>The caves</i>.</p> <p>5 <i>Well</i> provided with.</p> <p>6 <i>Total height</i>.</p> <p>7 <i>Exposure</i> to the sun.</p> <p>8 <i>Atmospheric phenomena</i>.</p> <p>9 <i>Shooting stars and lightning</i>.</p> <p>10 <i>Alter</i>, change.</p> <p>11 <i>Withering</i>.</p> <p>12 <i>Strengthening</i>.</p> <p>13 <i>Preserve</i> them only as examples or originals.</p> <p>14 <i>Changes</i> in intensity.</p> <p>15 <i>Planes</i>.</p> <p>16 <i>Forward courses</i>.</p> <p>17 <i>Return courses</i>.</p> <p>18 <i>Unslaked</i>.</p> <p>19 <i>Large cannons</i> named for a deadly serpent.</p> <p>20 <i>Some success</i>.</p> <p>21 <i>Life preservers</i>.</p> <p>22 <i>Precise</i>.</p> <p>23 <i>Machines</i> producing cyclical motion.</p> <p>24 <i>Robots, automata</i>.</p> <p>25 <i>Extraordinary</i> for regularity, sharpness, and complexity.</p> <p>26 <i>How they are false</i>.</p> <p>27 <i>That could in the practical world</i>.</p> | <p>28 <i>So much that</i>.</p> <p>29 <i>An acceptable double negative</i> in Bacon's time.</p> <p>30 <i>Exaggerated</i>.</p> <p>31 <i>Summaries</i>.</p> <p>32 <i>Those who plunder or pillage</i>.</p> <p>33 <i>Liberal arts</i>.</p> <p>34 <i>Unsystematic practices</i>.</p> <p>35 <i>Those who classify and list the experiments of the former</i>.</p> <p>36 <i>The better to enable</i>.</p> <p>37 <i>Direct their attention to</i>.</p> <p>38 <i>Consider</i>.</p> <p>39 <i>Theoretical demonstration</i>.</p> <p>40 <i>Discovering and predicting the secrets of nature</i>.</p> <p>41 <i>Characteristics, powers</i>.</p> <p>42 <i>Consultations</i>.</p> <p>43 <i>Producing more general knowledge</i>.</p> <p>44 <i>Men who bud trees</i>.</p> <p>45 <i>Statues</i>.</p> <p>46 <i>Roger Bacon</i> or Berthold Schwarz.</p> <p>47 <i>More trustworthy</i>.</p> <p>48 <i>Dark quartz or jasper</i>.</p> <p>49 <i>In praise of</i>.</p> <p>50 <i>Climate</i>.</p> <p>51 <i>Gold coins</i>.</p> <p>52 <i>Gift, gratuity</i>.</p> <p>53 <i>Free gifts</i>.</p> |
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Sphinx; or Science

Sphinx, says the story, was a monster combining many shapes in one. She had the face and voice of a virgin, the wings of a bird, the claws of a griffin. She dwelt on the ridge of a mountain near Thebes and infested the roads, lying in ambush for travellers, whom she would suddenly attack and lay hold of; and when she had mastered them, she propounded to them certain dark and perplexed riddles, which she was thought to have obtained from the Muses. And if the wretched captives could not at once solve and interpret the same, as they stood hesitating and

confused she cruelly tore them to pieces. Time bringing no abatement of the calamity, the Thebans offered to any man who should expound the Sphinx's riddles (for this was the only way to subdue her) the sovereignty of Thebes as his reward. The greatness of the prize induced Œdipus, a man of wisdom and penetration, but lame from wounds in his feet, to accept the condition and make the trial: who presenting himself full of confidence and alacrity before the Sphinx, and being asked what kind of animal it was which was born four-footed, afterwards became two-footed, then three-footed, and at last four-footed again, answered readily that it was man; who

at his birth and during his infancy sprawls on all four, hardly attempting to creep; in a little while walks upright on two feet; in later years leans on a walking-stick and so goes as it were on three; and at last in extreme age and decrepitude, his sinews all failing, sinks into a quadruped again, and keeps his bed. This was the right answer and gave him the victory; where-upon he slew the Sphinx; whose body was put on the back of an ass and carried about in triumph; while himself was made according to compact King of Thebes.

The fable is an elegant and a wise one, invented apparently in allusion to Science; especially in its application to practical life. Science, being the wonder of the ignorant and unskilful, may be not absurdly called a monster. In figure and aspect it is represented as many-shaped, in allusion to the immense variety of matter with which it deals. It is said to have the face and voice of a woman, in respect of its beauty and facility of utterance. Wings are added because the sciences and the discoveries of science spread and fly abroad in an instant; the communication of knowledge being like that of one candle with another, which lights up at once. Claws, sharp and hooked, are ascribed to it with great elegance, because the axioms and arguments of science penetrate and hold fast the mind, so that it has no means of evasion or escape; a point which the sacred philosopher also noted: *The words of the wise are as goads, and as nails driven deep in.* Again, all knowledge may be regarded as having its station on the heights of mountains; for it is deservedly esteemed a thing sublime and lofty, which looks down upon ignorance as from an eminence, and has moreover a spacious prospect on every side, such as we find on hill-tops. It is described as infesting the roads, because at every turn in the journey or pilgrimage of human life, matter and occasion for study assails and encounters us. Again Sphinx proposes to men a variety of hard questions and riddles which she received from the Muses. In these, while they remain with the Muses, there is probably no cruelty; for so long as the object of meditation and inquiry is merely to know, the understanding is not oppressed or straitened by it, but is free to wander and expatiate, and finds in the very uncertainty of conclusion and variety of choice a certain pleasure and delight; but when they pass from the Muses to Sphinx, that is from contemplation to practice, whereby there is necessity for present action, choice, and decision, then they begin to be painful and cruel; and unless they be solved and disposed of, they strangely torment and worry the mind, pulling

it first this way and then that, and fairly tearing it to pieces. Moreover the riddles of the Sphinx have always a twofold condition attached to them; distraction and laceration of mind, if you fail to solve them; if you succeed, a kingdom. For he who understands his subject is master of his end; and every workman is king over his work.

Now of the Sphinx's riddles there are in all two kinds: one concerning the nature of things, another concerning the nature of man; and in like manner there are two kinds of kingdom offered as the reward of solving them: one over nature, and the other over man. For the command over things natural, – over bodies, medicines, mechanical powers, and infinite other of the kind – is the one proper and ultimate end of true natural philosophy; however the philosophy of the School, content with what it finds, and swelling with talk, may neglect or spurn the search after realities and works. But the riddle proposed to Œdipus, by the solution of which he became King of Thebes, related to the nature of man; for whoever has a thorough insight into the nature of man may shape his fortune almost as he will, and is born for empire; as was well declared concerning the arts of the Romans, –

Be thine the art,
O Rome, with government to rule the nations,
And to know whom to spare and whom to abate,
And settle the condition of the world.

And therefore it fell out happily that Augustus Cæsar, whether on purpose or by chance, used a Sphinx for his seal. For he certainly excelled in the art of politics if ever man did; and succeeded in the course of his life in solving most happily a great many new riddles concerning the nature of man, which if he had not dexterously and readily answered he would many times have been in imminent danger of destruction. The fable adds very prettily that when the Sphinx was subdued, her body was laid on the back of an ass: for there is nothing so subtle and abstruse, but when it is once thoroughly understood and published to the world, even a dull wit can carry it. Nor is that other point to be passed over, that the Sphinx was subdued by a lame man with club feet; for men generally proceed too fast and in too great a hurry to the solution of the Sphinx's riddles; whence it follows that the Sphinx has the better of them, and instead of obtaining the sovereignty by works and effects, they only distract and worry their minds with disputations.

On the reformation of education

...let us now review and consider with ourselves what has hitherto been done by kings and others for the increase and advancement of learning, and what has been left undone; and let us discuss the question solidly and distinctly, in a style active and masculine, without digressing or dilating. We may begin then by assuming (which will not be disputed) that all the greatest and most difficult works are overcome either by amplitude of reward, or by prudence and soundness of direction, or by conjunction of labours; where of the first stimulates endeavour, the second removes uncertainty and error, and the third supplies the frailty of man. But of these three, prudence and soundness of direction, – that is, the pointing out and setting forth of the straight and ready way to the thing which is to be done, – must be placed first. For the cripple in the right way (as the saying is) outstrips the runner in the wrong. And Solomon observes, most aptly to the point in question, that “if the iron be blunt it requireth more strength, but wisdom is that which prevailed;” signifying that the prudent choice of the mean is more effectual for the purpose than either the enforcement or the accumulation of endeavours. This I am induced to say, for that (not derogating from the honour of those who have been in any way deservers towards the state of learning) I observe nevertheless that most of their works and acts have had in view rather their own magnificence and memory than the progress and advancement of learning, and have rather augmented the number of learned men than raised and rectified the sciences themselves.

The works or acts which pertain to the advancement of learning are conversant about three objects; the places of learning, the books of learning, and the persons of the learned. For as water, whether it be the dew of Heaven or the springs of the earth, easily scatters and loses itself in the ground, except it be collected into some receptacle where it may by union and consort comfort and sustain itself (and for that cause the industry of man has devised aqueducts, cisterns, and pools, and likewise beautified them with various ornaments, for magnificence and state as well as for use and necessity); so this excellent liquor of knowledge, whether it descend from divine inspiration or spring from human sense, would soon perish and vanish into oblivion, if it were not preserved in books, traditions, and conferences; and especially in places appointed for such matters, as universities, colleges, and schools, where

it may have both a fixed habitation and means and opportunity of increasing and collecting itself.

And first, the works which concern the *places of learning* are four; buildings, endowments with revenues, grants of franchises and privileges, and institutions and ordinances of government; all tending (for the most part) to retirement and quietness of life, and a release from cares and trouble; like the stations which Virgil prescribes for the hiving of honey bees.

Principio sedes apibus statioque petenda,
Quo neque sit ventis aditus, &c.¹

The principal works touching *books* are two; first, libraries, which are as the shrines wherein all the relics of the ancient saints full of true virtue are preserved. Secondly, new editions of authors, with more correct impressions, more faithful translations, more profitable commentaries, more diligent annotations, and the like.

The works pertaining to the *persons of the learned* (besides the advancement and countenancing of them in general) are likewise two. The remuneration and designation of lecturers in arts already extant and invented; and the remuneration and appointment of writers and inquirers concerning those parts of learning not yet sufficiently laboured or prosecuted.

These are summarily the works and acts wherein the merits of many excellent princes and other illustrious personages towards learning have been manifested. As for the particular commemoration of any one who has deserved well of literature, I call to mind what Cicero said when, on his return from exile, he gave general thanks; “It is hard to remember all, ungrateful to pass by any.”² Let us rather (after the advice of Scripture) look forward to that part of the race which is still to be run, than look back to that which has been passed.

First therefore, among so many noble foundations of colleges in Europe, I find it strange that they are all dedicated to professions, and none left free to the study of arts and sciences at large. For if men judge that learning should be referred to use and action, they judge well; but it is easy in this to fall into the error pointed at in the ancient fable; in which the other parts of the body found fault with the stomach, because it neither performed the office of motion as the limbs do, nor of sense, as the head does; but yet notwithstanding it is the stomach which digests and distributes the aliment to all the rest. So if any man think that Philosophy and Universality are idle and unprofitable studies, he does not consider that all arts and professions

are from thence supplied with sap and strength. And this I take to be a great cause, which has so long hindered the more flourishing progress of learning; because these fundamental knowledges have been studied but in passage, and not drunk deeper of. For if you will have a tree bear more fruit than it has used to do, it is not anything you can do to the boughs, but it is the stirring of the earth, and putting richer mould about the roots, that must work it. Neither is it to be forgotten that this dedication of colleges and societies to the use only of professorial learning has not only been inimical to the growth of the sciences, but has also been prejudicial to states and governments. For hence it proceeds that princes when they have to choose men for business of state find a wonderful dearth of able men around them; because there is no collegiate education designed for these purposes, where men naturally so disposed and affected might (besides other arts) give themselves especially to histories, modern languages, books of policy and civil discourse; whereby they might come better prepared and instructed to offices of state.

And because founders of Colleges do plant, and founders of Lectures do water, I must next speak of the deficiencies which I find in public lectures; wherein I especially disapprove of the smallness of the salary assigned to lecturers in arts and professions, particularly amongst ourselves. For it is very necessary to the progression of sciences that lecturers in every sort be of the most able and sufficient men; as those who are ordained not for transitory use, but for keeping up the race and succession of knowledge from age to age. This cannot be, except their condition and endowment be such that the most eminent professors may be well contented and willing to spend their whole life in that function and attendance, without caring for practice. And therefore if you will have sciences flourish, you must observe David's military law; which was, "That those who stayed with the baggage should have equal part with those who were in the action;"³ else will the baggage be ill attended. So lecturers in sciences are as it were the keepers and guardians of the whole store and provision of learning, whence the active and militant part of the sciences is furnished; and therefore they ought to have equal entertainment and profit with the men of active life. Otherwise if the fathers in sciences be not amply and handsomely maintained, it will come to pass, as Virgil says of horses, –

Et patrum invalidi referent jejunia nati;⁴

the poor keeping of the parents will be seen in the weakness of the children.

I will now notice another defect, wherein I should call in some alchemist to help me; one of those who advise the studious to sell their books and build furnaces, and forsaking Minerva and the Muses as barren virgins, to rely upon Vulcan. But certain it is that for depth of speculation no less than for fruit of operation in some sciences (especially natural philosophy and physic) other helps are required besides books. Wherein also the beneficence of men has not been altogether wanting; for we see spheres, globes, astrolabes, maps, and the like have been provided and prepared as assistants to astronomy and cosmography, as well as books. We see likewise that some places instituted for physic have gardens for the examination and knowledge of simples of all sorts, and are not without the use of dead bodies for anatomical observations. But these respect but a few things. In general, it may be held for certain that there will hardly be any great progress in the unravelling and unlocking of the secrets of nature, except there be a full allowance for expenses about experiments; whether they be experiments appertaining to Vulcan or Dædalus (that is, the furnace or engine), or any other kind. And therefore as secretaries and emissaries of princes are allowed to bring in bills of expenses for their diligence in exploring and unravelling plots and civil secrets, so the searchers and spies of nature must have their expenses paid, or else you will never be well informed of a great number of things most worthy to be known. For if Alexander made such a liberal assignation of money to Aristotle, to support hunters, fowlers, fishers and the like, that he might be better furnished for compiling a History of Animals; certainly much more do they deserve it, who instead of wandering in the forests of nature, make their way through the labyrinths of arts.

Another defect to be noticed (and one of great importance) is a neglect of consultation in governors of universities, and of visitation in princes or superior persons, to enter into careful account and consideration whether the readings, disputations, and other scholastic exercises anciently begun, and since continued up to our time, may be profitably kept up, or whether we should rather abolish them and substitute better. For I find it is one of your Majesty's most wise maxims; "That in all usages or precedents the times be considered wherein they first began; which, if they were disordered or ignorant, it derogates greatly from the authority of the precedents, and leaves all things for suspect." And therefore inasmuch as most of the institutions of the universities are derived from times a good deal more obscure and ignorant than our own, it is the more convenient that they be re-examined. In this kind I will give an instance or two, of things which appear

the most obvious and familiar. It is a general custom (and yet I hold it to be an error) that scholars come too soon and too unripe to the study of logic and rhetoric, arts fitter for graduates than children and novices; for these two rightly taken are the gravest of sciences, being the arts of arts, the one for judgment, the other for ornament; besides they give the rule and direction how both to set forth and illustrate the subject matter. And therefore for minds empty and ignorant (and which have not yet gathered what Cicero calls "stuff"⁵ or "furniture,"⁶ that is matter and variety) to begin with those arts (as if one should learn to weigh or to measure or to paint the wind), works but this effect, that the virtue and faculty of those arts (which are great and universal) are almost made contemptible, and either degenerate into childish sophistry and ridiculous affectation, or at least lose not a little of their reputation. And further, the premature and untimely learning of these arts has drawn on, by consequence, the superficial and unprofitable teaching and handling of them, - a manner of teaching suited to the capacity of children. Another instance of an error which has long prevailed in universities is this; that they make too great and mischievous a divorce between invention and memory. For most of the speeches there are either entirely premeditated, and delivered in preconceived words, where nothing is left to invention; or merely extempore, where little is left to memory; whereas in common life and action there is little use of either of these separately, but rather of intermixtures of them; that is of notes or commentaries and extempore speech; and thus the exercise fits not the practice, nor the image the life. But it must ever be observed as a rule in exercises, that they be made to represent in everything (as near as may be) the real actions of life; for otherwise they will pervert the motions and faculties of the mind, and not prepare them. The truth whereof appears clearly enough when scholars come to the practice of their professions, or other offices of civil life; which when they set into, this want I speak of is soon found out by themselves, but still sooner by others. But this part, touching the amendment of the Institutions and Orders of Universities, I will conclude with a sentence taken from one of Cassar's letters to Oppius and Balbus; "How this may be done, some means occur to me, and many may be found; I beg you therefore to take these matters into consideration."⁷

Another defect which I note ascends a little higher than the preceding. For as the progress of learning consists not a little in the wise ordering and institutions of each several university; so it would be yet much more advanced if there were a closer connexion and relationship between all the different universities of Europe than now there is.

For we see there are many orders and societies which, though they be divided under distant sovereignties and territories, yet enter into and maintain among themselves a kind of contract and fraternity, insomuch that they have governors (both provincial and general) whom they all obey. And surely as nature creates brotherhood in families, and arts mechanical contract brotherhoods in societies, and the anointment of God superinduces a brotherhood in kings and bishops, and vows and regulations make a brotherhood in religious orders; so in like manner there cannot but be a noble and generous brotherhood contracted among men by learning and illumination, seeing that God himself is called "the Father of Lights."⁸

The last defect I complain of (to which I have already alluded) is that there has not been, or very rarely been, any public designation of fit men either to write or to make inquiry concerning such parts of knowledge as have not been already sufficiently laboured. To which point it will greatly conduce, if a review and *census* be made of the sciences, and account be taken what parts of them are rich and well advanced, and what poor and destitute. For the opinion of plenty is amongst the causes of want; and the great quantity of books makes a show rather of superfluity than lack; of which surcharge nevertheless the true remedy is not to destroy the old books, but to make more good ones; of such a kind that like the serpent of Moses, they may devour the serpents of the enchanters.⁹

The removal of all the defects formerly enumerated, except the last, and of the active part also of the last, which relates to the designation of writers, are truly works for a king; towards which the endeavours and industry of a private man can be but as an image in a crossway, that may point at the way but cannot go it. But the speculative part of it, which relates to the survey of knowledges to see what in each is deficient, is open likewise to private industry. Wherefore I now intend to make a general and faithful perambulation and survey of learning, with a very careful and accurate inquiry what parts thereof lie fresh and waste, and not yet improved and converted to use by the industry of man; to the end that such a plot marked out, and recorded to memory, may minister light both to public designations and voluntary endeavours. Wherein nevertheless my purpose is at this time to note only omissions and deficiencies, and not to make any redargution of errors and failures; for it is one thing to point out what parts lie untilld, and another thing to mend the manner of tillage.

In addressing myself to which task I am not ignorant how great a work I attempt, and how difficult a province I take upon me; nor again how far unequal my

strength is to my will. Nevertheless I have great hope that *if my extreme* love to learning carry me too far, I may obtain the excuse of affection; for that “it is not granted to any man at the same time to love and to be wise.”¹⁰ But I know well I can use no other liberty of judgement, than I must leave to others; and I for my part shall be equally glad either to perform myself or to accept from others that duty of humanity, to put the wanderer on the right way: *nam qui erranti comiter monstrat viam*¹¹, &c. I foresee likewise that many of those things which I shall think fit to enter in this registry of mine as omitted and deficient will incur censure on different accounts; some as being already done and extant; others as savouring of curiosity, and promising very scanty fruit; others as being too difficult and almost impossible to be compassed and effected by man. For the two first I refer myself to the particulars

themselves. For the last, touching impossibility, I take it that all those things are to be held possible and performable, which may be done by some persons, though not by every one; and which may be done by many together, though not by one alone; and which may be done in the succession of ages, though not in one man’s life; and lastly, which may be done by public designation and expense, though not by private means and endeavour. But notwithstanding if any man will take to himself rather the saying of Solomon, “The slothful man says there is a lion in the path,”¹² than that of Virgil, *Possunt, quia posse videntur*¹³, “they find it possible because they think it possible,” I shall be content that my labours be esteemed but as the better *sort of* wishes. For as it asks some knowledge of a thing to demand a question not impertinent, so it requires some sense to make a wish not absurd.

Notes

- 1 Virg. Georg. iv. 8.: –First: for thy bees a quiet station find,
And lodge them under covert of the wind.
- 2 Cicero, Post Red. c. 12.
- 3 I Sam. xxx, 24.
- 4 Georg. iii. 128,
- 5 *Sylva*. De Orator, iii. 26.
- 6 *Supellex*. Orator, c. 24.

- 7 Cic. Ep. ad Att. ix. 8.
- 8 St. James, i. 17.
- 9 Not Moses, but Aaron. Ex. vii. 12.
- 10 Senecæ Proverbia.
- 11 Ennius, ap. Aul. Gelt. xii. 4. and ap. Cic. De Officiis, i. 17.
- 12 Prov. xxvi. 13.
- 13 Virg. *Æn.* v. 231.

Idea for a Universal History from a Cosmopolitan Point of View

Immanuel Kant

Whatever concept one may hold, from a metaphysical point of view, concerning the freedom of the will, certainly its appearances, which are human actions, like every other natural event are determined by universal laws. However obscure their causes, history, which is concerned with narrating these appearances, permits us to hope that if we attend to the play of freedom of the human will in the large, we may be able to discern a regular movement in it, and that what seems complex and chaotic in the single individual may be seen from the standpoint of the human race as a whole to be a steady and progressive though slow evolution of its original endowment. Since the free will of man has obvious influence upon marriages, births, and deaths, they seem to be subject to no rule by which the number of them could be reckoned in advance. Yet the annual tables of them in the major countries prove that they occur according to laws as stable as [those of] the unstable weather, which we likewise cannot determine in advance, but which, in the large, maintain the growth of plants, the flow of rivers, and other natural events in an unbroken, uniform course. Individuals and even whole peoples think little on this. Each, according to his own inclination, follows his own purpose, often in opposition to others; yet each individual and people, as if following some guiding thread, go toward a natural but to each of them unknown goal; all work toward furthering it, even if they would set little store by it if they did know it.

Since men in their endeavors behave, on the whole, not just instinctively, like the brutes, nor yet like rational citizens of the world according to some agreed-on plan, no history of man conceived according to a plan seems to be possible, as it might be possible to have such a history of bees or beavers. One cannot suppress a certain indignation when one sees men's actions on the great world-stage and finds, beside the wisdom that appears here and there among individuals, everything in the large woven together from folly, childish vanity, even from childish malice and destructiveness. In the end, one does not know what to think of the human race, so conceited in its gifts. Since the philosopher cannot presuppose any [conscious] individual purpose among men in their great drama, there is no other expedient for him except to try to see if he can discover a natural purpose in this idiotic course of things human. In keeping with this purpose, it might be possible to have a history with a definite natural plan for creatures who have no plan of their own.

We wish to see if we can succeed in finding a clue to such a history; we leave it to Nature to produce the man capable of composing it. Thus Nature produced Kepler, who subjected, in an unexpected way, the eccentric paths of the planets to definite laws; and she produced Newton, who explained these laws by a universal natural cause.

From Immanuel Kant, *On History*, ed. and introd. L.W. Beck, trans. L.W. Beck, R.E. Anchor, and E.L. Fackenheim (Indianapolis and New York: Bobbs-Merrill, Inc. 1957), pp. 11–26. Reprinted by permission of Hackett Publishing Company, Inc. All rights reserved.

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First Thesis

All natural capacities of a creature are destined to evolve completely to their natural end.

Observation of both the outward form and inward structure of all animals confirms this of them. An organ that is of no use, an arrangement that does not achieve its purpose, are contradictions in the ideological theory of nature. If we give up this fundamental principle, we no longer have a lawful but an aimless course of nature, and blind chance takes the place of the guiding thread of reason.

Second Thesis

In man (as the only rational creature on earth) those natural capacities which are directed to the use of his reason are to be fully developed only in the race, not in the individual.

Reason in a creature is a faculty of widening the rules and purposes of the use of all its powers far beyond natural instinct; it acknowledges no limits to its projects. Reason itself does not work instinctively, but requires trial, practice, and instruction in order gradually to progress from one level of insight to another. Therefore a single man would have to live excessively long in order to learn to make full use of all his natural capacities. Since Nature has set only a short period for his life, she needs a perhaps unreckonable series of generations, each of which passes its own enlightenment to its successor in order finally to bring the seeds of enlightenment to that degree of development in our race which is completely suitable to Nature's purpose. This point of time must be, at least as an ideal, the goal of man's efforts, for otherwise his natural capacities would have to be counted as for the most part vain and aimless. This would destroy all practical principles, and Nature, whose wisdom must serve as the fundamental principle in judging all her other offspring, would thereby make man alone a contemptible plaything.

Third Thesis

Nature has willed that man should, by himself produce everything that goes beyond the mechanical ordering of his animal existence, and that he should partake of no other happiness or perfection than that which he himself independently of instinct, has created by his own reason.

Nature does nothing in vain, and in the use of means to her goals she is not prodigal. Her giving to man reason and the freedom of the will which depends upon it is clear indication of her purpose. Man accordingly was not to be guided by instinct, not nurtured and instructed with ready-made knowledge; rather, he should bring forth everything out of his own resources. Securing his own food, shelter, safety and defense (for which Nature gave him neither the horns of the bull, nor the claws of the lion, nor the fangs of the dog, but hands only), all amusement which can make life pleasant, insight and intelligence, finally even goodness of heart – all this should be wholly his own work. In this, Nature seems to have moved with the strictest parsimony, and to have measured her animal gifts precisely to the most stringent needs of a beginning existence, just as if she had willed that, if man ever did advance from the lowest barbarity to the highest skill and mental perfection and thereby worked himself up to happiness (so far as it is possible on earth), he alone should have the credit and should have only himself to thank – exactly as if she aimed more at his rational self-esteem than at his well-being. For along this march of human affairs, there was a host of troubles awaiting him. But it seems not to have concerned Nature that he should live well, but only that he should work himself upward so as to make himself, through his own actions, worthy of life and of well-being.

It remains strange that the earlier generations appear to carry through their toilsome labor only for the sake of the later, to prepare for them a foundation on which the later generations could erect the higher edifice which was Nature's goal, and yet that only the latest of the generations should have the good fortune to inhabit the building on which a long line of their ancestors had (unintentionally) labored without being permitted to partake of the fortune they had prepared. However puzzling this may be, it is necessary if one assumes that a species of animals should have reason, and, as a class of rational beings each of whom dies while the species is immortal, should develop their capacities to perfection.

Fourth Thesis

The means employed by Nature to bring about the development of all the capacities of men is their antagonism in society, so far as this is, in the end, the cause of a lawful order among men.

By “antagonism” I mean the unsocial sociability of men, i.e., their propensity to enter into society, bound together with a mutual opposition which constantly threatens to break up the society. Man has an inclination to associate with others, because in society he feels himself to be more than man, i.e., as more than the developed form of his natural capacities. But he also has a strong propensity to isolate himself from others, because he finds in himself at the same time the unsocial characteristic of wishing to have everything go according to his own wish. Thus he expects opposition on all sides because, in knowing himself, he knows that he, on his own part, is inclined to oppose others. This opposition it is which awakens all his powers, brings him to conquer his inclination to laziness and, propelled by vainglory, lust for power, and avarice, to achieve a rank among his fellows whom he cannot tolerate but from whom he cannot withdraw. Thus are taken the first true steps from barbarism to culture, which consists in the social worth of man; thence gradually develop all talents, and taste is refined; through continued enlightenment the beginnings are laid for a way of thought which can in time convert the coarse, natural disposition for moral discrimination into definite practical principles, and thereby change a society of men driven together by their natural feelings into a moral whole. Without those in themselves unamiable characteristics of unsociability from whence opposition springs – characteristics each man must find in his own selfish pretensions – all talents would remain hidden, unborn in an Arcadian shepherd’s life, with all its concord, contentment, and mutual affection. Men, good-natured as the sheep they herd, would hardly reach a higher worth than their beasts; they would not fill the empty place in creation by achieving their end, which is rational nature. Thanks be to Nature, then, for the incompatibility, for heartless competitive vanity, for the insatiable desire to possess and to rule! Without them, all the excellent natural capacities of humanity would forever sleep, undeveloped. Man wishes concord; but Nature knows better what is good for the race; she wills discord. He wishes to live comfortably and pleasantly; Nature wills that he should be plunged from sloth and passive contentment into labor and trouble, in order that he may find means of extricating himself from them. The natural urges to this, the sources of unsociableness and mutual opposition from which so many evils arise, drive men to new exertions of their forces and thus to the manifold development of their capacities. They thereby perhaps show the ordering of a wise Creator and not the hand of an evil spirit, who bungled in his great work or spoiled it out of envy.

Fifth Thesis

The greatest problem for the human race, to the solution of which Nature drives man, is the achievement of a universal civic society which administers law among men.

The highest purpose of Nature, which is the development of all the capacities which can be achieved by mankind, is attainable only in society, and more specifically in the society with the greatest freedom. Such a society is one in which there is mutual opposition among the members, together with the most exact definition of freedom and fixing of its limits so that it may be consistent with the freedom of others. Nature demands that humankind should itself achieve this goal like all its other destined goals. Thus a society in which freedom under external laws is associated in the highest degree with irresistible power, i.e., a perfectly just civic constitution, is the highest problem Nature assigns to the human race; for Nature can achieve her other purposes for mankind only upon the solution and completion of this assignment. Need forces men, so enamored otherwise of their boundless freedom, into this state of constraint. They are forced to it by the greatest of all needs, a need they themselves occasion in as much as their passions keep them from living long together in wild freedom. Once in such a preserve as a civic union, these same passions subsequently do the most good. It is just the same with trees in a forest: each needs the others, since each in seeking to take the air and sunlight from others must strive upward, and thereby each realizes a beautiful, straight stature, while those that live in isolated freedom put out branches at random and grow stunted, crooked, and twisted. All culture, art which adorns mankind, and the finest social order are fruits of unsociableness, which forces itself to discipline itself and so, by a contrived art, to develop the natural seeds to perfection.

Sixth Thesis

This problem is the most difficult and the last to be solved by mankind.

The difficulty which the mere thought of this problem puts before our eyes is this. Man is an animal which, if it lives among others of its kind, requires a master. For he certainly abuses his freedom with respect to other men, and although as a reasonable being he wishes to have a law which limits the freedom of all, his selfish animal impulses tempt him, where possible, to exempt himself from them.

He thus requires a master, who will break his will and force him to obey a will that is universally valid, under which each can be free. But whence does he get this master? Only from the human race. But then the master is himself an animal, and needs a master. Let him begin it as he will, it is not to be seen how he can procure a magistracy which can maintain public justice and which is itself just, whether it be a single person or a group of several elected persons. For each of them will always abuse him freedom if he has none above him to exercise force in accord with the laws. The highest master should be just in himself, and yet a man. This task is therefore the hardest of all; indeed, its complete solution is impossible, for from such crooked wood as man is made of, nothing perfectly straight can be built.¹ That it is the last problem to be solved follows also from this: it requires that there be a correct conception of a possible constitution, great experience gained in many paths of life, and – far beyond these – a good will ready to accept such a constitution. Three such things are very hard, and if they are ever to be found together, it will be very late and after many vain attempts.

Seventh Thesis

The problem of establishing a perfect civic constitution is dependent upon the problem of a lawful external relation among states and cannot be solved without a solution of the latter problem.

What is the use of working toward a lawful civic constitution among individuals, i.e., toward the creation of a common wealth? The same unsociability which drives man to this causes any single commonwealth to stand in unrestricted freedom in relation to others; consequently, each of them must expect from another precisely the evil which oppressed the individuals and forced them to enter into a lawful civic state. The friction among men, the inevitable antagonism, which is a mark of even the largest societies and political bodies, is used by Nature as a means to establish a condition of quiet and security. Through war, through the taxing and never-ending accumulation of armament, through the want which any state, even in peacetime, must suffer internally, Nature forces them to make at first inadequate and tentative attempts; finally, after devastations, revolutions, and even complete exhaustion, she brings them to that which reason could have told them at the beginning and with far less sad experience, to wit, to step from the lawless condition of savages into a league of nations. In a league

of nations, even the smallest state could expect security and justice, not from its own power and by its own decrees, but only from this great league of nations (*Foedus Amphictyonum*²), from a united power acting according to decisions reached under the laws of their united will. However fantastical this idea may seem – and it was laughed at as fantastical by the Abbé de St. Pierre³ and by Rousseau,⁴ perhaps because they believed it was too near to realization – the necessary outcome of the destination to which each man is brought by his fellows is to force the states to the same decision (hard though it be for them) that savage man also was reluctantly forced to take, namely, to give up their brutish freedom and to seek quiet and security under a lawful constitution.

All wars are accordingly so many attempts (not in the intention of man, but in the intention of Nature) to establish new relations among states, and through the destruction or at least the dismemberment of all of them to create new political bodies, which, again, either internally or externally, cannot maintain themselves and which must thus suffer like revolutions; until finally, through the best possible civic constitution and common agreement and legislation in external affairs, a state is created which, like a civic commonwealth, can maintain itself automatically.

[There are three questions here, which really come to one.] Would it be expected from an Epicurean concurrence of efficient causes that states, like minute particles of matter in their chance contacts, should form all sorts of unions which in their turn are destroyed by new impacts, until once, finally, by chance a structure should arise which could maintain its existence — a fortunate accident that could hardly occur? Or are we not rather to suppose that Nature here follows a lawful course in gradually lifting our race from the lower levels of animality to the highest level of humanity, doing this by her own secret art, and developing in accord with her law all the original gifts of man in this apparently chaotic disorder? Or perhaps we should prefer to conclude that, from all these actions and counteractions of men in the large, absolutely nothing, at least nothing wise, is to issue? That everything should remain as it always was, that we cannot therefore tell but that discord, natural to our race, may not prepare for us a hell of evils, however civilized we may now be, by annihilating civilization and all cultural progress through barbarous devastation? (This is the fate we may well have to suffer under the rule of blind chance – which is in fact identical with lawless freedom – if there is no secret wise guidance in Nature.)

These three questions, I say, mean about the same as this: Is it reasonable to assume a purposiveness in all the parts of nature and to deny it to the whole?

Purposeless savagery held back the development of the capacities of our race; but finally, through the evil into which it plunged mankind, it forced our race to renounce this condition and to enter into a civic order in which those capacities could be developed. The same is done by the barbaric freedom of established states. Through wasting the powers of the commonwealths in armaments to be used against each other, through devastation brought on by war, and even more by the necessity of holding themselves in constant readiness for war, they stunt the full development of human nature. But because of the evils which thus arise, our race is forced to find, above the (in itself healthy) opposition of states which is a consequence of their freedom, a law of equilibrium and a united power to give it effect. Thus it is forced to institute a cosmopolitan condition to secure the external safety of each state.

Such a condition is not unattended by the danger that the vitality of mankind may fall asleep; but it is at least not without a principle of balance among men's actions and counteractions, without which they might be altogether destroyed. Until this last step to a union of states is taken, which is the halfway mark in the development of mankind, human nature must suffer the cruelest hardships under the guise of external well-being; and Rousseau was not far wrong in preferring the state of savages, so long, that is, as the last stage to which the human race must climb is not attained.

To a high degree we are, through art and science, *cultured*. We are *civilized* – perhaps too much for our own good – in all sorts of social grace and decorum. But to consider ourselves as having reached *morality* – for that, much is lacking. The ideal of morality belongs to culture; its use for some simulacrum of morality in the love of honor and outward decorum constitutes mere civilization. So long as states waste their forces in vain and violent self-expansion, and thereby constantly thwart the slow efforts to improve the minds of their citizens by even withdrawing all support from them, nothing in the way of a moral order is to be expected. For such an end, a long internal working of each political body toward the education of its citizens is required. Everything good that is not based on a morally good disposition, however, is nothing but pretense and glittering misery. In such a condition the human species will no doubt remain until, in the way I have described, it works its way out of the chaotic conditions of its international relations.

Eighth Thesis

The history of mankind can be seen, in the large, as the realization of Nature's secret plan to bring forth a perfectly constituted state as the only condition in which the capacities of mankind can be fully developed, and also bring forth that external relation among states which is perfectly adequate to this end.

This is a corollary to the preceding. Everyone can see that philosophy can have her belief in a millennium, but her millenarianism is not Utopian, since the Idea can help, though only from afar, to bring the millennium to pass. The only question is: Does Nature reveal anything of a path to this end? And I say: She reveals something, but very little. This great revolution seems to require so long for its completion that the short period during which humanity has been following this course permits us to determine its path and the relation of the parts to the whole with as little certainty as we can determine, from all previous astronomical observation, the path of the sun and his host of satellites among the fixed stars. Yet, on the fundamental premise of the systematic structure of the cosmos and from the little that has been observed, we can confidently infer the reality of such a revolution.

Moreover, human nature is so constituted that we cannot be indifferent to the most remote epoch our race may come to, if only we may expect it with certainty. Such indifference is even less possible for us, since it seems that our own intelligent action may hasten this happy time for our posterity. For that reason, even faint indications of approach to it are very important to us. At present, states are in such an artificial relation to each other that none of them can neglect its internal cultural development without losing power and influence among the others. Therefore the preservation of this natural end [culture], if not progress in it, is fairly well assured by the ambitions of states. Furthermore, civic freedom can hardly be infringed without the evil consequences being felt in all walks of life, especially in commerce, where the effect is loss of power of the state in its foreign relations. But this freedom spreads by degrees. When the citizen is hindered in seeking his own welfare in his own way, so long as it is consistent with the freedom of others, the vitality of the entire enterprise is sapped, and therewith the powers of the whole are diminished. Therefore limitations on personal actions are step by step removed, and general religious freedom is permitted. Enlightenment comes gradually, with intermittent folly and caprice, as a great good which must finally save men from the selfish

aggrandizement of their masters, always assuming that the latter know their own interest. This enlightenment, and with it a certain commitment of heart which the enlightened man cannot fail to make to the good he clearly understands, must step by step ascend the throne and influence the principles of government.

Although, for instance, our world rulers at present have no money left over for public education and for anything that concerns what is best in the world, since all they have is already committed to future wars, they will still find it to their own interest at least not to hinder the weak and slow, independent efforts of their peoples in this work. In the end, war itself will be seen as not only so artificial, in outcome so uncertain for both sides, in aftereffects so painful in the form of an ever-growing war debt (a new invention) that cannot be met, that it will be regarded as a most dubious undertaking. The impact of any revolution on all states on our continent, so closely knit together through commerce, will be so obvious that the other states, driven by their own danger but without any legal basis, will offer themselves as arbiters, and thus they will prepare the way for a distant international government for which there is no precedent in world history. Although this government at present: exists only as a rough outline, nevertheless in all the members there is rising a feeling which each has for the preservation of the whole. This gives hope finally that after many reformative revolutions, a universal cosmopolitan condition, which Nature has as her ultimate purpose, will come into being as the womb wherein all the original capacities of the human race can develop.

Ninth Thesis

A philosophical attempt to work out a universal history according to a natural plan directed to achieving the civic union of the human race must be regarded as possible and, indeed, as contributing to this end of Nature.

It is strange and apparently silly to wish to write a history in accordance with an Idea of how the course of the world must be if it is to lead to certain rational ends. It seems that with such an Idea only a romance could be written. Nevertheless, if one may assume that Nature, even in the play of human freedom, works not without plan or purpose, this Idea could still be of use. Even if we are too blind to see the secret mechanism of its workings, this Idea may still serve as a guiding thread for presenting as a system, at least in broad outlines, what would otherwise

be a planless conglomeration of human actions. For if one starts with Greek history, through which every older or contemporaneous history has been handed down or at least certified;⁵ if one follows the influence of Greek history on the construction and misconstruction of the Roman state which swallowed up the Greek, then the Roman influence on the barbarians who in turn destroyed it, and so on down to our times; if one adds episodes from the national histories of other peoples insofar as they are known from the history of the enlightened nations, one will discover a regular progress in the constitution of states on our continent (which will probably give law, eventually, to all the others). If, further, one concentrates on the civic constitutions and their laws and on the relations among states, insofar as through the good they contained they served over long periods of time to elevate and adorn nations and their arts and sciences, while through the evil they contained they destroyed them, if only a germ of enlightenment was left to be further developed by this overthrow and a higher level was thus prepared – if, I say, one carries through this study, a guiding thread will be revealed. It can serve not only for clarifying the confused play of things human, and not only for the art of prophesying later political changes (a use which has already been made of history even when seen as the disconnected effect of lawless freedom), but for giving a consoling view of the future (which could not be reasonably hoped for without the presupposition of a natural plan) in which there will be exhibited in the distance how the human race finally achieves the condition in which all the seeds planted in it by Nature can fully develop and in which the destiny of the race can be fulfilled here on earth.

Such a justification of Nature – or, better, of Providence – is no unimportant reason for choosing a standpoint toward world history. For what is the good of esteeming the majesty and wisdom of Creation in the realm of brute nature and of recommending that we contemplate it, if that part of the great stage of supreme wisdom which contains the purpose of all the others – the history of mankind – must remain an unceasing reproach to it? If we are forced to turn our eyes from it in disgust, doubting that we can ever find a perfectly rational purpose in it and hoping for that only in another world?

That I would want to displace the work of practicing empirical historians with this Idea of world history, which is to some extent based upon an a priori principle, would be a misinterpretation of my intention. It is only a suggestion of what a philosophical mind (which would

have to be well versed in history) could essay from another point of view. Otherwise the notorious complexity of a history of our time must naturally lead to serious doubt as to how our descendants will begin to grasp the burden of the history we shall leave to them after a few centuries. They will naturally value the history of earlier times, from which the documents may long since have disappeared, only from the point of

view of what interests them, i.e., in answer to the question of what the various nations and governments have contributed to the goal of world citizenship, and what they have done to damage it. To consider this, so as to direct the ambitions of sovereigns and their agents to the only means by which their fame can be spread to later ages: this can be a minor motive for attempting such a philosophical history.

Notes

A statement in the “Short Notices” or the twelfth number of the *Gothaische Gelehrte Zeitung* of this year [1784], which no doubt was based on my conversation with a scholar who was traveling through, occasions this essay, without which that statement could not be understood.

[The notice said: “A favorite idea of Professor Kant’s is that the ultimate purpose of the human race is to achieve the most perfect civic constitution, and he wishes that a philosophical historian might undertake to give us a history of humanity from this point of view, and to show to what extent humanity in various ages has approached or drawn away from this final purpose and what remains to be done in order to reach it.”]

1 The role of man is very artificial. How it may be with the dwellers on other planets and their nature we do not know. If, however, we carry out well the mandate given us by Nature, we can perhaps flatter ourselves that we may claim among our neighbors in the cosmos no mean rank. Maybe among them each individual can perfectly attain his destiny in his own life. Among us, it is different; only the race can hope to attain it.

2 [An allusion to the Amphictyonic League, a league of Greek tribes originally for the protection of a religious shrine, which later gained considerable, political power.]

3 [Charles-Irénée Castel, Abbé de Saint Pierre (1658–1743), in his *Projet de paix perpétuelle* (Utrecht, 1713). Trans. H. H. Bellot (London, 1927).]

4 [In his *Extrait du projet de paix perpétuelle de M. l’Abbé de St. Pierre* (1760). Trans. C. E. Vaughn, *A Lasting Peace through the Federation of Europe* (London, 1917).]

5 Only a learned public, which has lasted from its beginning to our own day, can certify ancient history. Outside it, everything else is *terra incognita*; and the history of peoples outside it can only be begun when they come into contact with it. This happened with the Jews in the time of the Ptolemies through the translation of the Bible into Greek, without which we would give little credence to their isolated narratives. From this point, when once properly fixed, we can retrace their history. And so with all other peoples. The first page of Thucydides, says Hume (“Of the Populousness of Ancient Nations,” in *Essays Moral, Political and Literary*, eds. Green and Grose, Vol. I, p. 414), is the only beginning of all real history.

The Nature and Importance of the Positive Philosophy

Auguste Comte

In order to explain properly the true nature and peculiar character of the positive philosophy, it is indispensable that we should first take a brief survey of the progressive growth of the human mind viewed as a whole; for no idea can be properly understood apart from its history.

In thus studying the total development of human intelligence in its different spheres of activity, from its first and simplest beginning up to our own time, I believe that I have discovered a great fundamental law, to which the mind is subjected by an invariable necessity. The truth of this law can, I think, be demonstrated both by reasoned proofs furnished by a knowledge of our mental organization, and by historical verification due to an attentive study of the past. This law consists in the fact that each of our principal conceptions, each branch of our knowledge, passes in succession through three different theoretical states: the theological or fictitious state, the metaphysical or abstract state, and the scientific or positive state. In other words, the human mind – by its very nature – makes use successively in each of its researches of three methods of philosophizing, whose characters are essentially different and even radically opposed to each other. We have first the theological method, then the metaphysical method, and finally the positive method. Hence, there are three kinds of philosophy or general systems of conceptions on the aggregate of phenomena which are mutually exclusive

of each other. The first is the necessary starting point of human intelligence; the third represents its fixed and definitive state; the second is destined to serve only as a transitional method.

In the theological state, the human mind directs its researches mainly toward the inner nature of beings, and toward the first and final causes of all the phenomena that it observes – in a word, toward absolute knowledge. It therefore represents these phenomena as being produced by the direct and continuous action of more or less numerous supernatural agents, whose arbitrary intervention explains all the apparent anomalies of the universe.

In the metaphysical state, which is in reality only a simple general modification of the first state, the supernatural agents are replaced by abstract forces, real entities or personified abstractions, inherent in the different beings of the world. These entities are looked upon as capable of giving rise by themselves to all the phenomena observed, each phenomenon being explained by assigning it to its corresponding entity.

Finally, in the positive state, the human mind, recognizing the impossibility of obtaining absolute truth, gives up the search after the origin and hidden causes of the universe and a knowledge of the final causes of phenomena. It endeavours now only to discover, by a well-combined use of reasoning and observation, the actual laws of phenomena – that is to say, their invariable relations of

Auguste Comte, "Lesson One," in *Cours de philosophie positive*, from *Introduction to Positive Philosophy*, ed. and trans. Frederick Ferré (Indianapolis and Cambridge, MA: Hackett, 1988), pp. 1–33. Reprinted by permission of Hackett Publishing Company Inc. All rights reserved.

succession and likeness. The explanation of facts, thus reduced to its real terms, consists henceforth only in the connection established between different particular phenomena and some general facts, the number of which the progress of science tends more and more to diminish.

The theological system arrived at its highest form of perfection when it substituted the providential action of a single being for the varied play of the numerous independent gods which had been imagined by the primitive mind. In the same way, the last stage of the metaphysical system consisted in replacing the different special entities by the idea of a single great general entity – nature – looked upon as the sole source of all phenomena. Similarly, the ideal of the positive system, toward which it constantly tends, although in all probability it will never attain such a stage, would be reached if we could look upon all the different phenomena observable as so many particular cases of a single general fact, such as that of gravitation, for example.

This is not the place to give a special demonstration of this fundamental law of mental development, and to deduce from it its most important consequences. We shall make a direct study of it, with all the necessary details, in the part of this work relating to social phenomena.¹ I am considering it now only in order to determine precisely the true character of the positive philosophy, as opposed to the two other philosophies which have successively dominated our whole intellectual system up to these latter centuries. For the present, to avoid leaving entirely undemonstrated so important a law, the applications of which frequently occur throughout this work, I must confine myself to a rapid enumeration of the most evident general reasons that prove its exactitude.

In the first place, it is, I think, sufficient merely to enunciate such a law for its accuracy to be immediately verified by all those who are fairly well acquainted with the general history of the sciences. For there is not a single science that has today reached the positive stage, which was not in the past – as each can easily see for himself – composed mainly of metaphysical abstractions, and, going back further still, it was altogether under the sway of theological conceptions. Unfortunately, we shall have to recognize on more than one occasion in the different parts of this course, that even the most perfect sciences retain today some very evident traces of these two primitive states.

This general revolution of the human mind can, moreover, be easily verified today in a very obvious, although indirect, manner, if we consider the development of the

individual intelligence. The starting point being necessarily the same in the education of the individual as in that of the race, the various principal phases of the former must reproduce the fundamental epochs of the latter. Now, does not each of us in contemplating his own history recollect that he has been successively – as regards the most important ideas – a theologian in childhood, a metaphysician in youth, and a natural philosopher in manhood? This verification of the law can easily be made by all who are on a level with their era.

But in addition to the proofs of the truth of this law furnished by direct observation of the race or the individual, I must, above all, mention in this brief summary the theoretical considerations that show its necessity.

The most important of these considerations arises from the very nature of the subject itself. It consists in the need at every epoch of having some theory to connect the facts, while, on the other hand, it was clearly impossible for the primitive human mind to form theories based on observation.

All competent thinkers agree with Bacon² that there can be no real knowledge except that which rests upon observed facts. This fundamental maxim is evidently indisputable if it is applied, as it ought to be, to the mature state of our intelligence. But, if we consider the origin of our knowledge, it is no less certain that the primitive human mind could not and, indeed, ought not to have thought in that way. For if, on the one hand, every positive theory must necessarily be founded upon observations, it is, on the other hand, no less true that, in order to observe, our mind has need of some theory or other. If in contemplating phenomena we did not immediately connect them with some principles, not only would it be impossible for us to combine these isolated observations and, therefore, to derive any profit from them, but we should even be entirely incapable of remembering the facts, which would for the most part remain unnoted by us.

Thus, there were two difficulties to be overcome: the human mind had to observe in order to form real theories; and yet it had to form theories of some sort before it could apply itself to a connected series of observations. The primitive human mind, therefore, found itself involved in a vicious circle, from which it would never have had any means of escaping if a natural way out of the difficulty had not fortunately been found by the spontaneous development of theological conceptions. These presented a rallying point for the efforts of the mind, and furnished materials for its activity. This is

the fundamental motive which demonstrates the logical necessity for the purely theological character of primitive philosophy, apart from those important social considerations relating to the matter which I cannot even indicate now.

This necessity becomes still more evident when we regard the perfect congruity of theological philosophy with the peculiar nature of the researches on which the human mind in its infancy concentrated to so high a degree all its efforts. It is, indeed, very noticeable that the most insoluble questions – such as the inner nature of objects, or the origin and purpose of all phenomena – are precisely those which the human mind proposes to itself, in preference to all others, in its primitive state, all really soluble problems being looked upon as hardly worthy of serious thought. The reason for this is very obvious, since it is experience alone that has enabled us to estimate our abilities rightly, and, if man had not commenced by overestimating his forces, these would never have been able to acquire all the development of which they are capable. This fact is a necessity of our organization. But, be that as it may, let us picture to ourselves as far as we are able this [early] mental disposition, so universal and so prominent, and let us ask ourselves what kind of reception would have been accorded at such an epoch to the positive philosophy, supposing it to have been then formed. The highest ambition of this philosophy is to discover the laws of phenomena, and its main characteristic is precisely that of regarding as necessarily interdicted to the human reason all those sublime mysteries which theological philosophy, on the contrary, explains with such admirable facility, even to the smallest detail. [Under such circumstances, it is easy to see what the choice of primitive man would be.]

The same thing is true when we consider from a practical standpoint the nature of the pursuits with which the human mind first occupies itself. Under that aspect they offer to man the strong attraction of an unlimited control over the exterior world, which is regarded as being entirely destined for our use, while all its phenomena seem to have close and continuous relations with our existence. These chimerical hopes, these exaggerated ideas of man's importance in the universe, to which the theological philosophy gives rise, are destroyed irrevocably by the first fruits of the positive philosophy. But at the beginning they afforded an indispensable stimulus without the aid of which we cannot, indeed, conceive how the primitive human mind would have been induced to undertake any arduous labors.

We are at the present time so far removed from that early state of mind – at least as regards the majority of phenomena – that it is difficult for us to appreciate properly the force and necessity of such considerations. Human reason is now so mature that we are able to undertake laborious scientific researches without having in view any extraneous goal capable of strongly exciting the imagination, such as that which the astrologers or alchemists proposed to themselves. Our intellectual activity is sufficiently excited by the mere hope of discovering the laws of phenomena, by the simple desire of verifying or disproving a theory. This, however, could not be the case in the infancy of the human mind. Without the attractive chimeras of astrology, or the powerful deceptions of alchemy, for example, where should we have found the perseverance and ardor necessary for collecting the long series of observations and experiments which later on served as a basis for the first positive theories of these two classes of phenomena?

The need for such a stimulus to our intellectual development was keenly felt long ago by Kepler³ in the case of astronomy, and has been justly appreciated in our own time by Berthollet⁴ in chemistry.

The above considerations show us that, although the positive philosophy represents the true final state of human intelligence – that to which it has always tended more and more – it was nonetheless necessary to employ the theological philosophy at first and during many centuries, both as a method and as furnishing provisional doctrines. Because the theological philosophy was spontaneous in its character, it was the only one possible in the beginning; it was also the only one to offer a sufficient interest to our budding intelligence. It is now very easy to see that, in order to pass from this provisional form of philosophy to the final stage, the human mind was naturally obliged to adopt metaphysical methods and doctrines as a transitional form of philosophy. This last consideration is indispensable in order to complete the general sketch of the great law which I have pointed out.

It is easily seen that our understanding, [which was] compelled to progress by almost insensible steps, could not pass suddenly and without any intermediate stages from theological to positive philosophy. Theology and physics are so profoundly incompatible, their conceptions are so radically opposed in character, that, before giving up the one in order to employ the other exclusively, the human intelligence had to make use of intermediate conceptions, which, being of a hybrid character, were eminently fitted to bring about a gradual transition.

That is the part played by metaphysical conceptions, and they have no other real use. By substituting, in the study of phenomena, a corresponding inseparable entity for a direct supernatural agency – although at first the former was only held to be an offshoot of the latter – man gradually accustomed himself to consider only the facts themselves. This development was caused by the concepts of metaphysical agents gradually becoming so empty through oversubtle qualification that all right-minded persons considered them to be only the abstract names of the phenomena in question. It is impossible to imagine by what other method our understanding could have passed from frankly supernatural to purely natural considerations, or, in other words, from the theological to the positive régime.

I have thus established, insofar as it is possible without entering into a special discussion, which would be out of place at the present moment, that which I conceive to be the general law of mental development. It will now be easy for us to determine precisely the exact nature of the positive philosophy. To do that is the special object of this chapter.

We have seen that the fundamental character of the positive philosophy is to consider all phenomena as subject to invariable natural laws. The exact discovery of these laws and their reduction to the least possible number constitute the goal of all our efforts; for we regard the search after what are called causes, whether first or final, as absolutely inaccessible and unmeaning. It is unnecessary to dwell much on a principle that has now become so familiar to all who have made anything like a serious study of the observational sciences. Everybody, indeed, knows that in our positive explanations, even when they are most complete, we do not pretend to explain the real causes of phenomena, as this would merely throw the difficulty further back; we try only to analyze correctly the circumstances of their production, and to connect them by normal relations of succession and similarity.

Thus, to cite the best example, we say that the general phenomena of the universe are explained – as far as they can be – by the Newtonian law of gravitation. On the one hand, this admirable theory shows us all the immense variety of astronomical facts as only a single fact looked at from different points of view, that fact being the constant tendency of all molecules towards each other in direct proportion to their masses and inversely as the squares of their distances. On the other hand, this general fact is shown to be the simple extension of an extremely familiar and, therefore, well-known phenomenon – the weight of a body at the earth's surface. As to determining

what attraction and weight are in themselves, or what their causes are – these are questions which we regard as insoluble and outside the domain of the positive philosophy; we, therefore, rightly abandon them to the imagination of the theologians or the subtleties of the metaphysicians. That it is clearly impossible to solve such questions is shown by the fact that, whenever an attempt has been made to give a rational explanation of the matter, the greatest thinkers have only been able to define one of these principles by the other. Attraction is defined as nothing but universal weight, and weight is said to consist simply in terrestrial attraction. Explanations of this kind raise a smile, if put forward as furnishing us with a knowledge of “things-in-themselves” and the mode of causation of phenomena. They are, however, the only satisfactory results obtainable, for they present as identical two orders of phenomena which for so long a time were regarded as unconnected. No sensible person would nowadays seek to go beyond this.

It would be easy to multiply these examples, which will occur very frequently throughout this treatise, for at the present day all great intellectual operations are conducted in this spirit. To take a single example of this from contemporary works, I will choose the fine series of researches made by Fourier⁵ on the theory of heat. This affords us an excellent verification of the preceding general remarks. In this work, the philosophical character of which is so eminently positive, the most important and most precise laws of thermal phenomena are disclosed; but the author has not once inquired into the intimate nature of heat itself, nor has he mentioned, except to point out its uselessness, the vigorous controversy between the partisans of heat as a material substance and those who make it consist in the vibrations of a universal ether. Yet, that work treats of the most important questions, several of which had never been raised – a clear proof that the human mind, by simply confining itself to researches of an entirely positive order, can find therein inexhaustible food for its highest form of activity without attacking inaccessible problems.

Having thus indicated, insofar as it was possible in this general sketch, the spirit of the positive philosophy, which the whole of this course is intended to develop, we must next consider what stage in the formation of that philosophy has now been reached and what remains to be done in order to constitute it fully.

For this purpose, we must in the first place remember that the different branches of our knowledge were not able to pass at the same rate through the three great phases

of their development indicated above, and that consequently they did not arrive simultaneously at the positive state. There exists in this respect an invariable and necessary order that our various classes of conceptions have followed, and were bound to follow, in their progressive course; and the exact consideration of this order is the indispensable complement of the fundamental mental law previously enunciated. That order will form the special subject of the next chapter. At present it is sufficient to know that it conforms to the diverse nature of the phenomena, and that it is determined by their degree of generality, of simplicity, and of reciprocal independence – three considerations which, although quite distinct, lead to the same result. Thus, astronomical phenomena, being the most general, the simplest, and the most independent of all others, were the first to be subjected to positive theories; then followed in succession and for the same reasons the phenomena of terrestrial physics, properly so called, those of chemistry, and, finally, those of physiology.

It is impossible to fix the precise date of this mental revolution; we can say only that, like all other great human events, it took place continuously and at an increasing rate, especially since the labors of Aristotle and the Alexandrian school, and afterward from the introduction of natural science into the west of Europe by the Arabs. However, as it is better to fix an epoch in order to give greater precision to our ideas, I would select that of the great movement imparted to the human intellect two centuries ago by the combined influence of the precepts of Bacon, the conceptions of Descartes,⁶ and the discoveries of Galileo.⁷ It was then that the spirit of the positive philosophy began to assert itself in the world, in evident opposition to the theological and metaphysical spirit; for it was then that positive conceptions disengaged themselves clearly from the superstitious and scholastic alloy, which had more or less disguised the true character of all the previous scientific work.

Since that memorable epoch, the increasing influence of the positive philosophy and the decadent movement of theological and metaphysical philosophy have been extremely marked. These movements have at last become so pronounced that at the present day it is impossible for any observer acquainted with the spirit of his age to fail to recognize the final bent of the human mind toward positive studies, and the irrevocable break henceforth from those fruitless doctrines and provisional methods that were suited only to its first flight. This fundamental mental revolution will, therefore, necessarily be carried out to the fullest extent. If, then, there still remains some

great conquest to be made, some important division of the intellectual domain to be invaded, we can be certain that the transformation will take place there also, as it has been carried out in all the other branches of science. It would evidently be absurd to suppose that the human mind, which is so disposed to unity of method, would yet preserve indefinitely, in the case of a single class of phenomena, its primitive mode of philosophizing, when it has once adopted for the other classes a new philosophical path of an entirely opposite character.

The whole thing reduces itself, therefore, to a simple question of fact: Does the positive philosophy, which during the last two centuries has gradually acquired so great an extension, embrace at the present day all classes of phenomena? It is evident that it does not; therefore, a great scientific work still remains to be executed in order to give the positive philosophy that universal character indispensable for its final constitution.

In the four principal categories of natural phenomena enumerated above – astronomical, physical, chemical, and physiological – we notice an important omission relating to social phenomena. Although these are implicitly comprised among physiological phenomena, yet, owing to their importance and the inherent difficulties of their study, they deserve to form a distinct class. This last order of ideas is concerned with the most special, most complicated, and most dependent of all phenomena; it has, therefore, necessarily progressed more slowly than all the preceding orders, even if we do not take into account the more special obstacles to its study which we shall consider later on. However that may be, it is evident that it has not yet been included within the domain of positive philosophy. Theological and metaphysical methods are never used now by anyone in dealing with all the other kinds of phenomena, either as a means of investigation or even as a mode of reasoning. But these discarded methods are, on the contrary, still used exclusively for both purposes in everything that concerns social phenomena, although their insufficiency in this respect has been fully felt already by all good minds, such men being tired of these empty and endless discussions between, e.g., divine right and the sovereignty of the people.

Here, then, is the great, but evidently the only, gap that has to be filled in order to finish the construction of the positive philosophy. Now that the human mind has founded celestial physics, terrestrial physics (mechanical and chemical), and organic physics (vegetable and animal), it only remains to complete the system of observational sciences by the foundation of social physics.⁸ This is at

the present time, under several important aspects, the greatest and most pressing of our cognitive needs, and to meet this need is, I make bold to say, the first purpose of this work, its special object.

The conceptions which I shall endeavor to present relating to the study of social phenomena, and of which I hope the present chapter has already enabled us to see the germ, cannot be expected to raise social physics at once to the degree of perfection that has been reached by the earlier branches of natural philosophy. Such a hope would be evidently chimerical, seeing that these branches still differ widely from one another in perfectness, as was, indeed, inevitable. But I aim at impressing upon this last branch of our knowledge the same positive character that already marks all the other branches. If this condition is once really fulfilled, the philosophical system of the modern world will be founded at last in its entirety; for there is no observable fact that would not then be included in one or another of the five great categories of astronomical, physical, chemical, physiological, and social phenomena. All our fundamental conceptions having thus been rendered homogeneous, philosophy will be constituted finally in the positive state. Its character will be henceforth unchangeable, and it will then have only to develop itself indefinitely, by incorporating the constantly increasing knowledge that inevitably results from new observations or more profound meditations. Having by this means acquired the character of universality which as yet it lacks, the positive philosophy, with all its natural superiority, will be able to displace entirely the theological and metaphysical philosophies. The only real property possessed by theology and metaphysics at the present day is their character of universality, and when deprived of this motive for preference they will have for our successors only a historical interest.

The first and special object of this course having been thus set forth, it is easy to comprehend its second and general aim, that which constitutes it a course of positive philosophy, and not merely a course on social physics.

The formation of social physics at last completes the system of natural sciences. It, therefore, becomes possible and even necessary to summarize these different sciences, so that they may be coordinated by presenting them as so many branches of a single trunk, instead of continuing to look upon them as only so many isolated groups. Therefore, before proceeding to the study of social phenomena, I shall successively consider, in the encyclopedic order given above, the different positive sciences already formed.

It is, I think, unnecessary to warn the reader that I do not claim to give here a series of special courses of lectures on each of the principal branches of natural philosophy. Not to speak of the enormous time that such an enterprise would take, it is clear that I cannot claim to be equipped for it, nor, I think I may add, can anyone else in the present state of human education. On the contrary, a course of the kind contemplated here requires, if it is to be understood properly, a previous series of special studies on the different sciences which will be treated therein. In the absence of this condition, it is very difficult to realize, and impossible to estimate, the philosophical reflections that will be made upon these sciences. In one word, it is a course on positive philosophy, and not on the positive sciences, that I propose to give. We shall have to consider here only each fundamental science in its relations with the whole positive system and the spirit characterizing it; that is to say, under the twofold aspect of its essential methods and its principal achievements. As to the achievements, indeed, I shall often do no more than mention them as known to specialists, though I shall try to estimate their importance.

In order to sum up the ideas relating to the twofold purpose of this course, I must call attention to the two objects – the one special, the other general – that I have in view and that, although distinct in themselves, are necessarily inseparable.

On the one hand, it would be impossible to conceive of a course of positive philosophy unless social physics had been founded first, since an essential element would then be lacking; consequently, the conceptions of such a course would not have that character of generality that ought to be their principal attribute and that distinguishes our present study from any series of special studies. On the other hand, how can we proceed with sure step to the positive study of social phenomena if the mind has not been prepared first by the thorough consideration of positive methods in the case of less complex phenomena, and furnished in addition with a knowledge of the principal laws of earlier phenomena, all of which have a more or less direct influence upon social facts?

Although all the fundamental sciences do not inspire ordinary minds with an equal interest, there is not one of them that should be neglected in such a study as we are about to undertake. As regards the welfare of the human race, all of them are certainly of equal importance when we examine them thoroughly. Besides, those whose results seem at first sight to offer only a minor practical interest

are yet of the greatest importance, owing to either the greater perfection of their methods or the indispensable foundation of all the others. This is a consideration to which I shall have special occasion to refer in the next chapter.

To guard as far as possible against the misconceptions likely to arise respecting a work as novel as this, I must add a few remarks to the explanations already given. I refer especially to that universal predominance of specialism, which hasty readers might think was the tendency of this course, and which is so rightly looked upon as wholly contrary to the true spirit of the positive philosophy. These remarks, moreover, will have the more important advantage of exhibiting this spirit under a new aspect, calculated to make its general idea clearer.

In the primitive state of our knowledge, no regular division exists among intellectual labors; all the sciences are cultivated simultaneously by the same minds. This method of organizing human studies is at first inevitable and even indispensable, as I shall have occasion to show later on; but it gradually changes in proportion as the different orders of conceptions develop themselves. By a law whose necessity is evident, each branch of the scientific system gradually separates from the trunk when it has developed far enough to admit of separate cultivation — that is to say, when it has arrived at a stage in which it is capable of constituting the sole pursuit of certain minds. It is to this division of the various kinds of research among different orders of scientists that we evidently owe the development which each distinct class of human knowledge has attained in our time; but this very division renders it impossible for modern scientists to practice that simultaneous cultivation of all the sciences which was so easy and so common in antiquity. In a word, the division of intellectual labor, carried out further and further, is one of the most important and characteristic attributes of the positive philosophy.

But, while recognizing the prodigious results due to this division, and while seeing that it henceforth constitutes the true fundamental basis of the general organization of the scientific world, it is, on the other hand, impossible not to be struck by the great inconveniences which it at present produces, because of the excessive specialization of the ideas that exclusively occupy each mind. This unfortunate result, being inherent in the very principle of the division of labor, is no doubt inevitable up to a certain point. Do what we will, therefore, we shall never be able to equal the ancients in this respect, for their general superiority was due to the slight degree of development of their knowledge. Yet, I think we can, by

proper means, avoid the most pernicious effects of an exaggerated specialism without doing injury to the fruitful influence of the division of labor in research. There is an urgent need to consider this question seriously, for these inconveniences, which by their very nature tend constantly to increase, are now becoming very apparent. Everyone agrees that the divisions which we establish between the various branches of natural philosophy, in order to make our labors more perfect, are at bottom artificial. In spite of this admission, we must not forget that the number of scientists who study the whole of even a single science is already very small, although such a science is, in its turn, only a part of a greater whole. The majority of scientists already confine themselves entirely to the isolated consideration of a more or less extensive section of a particular science, without concerning themselves much about the relationship between their special work and the general system of positive knowledge. Let us hasten to remedy this evil before it becomes more serious. Let us take care that the human mind does not lose its way in a mass of detail. We must not conceal from ourselves that this is the essentially weak side of our system, and that this is the point on which the partisans of theological and metaphysical philosophy may still attack the positive philosophy with some hope of success.

The true means of arresting the pernicious influence that seems to threaten the intellectual future of mankind, because of too great a specialization of individual researches, is clearly not to return to the ancient confusion of labors. This would tend to put the human mind back; and, besides, such a return has happily become impossible now. The true remedy consists, on the contrary, in perfecting the division of labor itself. All that is necessary is to create one more great speciality, consisting in the study of general scientific traits. We need a new class of properly trained scientists who, instead of devoting themselves to the special study of any particular branch of science, shall employ themselves solely in the consideration of the different positive sciences in their present state. It would be their function to determine exactly the character of each science, to discover the relations and concatenation of the sciences, and to reduce, if possible, all their chief principles to the smallest number of common principles, while always conforming to the fundamental maxims of the positive method. At the same time the other scientists, before devoting themselves to their respective specialities, should have received a previous training embracing all the general principles of positive knowledge. This would enable them henceforth

to make immediate use of the light thrown on their work by the scientists devoted to the study of the sciences in general, whose results the specialists would in turn be able to rectify. That is a state of things to which the existing scientists are drawing nearer every day. If these two great conditions were once fulfilled, as they evidently can be, then the division of labor in the sciences could be carried on without any danger as far as the development of the different kinds of knowledge required. There would be a distinct class of men [always open to the critical discipline of all the other classes], whose special and permanent function would consist in connecting each new special discovery with the general system; and we should then have no cause to fear that too great an attention bestowed upon the details would ever prevent us from perceiving the whole. In a word, the modern organization of the scientific world would then be accomplished, and would be susceptible of indefinite development, while always preserving the same character.

To make the study of the universal characteristics of the sciences a distinct department of intellectual labor is merely a further extension of the same principle of division that led to the successive separation of the different sciences. As long as the different positive sciences were only slightly developed, their mutual relations were not important enough to give rise (at all events permanently) to a special discipline, nor was the need of this new study nearly as urgent as it is now. But at the present day each of the sciences has developed on its own lines to such an extent that the examination of a mutual relationship affords material for systematic and continued labor, while at the same time this new order of studies becomes indispensable to prevent the dispersion of human ideas.

Such, in my view, is the office of the positive philosophy in relation to the positive sciences, properly so called. Such, at all events, is the aim of the present work.

I have now determined, as exactly as possible in a first sketch, the general spirit of a course of positive philosophy. In order to bring out its full character, I must state concisely the principal general advantages that such a work may have – if its essential conditions are fulfilled properly – as regards intellectual progress. I will mention only four. They are fundamental qualities of the positive philosophy.

In the first place, the study of the positive philosophy, by considering the results of the activity of our intellectual faculties, furnishes us with the only really rational means of exhibiting the logical laws of the human mind, which have hitherto been sought by methods so ill calculated to reveal them.

To explain what I mean on this point I must first recall a philosophical conception of the highest importance, set forth by Blainville⁹ in the fine introduction to his *Principles of Comparative Anatomy*. According to him, every active being, and especially every living being, may be studied in all its manifestations under two fundamental relations – the static and the dynamic; that is, as fitted to act and as actually acting. It is clear that all the considerations which might be presented will necessarily fall under the one or the other of these heads. Let us apply this luminous fundamental maxim to the study of intellectual functions.

If these functions are regarded from a static point of view, their study can consist only in determining the organic conditions on which they depend; it thus forms an essential part of anatomy and physiology. When considering the question from a dynamic point of view, we have merely to study the actual march of the human intellect, in practice, by examining the procedures used by it in order to acquire a knowledge of the various sciences; this constitutes essentially the general object of the positive philosophy as I have already defined it in this chapter. In brief, we must look upon all scientific theories as so many great logical facts; and it is only by a thorough observation of these facts that we can rise to the knowledge of logical laws.

These are evidently the only two general methods, complementary to each other, by the use of which we are able to arrive at any really rational ideas concerning intellectual phenomena. We see that in no case is there room for that illusory psychology – the last transformation of theology – the revival of which attempts are being made so vainly at the present day. This theory, while ignoring and discarding the physiological study of our intellectual organs and the observation of the rational methods that actually direct our various scientific researches, claims that it can discover the fundamental laws of the human mind, by contemplating it in itself, without paying any attention to either the causes or the effects of its activity.

The preponderance of the positive philosophy has been growing steadily since Bacon's time. It has today acquired, indirectly, so great a hold over even those minds that are the least familiar with its immense development that the metaphysicians devoted to the study of the intellect could only hope to check the decadence of their pretended science by presenting their doctrines as also being founded upon the observation of facts. In order to do this, they have recently attempted to distinguish, by

a very singular subtlety, two kinds of observation of equal importance, the one exterior, the other interior, the latter being devoted solely to the study of intellectual phenomena. To enter into a special discussion of this fundamental sophism would be out of place here. I must be content with indicating the principal consideration which proves clearly that this pretended direct contemplation of the mind by itself is a pure illusion.

It was thought until quite recently that vision was explained by saying that the luminous action of bodies produces on the retina actual images representing exterior forms and colors. To this the physiologists have reasonably objected that, if the luminous impressions produced real images on the retina, we should need another eye to see them. Is not this reasoning still more applicable in the present instance?

It is clear that, by an inevitable necessity, the human mind can observe all phenomena directly, except its own. Otherwise, by whom would the observation be made? As far as moral phenomena are concerned, it may be granted that it is possible for a man to observe the passions that animate him, for the anatomical reason that the organs which are their seat are distinct from those whose functions are devoted to observation. Everyone has had occasion to notice this fact for himself, but such observations would evidently never possess much scientific value. The best way of knowing the passions will always be to observe them from the outside; for a person in any state of extreme passion – that is to say, in precisely the state that it is most essential to examine – would necessarily be incapacitated for observing himself. But in the case of intellectual phenomena, to observe them in this manner while they are taking place is clearly out of the question. The thinking individual cannot cut himself in two – one of the parts reasoning, while the other is looking on. Since in this case the organ observed and the observing organ are identical, how could any observation be made?

The principle of this so-called psychological method is therefore entirely worthless. Besides, consider to what thoroughly contradictory proceedings it immediately leads! On the one hand, you are recommended to isolate yourself as far as possible from the outer world, and you must especially give up all intellectual work; for if you were engaged in making only the simplest calculation, what would become of the interior observation? On the other hand, after having, by means of due precautions, at last attained this perfect state of intellectual slumber, you must then occupy yourself in contemplating the opera-

tions that will be taking place in a mind supposed to be blank! Our descendants will no doubt see such pretensions ridiculed on the stage some day.

The results of such a strange procedure are in thorough accordance with the principle. For the last two thousand years metaphysicians have been cultivating psychology in this manner, and yet they have not been able to agree on one single intelligible and sound proposition. They are, even at the present day, divided into a multitude of schools that are incessantly disputing on the first elements of their doctrines. In fact, interior observation gives rise to almost as many divergent opinions as there are so-called observers.

The true scientists – the men devoted to the positive sciences – are still calling in vain on these psychologists to cite a single real discovery, great or small, due to this much-vaunted method. It does not follow that all their labors have been absolutely fruitless as regards the general progress of our knowledge, and we must remember the valuable service that they rendered in sustaining the activity of human intelligence at a time when it could not find a more substantial ailment. But their writings consist largely of that which an illustrious positive philosopher, M. Cuvier,¹⁰ has well called “metaphors mistaken for reasoning.” We may safely affirm that any true notions they present have been obtained, not by their pretended method, but by observations on the progress of the human mind – observations to which the development of the sciences has from time to time given birth. And even these ideas, so scanty in number, although proclaimed with so much emphasis, and due only to the unfaithfulness of the psychologists to their pretended methods, are generally either greatly exaggerated or very incomplete, and they are very inferior to the remarks that scientists have already unostentatiously made upon the methods which they employ. It would be easy to cite some striking examples of this, if I did not fear that I should be prolonging the discussion of the point too much: take, for instance, the treatment of the theory of [algebraical] signs [by metaphysicians and geometers respectively].

The considerations relating to logical science which I have just indicated become still more evident when we deal with the art of logic.

For when we want not only to know what the positive method consists in, but also to have such a clear and deep knowledge of it as to be able to use it effectively, we must consider it in action; we must study the various great applications of the method that the human mind has made and already verified. In a word, it is only by a

philosophical examination of the sciences that we can attain the desired result. The method does not admit of being studied apart from the researches on which it is employed; or, at all events, it is only a lifeless study, incapable of fertilizing the mind that resorts to it. Looking at it in that abstract way, the only real information that you can give about it amounts to no more than a few general propositions, so vague that they can have no influence on mental habits. When we have thoroughly established as a logical thesis that all our knowledge must be founded upon observation, that we must proceed sometimes from facts to principles, at other times from principles to facts, and some other similar aphorisms, we still know the method far less clearly than he who, even without any philosophical purpose in view, has studied at all completely a single positive science. It is because they have failed to recognize this essential fact that our psychologists have been led to take their reveries for science, in the belief that they understood the positive method because they have read the precepts of Bacon or the discourse of Descartes.

I do not know if, in the future, it will become possible to construct by a priori reasoning a genuine course on method, wholly independent of the philosophical study of the sciences; but I am quite convinced that it cannot be done at present, for the great logical methods cannot yet be explained with sufficient precision apart from their applications. I venture to add, moreover, that, even if such an enterprise could be carried out eventually, which is conceivable, it would nevertheless be only through the study of regular applications of scientific methods that we could succeed in forming a good system of intellectual habits; this is, however, the essential object to be gained by studying method. There is no need to insist further just now on a subject that will recur frequently throughout this work and in regard to which I shall present some new considerations in the next chapter.

The first great direct result of the positive philosophy is then the manifestation by experience of the laws that our intellectual functions follow in their operations and, consequently, a precise knowledge of the general rules that are suitable for our guidance in the investigation of truth.

A second consequence, of no less importance and of much more urgent concern, which must immediately result from the establishment of the positive philosophy as defined in this chapter, is the general recasting of our educational system.

Competent judges are already unanimous in recognizing the necessity of replacing our European education, which is still essentially theological, metaphysical, and literary, by a positive education in accordance with the spirit of our time and adapted to the needs of modern civilization. Various attempts have been made in increasing number during the last hundred years, and especially during recent years, to spread and augment, without ceasing, instruction of a positive kind. Such attempts, which the different European governments have always eagerly encouraged and often initiated, are a sufficient testimony that the spontaneous feeling of this necessity is everywhere growing. But, while supporting these useful enterprises as much as possible, we must not conceal the fact that in the present state of our ideas they are not at all capable of attaining their principal object – namely, the fundamental regeneration of general education. The exclusive speciality, the too rigid isolation, which still characterizes our way of conceiving and of cultivating the sciences, has necessarily a marked influence upon the mode of teaching them. An intelligent person who wishes at the present day to study the principal branches of natural philosophy, in order to acquire a general system of positive ideas, is obliged to study each separate science in the same way and with the same amount of detail as if he wished to become an astronomical or chemical specialist, etc. This renders such an education almost impossible and necessarily very imperfect, even in the case of the most intelligent minds placed in the most favorable circumstances. Such a mode of proceeding would, therefore, be wholly chimerical as regards general education; and yet, an essential requirement of the latter is a complete body of positive conceptions on all the great classes of natural phenomena. It is such a general survey, on a more or less extended scale, which must henceforth constitute, even among the mass of the people, the permanent basis of all human combinations; it must, in short, constitute the mental framework of our descendants. In order that natural philosophy may be able to complete the already partially accomplished regeneration of our intellectual system, it is therefore indispensable that the different sciences of which it is composed – regarding them as the different branches of a single trunk – should first be reduced to what constitutes their essence – that is, to their principal methods and most important results. It is in this way only that the teaching of the sciences can become the basis of a new general and really rational education for our people. Of

course, each individual, after receiving this general education, will have to supplement it by such special education as he may require, in which he will study one or other of the special sciences. But the essential consideration which I wish to point out here is that all these special studies, even if all of them were toilsomely compiled, would necessarily be insufficient really to renew our educational system, if they did not rest on the preliminary basis of this general education which is itself the direct result of the positive philosophy as defined in this discourse.

The special study of the general traits of the sciences is not only destined to reorganize education, but it will also contribute to the particular progress of the different positive sciences. This constitutes the third fundamental property that I have to point out.

The divisions that we establish between the sciences, although not arbitrary as some people suppose, are yet essentially artificial. In reality, the subject of all our researches is one; we divide it only so that we may, by separating the difficulties, resolve them more easily. And so it not infrequently happens that these established divisions are a hindrance, and that questions arise which need to be treated by combining the points of view of several sciences. This cannot be done easily when scientists are so addicted to specialization. Hence, the problems are left unsolved for a much longer time than would otherwise be necessary. Such an inconvenience must make itself especially felt in the case of the more essential doctrines of each positive science. Very striking examples of this fact could be cited easily, and I shall carefully call attention to them as they occur in the course of this work.

I could cite a very memorable example of this from the past, in the case of the admirable conception of Descartes relating to analytical geometry. This fundamental discovery, which has changed the aspect of mathematical science and in which we should see the true germ of all the great subsequent progress, is it not simply the result of establishing a closer connection between two sciences that had hitherto been regarded from separate standpoints. But the case will be even more decisive if we consider some questions that are still under discussion.

I will take the case, in chemistry, of the important doctrine of definite proportions. It is certain that the memorable discussion which has been raised in our own time, relating to the fundamental principle of this theory, cannot yet be considered, in spite of appearances, as irrevocably terminated. For this is not, in my opinion, a simple

question of chemistry. I venture to assert that, in order to settle the point definitively – that is, to determine whether it is a law of nature that atoms necessarily combine together in fixed proportions – it will be indispensable to unite the chemical with the physiological point of view. This is shown by the fact that, even in the opinion of the illustrious chemists who have most powerfully contributed to the formation of this doctrine, the utmost that can be said is that it is always verified in the composition of inorganic bodies; but it is no less constantly at fault in the case of organic compounds, to which up to the present it seems quite impossible to extend the doctrine. Now, before erecting the theory into a truly fundamental principle, ought not this immense exception to be considered first? Does it not belong to the same general characteristic of all organic bodies, that in none of their phenomena can we make use of invariable numbers? However that may be, an entirely new order of considerations, belonging equally to chemistry and physiology, is evidently necessary in order to decide finally, in some way or other, this great question of natural philosophy.

I think it will be well to consider here a second example of the same kind, which since it relates to a subject of much more limited scope, shows even more conclusively the special importance of the positive philosophy in the solution of questions that need the combination of several sciences. This example, which I also take from chemistry, is the still controverted question as to whether, in the present state of our knowledge, nitrogen should be regarded as an element or a compound. The illustrious Berzelius¹¹ [differing from almost all living chemists] believes it to be a compound; and his reasons, of a purely chemical nature, successfully balance those of present-day chemists. But what I want particularly to point out is that Berzelius, as he admits himself – and a most instructive admission it is – was greatly influenced by the physiological observation that animals that feed on non-nitrogenous matter contain in their tissues just as much nitrogen as the carnivorous animals. It is therefore quite clear that, in order to decide whether nitrogen is or is not an element, we must necessarily call in the aid of physiology, and combine with chemical considerations, properly so called, a series of new researches on the relationships between the composition of living bodies and the nature of their food.

It would be superfluous now to go on multiplying examples of these complex problems, which can be solved only by the ultimate combination of several sciences that are at present cultivated in a wholly independent manner.

Those which I have just cited are sufficient to show in a general way the importance of the function that the positive philosophy will perform in perfecting each of the natural sciences, for it is directly destined to organize in a permanent manner combinations of this kind, which could not be formed suitably without its aid. I must draw attention to a fourth and last fundamental property of that which I have called the positive philosophy, and which no doubt deserves our notice more than any other property, for it is today the most important one from a practical point of view. We may look upon the positive philosophy as constituting the only solid basis of the social reorganization that must terminate the crisis in which the most civilized nations have found themselves for so long. The last part of this course will be specially devoted to establish and develop this proposition. But the general sketch of my great subject which I have undertaken to give in this chapter would lack one of its most characteristic elements if I failed to call attention here to such an essential consideration.

It may be thought that I am making too ambitious a claim for the positive philosophy. But a few very simple reflections will suffice to justify it.

There is no need to prove to readers of this work that the world is governed and overturned by ideas, or, in other words, that the whole social mechanism rests finally on opinions. They know, above all, that the great political and moral crisis of existing societies is due at bottom to intellectual anarchy. Our gravest evil consists, indeed, in this profound divergence that now exists among all minds, with regard to all the fundamental maxims whose fixity is the first condition of a true social order. As long as individual minds are not unanimously agreed upon a certain number of general ideas capable of forming a common social doctrine, we cannot disguise the fact that the nations will necessarily remain in an essentially revolutionary state, in spite of all the political palliatives that may be adopted. Such a condition of things really admits only of provisional institutions. It is equally certain that, if this general agreement upon first principles can once be obtained, the appropriate institutions will necessarily follow, without giving rise to any grave shock; for the greater part of the disorder will have been already dissipated by the mere fact of the agreement. All those, therefore, who feel the importance of a truly normal state of things should direct their attention mainly to this point.

And now, from the lofty standpoint to which the various considerations indicated in this chapter have step by step raised us, it is easy both to characterize clearly the

present state of society as regards its inner spirit, and to deduce therefrom the means by which that state can be changed essentially. Returning to the fundamental law enunciated at the commencement of this chapter.

I think we may sum up exactly all the observations relating to the existing situation of society, by the simple statement that the actual confusion of men's minds is at bottom due to the simultaneous employment of three radically incompatible philosophies – the theological, the metaphysical, and the positive. It is quite clear that, if any one of these three philosophies really obtained a complete and universal preponderance, a fixed social order would result, whereas the existing evil consists above all in the absence of any true organization. It is the existence of these three opposite philosophies that absolutely prevents all agreement on any essential point. Now, if this opinion be correct, all that is necessary is to know which of the three philosophies can and must prevail by the nature of things; every sensible man should next endeavor to work for the triumph of that philosophy, whatever his particular opinions may have been before the question was analyzed. The question being once reduced to these simple terms, the issue cannot long remain doubtful, because it is evident for all kinds of reasons, some of the principal of which have been indicated in this chapter, that the positive philosophy is alone destined to prevail in the ordinary course of things. It alone has been making constant progress for many centuries, while its antagonists have been as constantly in a state of decay. Whether this is a good or a bad thing matters little; the general fact cannot be denied, and that is sufficient. We may deplore the fact, but we are unable to destroy it; nor, consequently, can we neglect it, on pain of giving ourselves up to illusory speculations. This general revolution of the human mind is at the present time almost entirely accomplished. Nothing more remains to be done, as I have already explained, than to complete the positive philosophy by including in it the study of social phenomena, and then to sum them up in a single body of homogeneous doctrine. When these two tasks have made sufficient progress, the final triumph of the positive philosophy will take place spontaneously, and will reestablish order in society. The marked preference which almost all minds, from the highest to the lowest, show at the present day for positive knowledge, as contrasted with vague and mystical conceptions, augers well for the reception that awaits this philosophy when it shall have

acquired the only quality that it still lacks – a character of suitable generality.

To sum up the matter: the theological and metaphysical philosophies are now disputing with each other the task of reorganizing society, although the task is really too hard for their united efforts; it is between these schools only that any struggle still exists in this respect. The positive philosophy has, up to the present, intervened in the contest only in order to criticize both schools; and it has accomplished this task so well as to discredit them entirely. Let us put it in a condition to play an active part, without paying any further attention to debates that have become useless. We must complete the vast intellectual operation commenced by Bacon, Descartes, and Galileo, by furnishing the positive philosophy with the system of general ideas that is destined to prevail henceforth, and for an indefinite future, among the human race. The revolutionary crisis which harasses civilized peoples will then be at an end.

Such are the four principal advantages that will follow from the establishment of the positive philosophy. I have thought it well to mention them at once, because they supplement the general definition that I have tried to give of it.

Before concluding, I desire to caution the reader briefly against an erroneous anticipation which he might form as to the nature of the present work.

In saying that the aim of the positive philosophy was to sum up, in a single body of homogeneous doctrine, the aggregate of acquired knowledge relating to the different orders of natural phenomena, I did not mean that we should proceed to the general study of these phenomena by looking upon them all as so many different effects of a single principle, as reducible to one sole law. Although I must treat this question specially in the next chapter, I think it necessary to say so much at once, in order to avoid unfounded objections that might otherwise be raised. I refer to those critics who might jump to the conclusion that this course is one of those attempts at universal explanation by a single law, which one sees made daily by men who are entire strangers to scientific methods and knowledge. Nothing of that kind is intended here; and the development of this course will furnish the best proof of it to all those whom the explanations contained in this chapter might have left in any doubt on the subject.

It is my deep personal conviction that these attempts at the universal explanation of all phenomena by a single law are highly chimerical, even when they are

made by the most competent minds. I believe that the resources of the human mind are too feeble, and the universe is too complicated, to admit of our ever attaining such scientific perfection; and I also think that a very exaggerated idea is generally formed of the advantages to be derived from it, even were it attainable. In any case, it seems to me evident that, considering the present state of our knowledge, we are yet a long way from the time when any such attempt might reasonably be expected to succeed. It seems to me that we could hope to arrive at it only by connecting all natural phenomena with the most general positive law with which we are acquainted – the law of gravitation – which already links all astronomical phenomena to some of the phenomena of terrestrial physics. Laplace¹² has effectively brought forward a conception by which chemical phenomena would be regarded as purely simple molecular effects of Newtonian attraction, modified by the figure and mutual position of the atoms. This conception would probably always remain an open question, owing to the absence of any essential data respecting the intimate constitution of bodies; and it is almost certain that the difficulty of applying the idea would be so great that we should still be obliged to retain, as an artificial aid, the division which at present is regarded as natural between astronomy and chemistry. Accordingly, Laplace only presented this idea as a mere philosophical game which is incapable of really exercising any useful influence on the progress of chemical science. The case is really stronger, however, for even if we supposed this insurmountable difficulty overcome, we should still not have attained scientific unity, since it would be necessary next to connect the same law of gravitation with the whole of physiology; and this would certainly not be the least difficult part of the task. Yet, the hypothesis which we have just been discussing would be, on the whole, the most favorable to this much-desired unity.

I have no need to go further into details in order to convince the reader that the object of this course is by no means to present all natural phenomena as being at bottom identical, apart from the variety of circumstances. The positive philosophy would no doubt be more perfect if this were possible. But this condition is not at all necessary, either for its systematic formation or for the realization of the great and happy consequences which we have seen that it is destined to produce. The only indispensable unity for those purposes is that of method, which can and evidently must be, and is already largely established. As to the scientific product,

it is not necessary that it should be unified; it is sufficient if it be homogeneous. It is, therefore, from the double standpoint of unity of method and homogeneity of scientific propositions that the different classes of positive theories will be considered in the present work. While trying to diminish as far as possible the number of general laws necessary for the positive explanation of natural phenomena – which is the real philosophic purpose of all science – we shall think it rash ever to hope, even in the most distant future, to reduce these laws rigorously to a single one.

I have attempted in this chapter to determine, as exactly as I could, the aim, the spirit, and the influence of the positive philosophy. I have, therefore, indicated the goal toward which my labors have always tended, and always will tend unceasingly, in this course or

elsewhere. No one is more profoundly convinced than myself of the inadequacy of my intellectual powers, even if they were far superior to what they are, to undertake such a vast and noble work. But, although the task is too great for a single mind or a single lifetime, yet one man can state the problem clearly, and that is all I am ambitious of doing.

Having thus expounded the true aim of this course, by setting the point of view from which I shall consider the various principal branches of natural philosophy, I shall in the next chapter complete these general preliminaries by explaining the plan I have adopted – that is to say, by determining the encyclopedic order that should be established among the several classes of natural phenomena and, consequently, among the corresponding positive sciences.

Notes

- 1 Readers who desire to have a fuller explanation of this subject, without delay, may consult with advantage three articles entitled “Philosophical Considerations on the Sciences and Men of Science,” which I published in November, 1825, in a journal called the *Producteur* (numbers seven, eight, and ten), and especially the first part of my *System of Positive Polity*, addressed in April, 1824, to the Academy of Sciences, where I placed on record for the first time my discovery of this law. [This note appears in the original text. All other notes have been added by the editors.]
- 2 Francis Bacon (1561–1626), English philosopher largely responsible for laying the modern foundations of experimentalism in science and resolute empiricism in philosophy.
- 3 Johann Kepler (1571–1630), German astronomer and mathematician, one of the principal founders of modern astronomy through the mathematical formulation of the laws of planetary motion.
- 4 Claude Louis Berthollet (1748–1822), French chemist who, with Antoine Lavoisier (1743–1794) reformed modern chemical nomenclature and thus helped to found the modern science of chemistry.
- 5 Jean Baptise Joseph Fourier (1768–1830), French mathematician and physicist. Probably in the private audience to which these remarks were first addressed.
- 6 René Descartes (1596–1650), French philosopher and mathematician, largely responsible for shaping the problems of modern philosophy and for emphasizing the rational, mathematical, and theoretical aspects of science and philosophy.
- 7 Galileo Galilei (1564–1642), Italian physicist and astronomer, whose combination of inductive with deductive ways of thinking (uniting Bacon and Descartes, as it were) founded the methodology of modern science, and whose discoveries in various fields provided tremendous impetus to early modern science.
- 8 Comte invented the term “sociology,” meant to designate the rigorous study of social phenomena according to the precepts of positive philosophy. But since here Comte is clearly attempting to show the parallels between the various fields of science, his expression “social physics” will be retained.
- 9 Henri Marie Ducrotay de Blainville (1778–1850), French naturalist. Probably in the private audience to which these remarks were first addressed.
- 10 Georges L. C. F. D. Cuvier (1769–1832), French naturalist and founder of the science of comparative anatomy. An opponent of the evolutionary theories of Jean Baptiste Lamarck (1744–1829).
- 11 Jöns Jakob Berzelius (1779–1848), Swedish chemist, discoverer of several new elements and notable contributor to atomic theory after John Dalton (1766–1844).
- 12 Pierre Simon Laplace (1749–1827), French astronomer and mathematician, author of *Mécanique céleste* (1799–1825) and particularly noted for his conviction that all the phenomena of the universe can in principle be explained and predicted in terms of the laws of classical mechanics alone.

On the Sciences and Arts

Jean-Jacques Rousseau

Final Reply [by] J. J. Rousseau of Geneva¹

Ne, dum tacemus, non verecundiae sed diffidentiae causa tacere videamur.²

Cyprian, Against Demetrianus

It is with extreme reluctance that I amuse idle Readers who care very little about the truth with my disputes. But the manner in which it has just been attacked forces me to spring to its defense once again, so that my silence is not taken by the multitude as consent, nor by Philosophers as disdain.

I must be repetitious. I know that very well, and the public will not forgive me for it. But the wise will say: this man does not need to seek new reasons continually. That is a proof of the solidity of his own.³

Since those who attack me never fail to stray from the question and leave out the essential distinctions I included, I must always begin by taking them back to them. Here, then, is a summary of the propositions I affirmed and will continue to affirm as long as I consult no other interest than that of the truth.

The Sciences are the masterpiece of genius and reason. The spirit of imitation produced the fine Arts and experience has perfected them. We are indebted to the mechanical arts for a great number of useful inventions which have

added to the pleasures and conveniences of life. These are truths about which I surely agree wholeheartedly. But now let's consider all this knowledge in relation to morals.⁴

If celestial intellects cultivated the sciences, only good would result. I say the same of great men, who are destined to guide others. A learned and virtuous Socrates was the pride of humanity. But the vices of ordinary men poison the most sublime knowledge and make it pernicious for Nations. The wicked derive many harmful things from it. The good derive little more. If no one other than Socrates had prided himself on Philosophy in Athens, the blood of a just man would not have cried out for revenge against the fatherland of the Sciences and Arts.⁵

One question to examine is whether it would be advantageous for men to have Science, assuming that what they call by that name in fact deserves it. But it is folly to pretend that the chimeras of Philosophy, the errors and lies of Philosophers can ever be good for anything. Will we always be the dupe of words? And won't we ever understand that study, knowledge, learning, and Philosophy are only vain semblances constructed by human pride and very unworthy of the pompous names it gives them?

To the extent that the taste for these foolish things spreads in a nation, it loses the taste for solid virtues. For it costs less to distinguish oneself by babble than by good morals, as soon as one is dispensed from being a good man provided one is a pleasant man.

Jean-Jacques Rousseau, "Final Reply," from *Discourse on the Sciences and Arts*, in *Collected Writings of Jean-Jacques Rousseau*, vol. 1, ed. Roger D. Masters and Christopher Kelly (Hanover, NH and London: University Press of New England, 1992), pp. 110–116. © University Press of New England, Lebanon, NH. Reprinted by permission.

The more the interior is corrupted, the more the exterior is composed.⁶ In this way the cultivation of Letters imperceptibly engenders politeness. Taste is also born from the same source. Public approbation being the first reward for literary works, it is natural for those pre-occupied by them to reflect on the ways to please. And it is these reflections which, in the long run, form style, purify taste, and spread the graces and urbanity everywhere. All these things will be, if you will, the supplement of virtue. But it will never be possible to say that they are virtue, and they will rarely be associated with it. There will always be this difference, that the person who makes himself useful labors for others, and the one who thinks only of making himself pleasing labors only for himself. The flatterer, for example, spares no effort to please, and yet he does only evil.

The vanity and idleness that have engendered our sciences have also engendered luxury. The taste for luxury always accompanies that of Letters, and the taste for Letters often accompanies that for luxury.⁷ All these things are rather faithful companions, because they are all the work of the same vices.

If experience were not in accord with these demonstrated propositions, it would be necessary to seek the particular causes of that contrary result. But the first idea of these propositions is itself born from a long meditation about experience. And to see to what extent it confirms them, it is necessary only to open the annals of the world.

The first men were very ignorant. How would anyone dare to say they were corrupt in times when the sources of corruption were not yet open?

Across the obscurity of ancient times and the rusticity of ancient Peoples, one perceives very great virtues in several of them, especially a severity of morals that is an infallible mark of their purity, good faith, hospitality, justice, and – what is very important – great horror for debauchery,⁸ the fertile mother of all the other vices. Virtue is therefore not incompatible with ignorance.

It is not always its companion, either, for several very ignorant peoples were very vicious. Ignorance is an obstacle to neither good nor evil. It is only the natural state of man.⁹

One cannot say as much about science. All learned Peoples have been corrupt, and that is already a terrible prejudice against it. But since comparisons from People to People are difficult, since a great number of objects must be taken into consideration, and since they always lack exactness in some respect, it is much more certain to

follow the history of the same People and compare the progress of its knowledge with the revolutions of its morals. Now the result of this examination is that the beautiful time, the time of virtue for each People was that of its ignorance. And to the extent to which it has become learned, Artistic, and Philosophical, it has lost its morals and its probity. It has redescended in this respect to the rank of ignorant and vicious Nations which are the shame of humanity. If one wishes to persist stubbornly in seeking out the differences, I can recognize one, and this is it: It is that all barbarous Peoples, even those who are without virtue, nonetheless always honor virtue, whereas by dint of progress, learned and Philosophical Peoples finally come to ridicule and scorn it. It is when a nation has once reached this point that corruption can be said to be at its peak and there is no hope for remedies.

That is the summary of the things I asserted, and for which I believe I gave proofs. Let us look now at the summary of the Doctrine opposed to me.

“Men are naturally evil. They were that way before the formation of societies. And every place where the sciences have not carried their flame, peoples – abandoned to the *faculties of instinct* alone, reduced with the lions and bears to a purely animal life – have remained immersed in barbarity and wretchedness.

“Greece alone in ancient times thought and *elevated itself by the mind* to all that can make a People praiseworthy. Philosophers formed its morals and gave it laws.

“Sparta, it’s true, was poor and ignorant by institution and by choice. But its laws had great defects, its Citizens a great tendency to allow themselves to be corrupted. Its glory had little solidity, and it soon lost its institutions, its laws, and its morals.

“Athens and Rome degenerated too. One yielded to the success of Macedonia. The other succumbed under the weight of its own greatness, because the laws of a small city were not made to govern the whole world. If it has happened sometimes that the glory of great Empires has not long survived that of letters, it is because the Empire was at its peak when letters were cultivated there, and it is the fate of human things not to last long in the same state. By granting, then, that the alteration of laws and morals influenced these great events, one is not forced to agree that the Sciences and Arts contributed to it. And on the contrary, it can be observed that the progress of letters and their decline is always in exact proportion with the success and fall of empires.

“This truth is confirmed by the experience of recent times, when one sees in a vast and powerful Monarchy

the prosperity of the State, the cultivation of the Sciences and Arts, and warlike virtue cooperating simultaneously for the glory and greatness of the Empire.

“Our morals are the best there can be. Several vices have been proscribed among us. Those that remain belong to humanity, and the sciences have no part in them.

“Luxury has nothing in common with them either. Thus the disorders it can cause must not be attributed to them. Besides, luxury is necessary in large States. It does more good than harm. It is useful in occupying idle Citizens and providing bread for the poor.

“Politeness ought to be counted among the virtues rather than among the vices. It prevents men from showing themselves as they are, a very necessary precaution to make them tolerable to one another.

“The Sciences have rarely attained the goal they set, but at least they aim for it. We progress by slow steps in knowledge of the truth, which doesn’t prevent us from making some progress.

“Finally, even if it were true that the Sciences and Arts enfeeble courage, aren’t the infinite goods they procure for us still preferable to the barbarous and fierce virtue that makes humanity tremble?” I skip the useless and pompous review of these goods. And to start on this last point with an admission suited to forestall much verbiage, I declare once and for all that if something can compensate for the ruin of morals, I am ready to concede that the Sciences do more good than harm. Let us turn now to the rest.

I could without much risk assume all this as proven, since in so many boldly advanced assertions, there are very few that touch on the heart of the question, fewer still from which one can draw any valid conclusion against my sentiment, and since most of them even provide new arguments in my favor if my cause needed some. Indeed,

- (1) If men are wicked by nature, it can happen, if you will, that the sciences will produce some good in their hands. But it is very certain that they will do much more harm. Madmen should not be given weapons.
- (2) If the sciences rarely attain their goal, there will always be much more time lost than time well used. And if it were true that we had found the best methods, most of our labors would still be as ridiculous as those of a man who, very sure he follows the plumb line precisely, would like to drive a well to the center of the earth.

- (3) We must not be so afraid of the purely animal life, nor consider it as the worst state into which we can fall. For it is still better to resemble a sheep than a fallen Angel.
- (4) Greece owed its morals and its laws to Philosophers and Legislators. I acknowledge that. I have already said a hundred times that it is good for there to be Philosophers provided that the People doesn’t get mixed up in being Philosophers.
- (5) Not daring to assert that Sparta didn’t have good laws, one blames the laws of Sparta for having had great defects. So that in order to twist around my reproaches to learned peoples for having always been corrupt, ignorant Peoples are reproached for not having attained perfection.
- (6) The progress of letters is always proportional to the greatness of Empires. So be it. I see that one always speaks to me of success and greatness. I was talking about morals and virtue.
- (7) Our morals are the best that wicked men like ourselves can have. That may be. We have proscribed several vices. I don’t disagree about that. I don’t accuse the men of this century of having all the vices. They have only those of cowardly souls. They are merely imposters and rascals. As for the vices that presuppose courage and firmness, I think they are incapable of them.
- (8) Luxury may be necessary to provide bread for the poor. But if there were no luxury, there would not be any poor people.¹⁰ It keeps idle Citizens occupied. And why are there idle Citizens? When agriculture held a place of honor, there was neither misery nor idleness, and there were many fewer vices.
- (9) I see they take very much to heart this issue of luxury, which they pretend, however, to want to separate from that of the Sciences and Arts. I will agree, then, since they wish for it so absolutely, that luxury serves to support States as Caryatids serve to hold up the palaces they decorate, or rather like those beams with which rotted buildings are supported and which often end up toppling them. Wise and prudent men, get out of any house that is propped up.

This may show how easy it would be for me to turn around in my favor most of the things with which people claim to oppose me. But to speak frankly, I don’t find them well enough proved to have the courage to take advantage of them.

It is asserted that the first men were wicked, from which it follows that man is naturally wicked.¹¹ This is not an assertion of slight importance. It seems to me it was worth the trouble of being proved. The Annals of all the peoples one dares to cite as proof are much more favorable to the opposite assumption. And there would have to be much testimony to oblige me to believe an absurdity. Before those dreadful words *thine* and *mine* were invented, before there were any of that cruel and brutal species of man called masters and of that other species of

roguish and lying men called slaves; before there were men abominable enough to dare have superfluities while other men die of hunger; before mutual dependance forced them all to become imposters, jealous, and traitors; I very much wish someone would explain to me what those vices, those crimes could have been with which they are reproached so emphatically. I am assured that people have long since been disabused of the chimera of the golden Age. Why not add that people have long since been disabused of the chimera of virtue?

Notes

Rousseau originally intended this reply to Charles Bordes's "Discourse on the Advantages of the Sciences and Arts," published in the *Mercury* in April 1752, to close the debate over his *First Discourse*. Although he ultimately published another defense ("Letter [to Lecat]," [Collected Writings, I] pp. 175–179) and, after Bordes published a rejoinder in 1753, started the manuscript of a "Second Letter to Bordes" (pp. 182–185), the "Final Reply" is one of the clearest statements of his paradoxical and often misunderstood position. See Pléiade, II, 1270–1271, 1283 and compare *Confessions*, Book VIII (Pléiade, I, 366). [Ed.]

- 1 In 1761, Rousseau explained that he had used the words "Citizen of Geneva" only "on those works that I think will do honor" to the city (*La Nouvelle Héloïse*, Second Preface [Pléiade, II, 27]); hence, this self-identification indicates the importance he attached to the "Final Reply." Such an interpretation is not contradicted by the fact that, on a copy of his text intended for a corrected edition of his *Collected Writings*, Rousseau later deleted the words "of Geneva" (Pléiade, I, 1270). These corrections are subsequent to the condemnation of Rousseau's work by Geneva in 1762 and include a similar deletion on the title page of the *First Discourse* (Pléiade, I, 1240). [Ed.]
- 2 "We must no longer remain silent for fear that silence seem to be dictated by weakness rather than by discretion" St. Cyprian (c. 210–258) was bishop of Carthage. [Ed.]
- 3 There are very reliable truths that appear at first glance to be absurdities, and that will always be viewed as such by most people. Go say to a man of the People that the sun is closer to us in winter than in summer, or that it has set before we stop seeing it, and he will laugh at you. The same is true of the sentiment I hold. The most superficial men have always been the quickest to oppose me. The true Philosophers are in less of a hurry. And if I have the honor of having made some proselytes, it is only among the latter. Before explaining myself, I meditated on my subject at length and deeply, and I tried to consider all aspects of it. I doubt that any of my adversaries can say as much. At least

I don't perceive in their writings any of those luminous truths that are no less striking in their obviousness than in their novelty, and that are always the fruit and proof of an adequate meditation. I dare say that they have never raised a reasonable objection that I did not anticipate and to which I did not reply in advance. That is why I am always compelled to restate the same things.

- 4 *Knowledge makes men gentle*, says that famous philosopher whose work – always profound and sometimes sublime – exudes everywhere love of humanity. [Editor's note: Plutarch, "On Tranquillity of Mind," 4; *Moralia*, 466D; Loeb Classical Library, trans. W. C. Helmbold (London: Heinemann, 1939), VI, 177.] In these few words and, which is rare, without declamation, he wrote the most solid statement ever made in favor of letters. It is true, knowledge does make men gentle. But gentleness, which is the most appealing of the virtues, is sometimes also a weakness of the soul. Virtue is not always gentle. It knows how to arm itself appropriately with severity against vice; it is inflamed with indignation against crime.

And the just knows no way to pardon the wicked.

A king of Lacedaemonia gave a very wise reply to those who praised in his presence the extreme goodness of his Colleague Charillus. *And how can he be good*, he said to them, *if he doesn't know how to be terrible to the wicked?* [Editor's note: Plutarch, "On Envy and Hate," 5, *Moralia*, 537D; Loeb Classical Library, trans. Philip H. de Lacey and Benedict Einarson (London: Heinemann, 1959), VII, 101. This same text had been cited, without an attribution to a Spartan king, by Montaigne, *Essays*, II, xii, *ad finem*. In the manuscript of corrections (see note 1 above), Rousseau added: *quos malos boni oderint, bonos oportet esse* ("That good men hate the wicked is the proof of their goodness"). Cf. Plutarch, "On Moral Virtue," 12; *Moralia*, 451E (Loeb ed., VI, 81).] Brutus was not a gentle man. Who would have the impudence to say that he was not virtuous? On the contrary, there are cowardly and pusillanimous souls that have

neither fire nor warmth, and that are gentle only through indifference about good and evil. Such is the gentleness that is inspired in Peoples by the taste for Letters.

- 5 It cost Socrates his life to say precisely the same things I am saying. In the proceedings that were instituted against him, one of his accusers pleaded for Artists, another for Orators, the third for Poets, all for the supposed cause of the Gods. The Poets, the Artists, the Fanatics, the Rhetoricians triumphed; and Socrates perished. I am very afraid I have given my century too much credit in asserting that Socrates would not have drunk the hemlock now. [Editor's note: Note that, as in the text of the *First Discourse*, Rousseau speaks of "artists" where Plato had referred to "artisans": cf. *Apology*, 23e and *First Discourse*, p. 10 and Introduction, note 10. In the manuscript corrected when preparing republication of his works, referring to the legal prosecution to which he had been subject, Rousseau added the note: "It will be remarked that I said this as early as the year 1752" (Pléiade, III, 1272; Intégrate, II, 142).]
- 6 I never attend a presentation of a Comedy by Molière without admiring the delicacy of the Spectators. A word that is a little loose, an expression that is coarse rather than obscene, everything wounds their chaste ears. And I have no doubt whatever that the most corrupt are always the most scandalized. Yet if the morals of Molière's century were compared with those of ours, is there anyone who believes that the result will be in favor of ours? Once the imagination has been sullied, everything becomes a subject of scandal for it. When nothing good is left but the exterior, all efforts are redoubled to preserve it.
- 7 Somewhere the luxury of Asiatic peoples has been used to contradict me, by the same manner of reasoning which uses the vices of ignorant peoples to contradict me. But through a misfortune that pursues my adversaries, they are mistaken even about facts that prove nothing against me. I know that the peoples of the Orient are not less ignorant than we are. But that doesn't prevent them from being as vain and from writing almost as many books. The Turks, those who cultivate Letters the least of them all, counted five hundred eighty classical Poets among them toward the middle of the last century.
- 8 I have no scheme to pay court to women. I consent to their honoring me with the epithet Pedant, so dreaded by all our gallant Philosophers. I am coarse, sullen, impolite on principle, and want no supporters. Therefore I am going to speak the truth just as I please.

Man and woman are made to love one another and unite. But beyond this legitimate union, all commerce of love between them is a dreadful source of disorders in society and morals. It is certain that women alone could restore honor and probity among us. But they disdain to take from the hands of virtue an empire they wish to owe only to their charms. Thus, they do only evil, and often receive themselves the punishment for this preference. It is hard to

conceive how, in such a pure Religion, chastity could have become a base and monkish virtue, capable of making ridiculous any man and I daresay almost any woman who would dare to pride themselves on it. Whereas among the Pagans, this same virtue was universally honored, regarded as suited to great men, and admired in their most illustrious heroes. I can name three of them who will not be inferior to any other and who – without Religion being involved – all gave memorable examples of continence: Cyrus, Alexander, and Scipio the Younger. [Editor's note: On Cyrus and Alexander, see Plutarch, "Of Curiosity," *Moralia*, 521F–522A (Loeb ed., VI, 509). On Scipio, Rousseau seems to refer to a saying attributed to Scipio the Elder when he captured Carthage as a man of twenty-five; Plutarch, "Sayings of the Romans," *Moralia*, 196B (Loeb ed., III, 163).] Of all the rare objects in the King's Collection, I would like to see only the silver shield that was given to the latter by the Peoples of Spain; on which they engraved the triumph of his virtue. This was the Romans' way of subjugating Peoples, as much by the veneration due to their morals as by the effort of their arms. This was how the city of the Falisei was subjugated and Pyrrhus the victor chased out of Italy.

I remember having read somewhere a rather good reply by the Poet Dryden to some young English Lord, who reproached him because in one of his Tragedies, Cleomenes enjoyed chatting tête-à-tête with his love rather than formulating some enterprise worthy of his love. When I am near a beautiful woman, the young Lord said to him, I make better use of my time. I believe it, replied Dryden, but you also have to admit that you aren't a Hero.

- 9 I can't help laughing when I see I don't know how many very learned men who honor me with their criticism always raising in objection the vices of a multitude of ignorant Peoples, as though that had something to do with the question. Does it follow from the fact that science necessarily engenders vice that ignorance necessarily engenders virtue? This manner of arguing may be good for Rhetoricians or for the children by whom I was refuted in my country. [Editor's note: There was a refutation of Rousseau, in the form of a dialogue in Latin, at the graduation ceremonies of the College of Geneva on May 23, 1751. Actually, however, it appears that the sixteen-year-old Jean-Alphonse Turretini praised Rousseau's position, and the condemnation was presented by the Pastor Jacob Vernes (Pléiade, III, 1273; Intégrate, II, 143).] But Philosophers ought to reason in another way.
- 10 Luxury feeds a hundred poor people in our cities and causes a hundred thousand to die in our countryside. The money that circulates between the hands of the rich and the Artists in order to provide for their superfluities is lost for the subsistence of the Farmer. And the latter has no clothes precisely because the former have braid on theirs. The waste of materials that go into food for people alone

suffices to make luxury odious to humanity. My adversaries are most fortunate that the culpable delicacy of our language prevents me from offering details about this that would make them blush for the cause that they dare defend. Gravy is necessary for our cooking; that is why so many sick people lack broth. We must have liquors on our table; that is why the peasant drinks only water. We must powder our wigs; that is why so many poor people have no bread.

- 11 This note is for Philosophers. I advise others to skip over it.

If man is wicked by his nature, it is clear that the Sciences will only make him worse. Thus their cause is lost by this assumption alone. But it is necessary to note well that although man is naturally good, as I believe and as I have the happiness to feel, it does not follow from this that the sciences are salutary for him. For every situation that places a people in the position to cultivate them necessarily announces the beginning of corruption which the sciences quickly accelerate. Then the vice of the constitution does all the harm that nature could have done, and bad prejudices take the place of bad inclinations.

References

Collected Writings, I: Jean-Jacques Rousseau. *Rousseau Judge of Jean-Jacques, Dialogues*. *Collected Writings of Rousseau*, Vol. 1. Edited by Roger D. Masters and Christopher Kelly. Hanover, N.H.: University Press of New England, 1991.

Pléiade: Jean-Jacques Rousseau. *Oeuvres complètes*. Vols. 1–5. Paris: NRF-Editions de la Pléiade, 1959ff.

Capitalism and the Modern Labor Process

Karl Marx and Friedrich Engels

From Karl Marx, *Capital: A Critique of Political Economy*

Chapter VII: The labour-process

The labour-process or the production of use-values

Labour is, in the first place, a process in which both man and Nature participate, and in which man of his own accord starts, regulates, and controls the material re-actions between himself and Nature. He opposes himself to Nature as one of her own forces, setting in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate Nature's productions in a form adapted to his own wants. By thus acting on the external world and changing it, he at the same time changes his own nature. He develops his slumbering powers and compels them to act in obedience to his sway. We are not now dealing with those primitive instinctive forms of labour that remind us of the mere animal. An immeasurable interval of time separates the state of things in which a man brings his labour-power to market for sale as a commodity, from that state in which human labour was still in its first instinctive stage. We pre-suppose labour in

a form that stamps it as exclusively human. A spider conducts operations that resemble those of a weaver, and a bee puts to shame many an architect in the construction of her cells. But what distinguishes the worst architect from the best of bees is this, that the architect raises his structure in imagination before he erects it in reality. At the end of every labour-process, we get a result that already existed in the imagination of the labourer at its commencement. He not only effects a change of form in the material on which he works, but he also realises a purpose of his own that gives the law to his modus operandi, and to which he must subordinate his will. And this subordination is no mere momentary act. Besides the exertion of the bodily organs, the process demands that, during the whole operation, the workman's will be steadily in consonance with his purpose. This means close attention. The less he is attracted by the nature of the work, and the mode in which it is carried on, and the less, therefore, he enjoys it as something which gives play to his bodily and mental powers, the more close his attention is forced to be.

The elementary factors of the labour-process are 1, the personal activity of man, *i.e.*, work itself, 2, the subject of that work, and 3, its instruments.

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The soil (and this, economically speaking, includes water) in the virgin state in which it supplies¹ man with necessaries or the means of subsistence ready to hand, exists independently of him, and is the universal subject of human labour. All those things which labour merely separates from immediate connexion with their environment, are subjects of labour spontaneously provided by Nature. Such are fish which we catch and take from their element, water, timber which we fell in the virgin forest, and ores which we extract from their veins. If, on the other hand, the subject of labour has, so to say, been filtered through previous labour, we call it raw material; such is ore already extracted and ready for washing. All raw material is the subject of labour, but not every subject of labour is raw material: it can only become so, after it has undergone some alteration by means of labour.

An instrument of labour is a thing, or a complex of things, which the labourer interposes between himself and the subject of his labour, and which serves as the conductor of his activity. He makes use of the mechanical, physical, and chemical properties of some substances in order to make other substances subservient to his aims.² Leaving out of consideration such ready-made means of subsistence as fruits, in gathering which a man's own limbs serve as the instruments of his labour, the first thing of which the labourer possesses himself is not the subject of labour but its instrument. Thus Nature becomes one of the organs of his activity, one that he annexes to his own bodily organs, adding stature to himself in spite of the Bible. As the earth is his original larder, so too it is his original tool house. It supplies him, for instance, with stones for throwing, grinding, pressing, cutting, &c. The earth itself is an instrument of labour, but when used as such in agriculture implies a whole series of other instruments and a comparatively high development of labour.³ No sooner does labour undergo the least development, than it requires specially prepared instruments. Thus in the oldest caves we find stone implements and weapons. In the earliest period of human history domesticated animals, *i.e.*, animals which have been bred for the purpose, and have undergone modifications by means of labour, play the chief part as instruments of labour along with specially prepared stones, wood, bones, and shells.⁴ The use and fabrication of instruments of labour, although existing in the germ among certain species of animals, is specifically characteristic of the human labour-process, and Franklin therefore defines man as a tool-making animal. Relics of bygone instruments of labour possess the same importance for

the investigation of extinct economic forms of society, as do fossil bones for the determination of extinct species of animals. It is not the articles made, but how they are made, and by what instruments, that enables us to distinguish different economic epochs.⁵ Instruments of labour not only supply a standard of the degree of development to which human labour has attained, but they are also indicators of the social conditions under which that labour is carried on. Among the instruments of labour, those of a mechanical nature, which, taken as a whole, we may call the bone and muscles of production, offer much more decided characteristics of a given epoch of production, than those which, like pipes, tubs, baskets, jars, &c., serve only to hold the materials for labour, which latter class, we may in a general way, call the vascular system of production. The latter first begins to play an important part in the chemical industries.

In a wider sense we may include among the instruments of labour, in addition to those things that are used for directly transferring labour to its subject, and which therefore, in one way or another, serve as conductors of activity, all such objects as are necessary for carrying on the labour-process. These do not enter directly into the process, but without them it is either impossible for it to take place at all, or possible only to a partial extent. Once more we find the earth to be a universal instrument of this sort, for it furnishes a *locus standi* to the labourer and a field of employment for his activity. Among instruments that are the result of previous labour and also belong to this class, we find workshops, canals, roads, and so forth.

In the labour-process, therefore, man's activity, with the help of the instruments of labour, effects an alteration, designed from the commencement, in the material worked upon. The process disappears in the product; the latter is a use-value, Nature's material adapted by a change of form to the wants of man. Labour has incorporated itself with its subject: the former is materialised, the latter transformed. That which in the labourer appeared as movement, now appears in the product as a fixed quality without motion. The blacksmith forges and the product is a forging.

If we examine the whole process from the point of view of its result, the product, it is plain that both the instruments and the subject of labour, are means of production,⁶ and that the labour itself is productive labour.⁷

Though a use-value, in the form of a product, issues from the labour-process, yet other use-values, products of previous labour, enter into it as means of production. The same use-value is both the product of a previous

process, and a means of production in a later process. Products are therefore not only results, but also essential conditions of labour.

With the exception of the extractive industries, in which the material for labour is provided immediately by Nature, such as mining, hunting, fishing, and agriculture (so far as the latter is confined to breaking up virgin soil), all branches of industry manipulate raw material, objects already filtered through labour, already products of labour.

Such is seed in agriculture. Animals and plants, which we are accustomed to consider as products of Nature, are in their present form, not only products of, say last year's labour, but the result of a gradual transformation, continued through many generations, under man's superintendence, and by means of his labour. But in the great majority of cases, instruments of labour show even to the most superficial observer, traces of the labour of past ages. [...]

Notes

- 1 "The earth's spontaneous productions being in small quantity, and quite independent of man, appear, as it were, to be furnished by Nature, in the same way as a small sum is given to a young man, in order to put him in a way of industry, and of making his fortune." (James Steuart: "Principles of Polit. Econ." edit. Dublin, 1770, v. I, p. 116.)
- 2 "Reason is just as cunning as she is powerful. Her cunning consists principally in her mediating activity, which, by causing objects to act and re-act on each other in accordance with their own nature, in this way, without any direct interference in the process, carries out reason's intentions." (Hegel: "Enzyklopädie, Erster Theil, Die Logik," Berlin, 1840, p. 382.)
- 3 In his otherwise miserable work ("Théorie de l'Econ. Polit." Paris, 1815), Ganilh enumerates in a striking manner in opposition to the "Physiocrats" the long series of previous processes necessary before agriculture properly so called can commence.
- 4 Turgot in his "Réflexions sur la Formation et la Distribution des Richesses" (1766) brings well into prominence the importance of domesticated animals to early civilisation.
- 5 The least important commodities of all for the technological comparison of different epochs of production are articles of luxury, in the strict meaning of the term. However little our written histories up to this time notice the development of material production, which is the basis of all social life, and therefore of all real history, yet prehistoric times have been classified in accordance with the results, not of so-called historical, but of materialistic investigations. These periods have been divided, to correspond with the materials from which their implements and weapons were made, viz., into the stone, the bronze, and the iron ages.
- 6 It appears paradoxical to assert, that uncaught fish, for instance, are a means of production in the fishing industry. But hitherto no one has discovered the art of catching fish in waters that contain none.
- 7 This method of determining, from the standpoint of the labour-process alone, what is productive labour, is by no means directly applicable to the case of the capitalist process of production.

From Karl Marx, *A Contribution to the Critique of Political Economy*

Preface

[...]

The general conclusion at which I arrived and which, once reached, became the guiding principle of my studies can be summarised as follows. In the social production of their existence, men inevitably enter into definite relations, which are independent of their will, namely relations of production appropriate to a given stage in the development of their material forces of production. The totality of these relations of production constitutes

the economic structure of society, the real foundation, on which arises a legal and political superstructure and to which correspond definite forms of social consciousness. The mode of production of material life conditions the general process of social, political and intellectual life. It is not the consciousness of men that determines their existence, but their social existence that determines their consciousness. At a certain stage of development, the material productive forces of society come into conflict with the existing relations of production or – this merely expresses the same thing in legal terms – with the property relations within the framework of which they have operated hitherto. From forms of development of the productive forces these relations turn into their fetters. Then begins an era of social revolution. The changes in

the economic foundation lead sooner or later to the transformation of the whole immense superstructure. In studying such transformations it is always necessary to distinguish between the material transformation of the economic conditions of production, which can be determined with the precision of natural science, and the legal, political, religious, artistic or philosophic – in short, ideological forms in which men become conscious of this conflict and fight it out. Just as one does not judge an individual by what he thinks about himself, so one cannot judge such a period of transformation by its consciousness, but, on the contrary, this consciousness must be explained from the contradictions of material life, from the conflict existing between the social forces of production and the relations of production. No social order is ever destroyed before all the productive forces for which it is sufficient have been developed, and new superior relations of production never replace older ones before the material conditions for their existence have matured within the framework of the old society. Mankind thus inevitably sets itself only such tasks as it is able to solve, since closer examination will always show that the problem itself arises only when the material conditions for its solution are already present or at least in the course of formation. In broad outline, the Asiatic, ancient, feudal and modern bourgeois modes of production may be designated as epochs marking progress in the economic development of society. The bourgeois mode of production is the last antagonistic form of the social process of production – antagonistic not in the sense of individual antagonism but of an antagonism that emanates from the individuals' social conditions of existence – but the productive forces developing within bourgeois society create also the material conditions for a solution of this antagonism. The prehistory of human society accordingly closes with this social formation.

From Karl Marx and Friedrich Engels, *The German Ideology*

First premises of materialist method

The premises from which we begin are not arbitrary ones, not dogmas, but real premises from which abstraction can only be made in the imagination. They are the real individuals, their activity and the material conditions under which they live, both those which they find already

existing and those produced by their activity. These premises can thus be verified in a purely empirical way.

The first premise of all human history is, of course, the existence of living human individuals. Thus the first fact to be established is the physical organisation of these individuals and their consequent relation to the rest of nature. Of course, we cannot here go either into the actual physical nature of man, or into the natural conditions in which man finds himself – geological, orehydrographical, climatic and so on. The writing of history must always set out from these natural bases and their modification in the course of history through the action of men.

Men can be distinguished from animals by consciousness, by religion or anything else you like. They themselves begin to distinguish themselves from animals as soon as they begin to *produce* their means of subsistence, a step which is conditioned by their physical organisation. By producing their means of subsistence men are indirectly producing their actual material life.

The way in which men produce their means of subsistence depends first of all on the nature of the actual means of subsistence they find in existence and have to reproduce. This mode of production must not be considered simply as being the production of the physical existence of the individuals. Rather it is a definite form of activity of these individuals, a definite form of expressing their life, a definite *mode of life* on their part. As individuals express their life, so they are. What they are, therefore, coincides with their production, both with *what* they produce and with *how* they produce. The nature of individuals thus depends on the material conditions determining their production.

This production only makes its appearance with the *increase of population*. In its turn this presupposes the *intercourse* [*Verkehr*]¹ of individuals with one another. The form of this intercourse is again determined by production.

The relations of different nations among themselves depend upon the extent to which each has developed its productive forces, the division of labour and internal intercourse. This statement is generally recognised. But not only the relation of one nation to others, but also the whole internal structure of the nation itself depends on the stage of development reached by its production and its internal and external intercourse. How far the productive forces of a nation are developed is shown most manifestly by the degree to which the division of labour has been carried. Each new productive force, insofar as it is not merely a quantitative extension of productive forces already known (for instance the bringing into

cultivation of fresh land), causes a further development of the division of labour.

The division of labour inside a nation leads at first to the separation of industrial and commercial from agricultural labour, and hence to the separation of *town* and *country* and to the conflict of their interests. Its further development leads to the separation of commercial from industrial labour. At the same time through the division of labour inside these various branches there develop various divisions among the individuals co-operating in definite kinds of labour. The relative position of these individual groups is determined by the methods employed in agriculture, industry and commerce (patriarchalism, slavery, estates, classes). These same conditions are to be seen (given a more developed intercourse) in the relations of different nations to one another.

The various stages of development in the division of labour are just so many different forms of ownership, i.e. the existing stage in the division of labour determines also the relations of individuals to one another with reference to the material, instrument, and product of labour.

[...]

The fact is, therefore, that definite individuals who are productively active in a definite way enter into these definite social and political relations. Empirical observation must in each separate instance bring out empirically, and without any mystification and speculation, the connection of the social and political structure with production. The social structure and the State are continually evolving out of the life-process of definite individuals, but of individuals, not as they may appear in their own or other people's imagination, but as they *really* are; i.e. as they operate, produce materially, and hence as they work under definite material limits, presuppositions and conditions independent of their will.

The production of ideas, of conceptions, of consciousness, is at first directly interwoven with the material activity and the material intercourse of men, the language of real life. Conceiving, thinking, the mental intercourse of men, appear at this stage as the direct efflux of their material behaviour. The same applies to mental production as expressed in the language of politics, laws, morality, religion, metaphysics, etc. of a people. Men are the producers of their conceptions, ideas, etc. – real, active men, as they are conditioned by a definite development of their productive forces and of the intercourse corresponding to these, up to its furthest forms. Consciousness can never be anything else than conscious existence, and the existence of men is

their actual life-process. If in all ideology men and their circumstances appear upside-down as in a *camera obscura*, this phenomenon arises just as much from their historical life-process as the inversion of objects on the retina does from their physical life-process.

In direct contrast to German philosophy which descends from heaven to earth, here we ascend from earth to heaven. That is to say, we do not set out from what men say, imagine, conceive, nor from men as narrated, thought of, imagined, conceived, in order to arrive at men in the flesh. We set out from real, active men, and on the basis of their real life-process we demonstrate the development of the ideological reflexes and echoes of this life-process. The phantoms formed in the human brain are also, necessarily, sublimates of their material life-process, which is empirically verifiable and bound to material premises. Morality, religion, metaphysics, all the rest of ideology and their corresponding forms of consciousness, thus no longer retain the semblance of independence. They have no history, no development; but men, developing their material production and their material intercourse, alter, along with this their real existence, their thinking and the products of their thinking. Life is not determined by consciousness, but consciousness by life. In the first method of approach the starting-point is consciousness taken as the living individual; in the second method, which conforms to real life, it is the real living individuals themselves, and consciousness is considered solely as *their* consciousness.

[...]

History: fundamental conditions

...we must begin by stating the first premise of all human existence and, therefore, of all history, the premise, namely, that men must be in a position to live in order to be able to “make history.” But life involves before everything else eating and drinking, a habitation, clothing and many other things. The first historical act is thus the production of the means to satisfy these needs, the production of material life itself. And indeed this is an historical act, a fundamental condition of all history, which today, as thousands of years ago, must daily and hourly be fulfilled merely in order to sustain human life. Even when the sensuous world is reduced to a minimum, to a stick as with Saint Bruno [Bauer], it presupposes the action of producing the stick. Therefore in any interpretation of history one has first of all to observe this fundamental fact in all its significance and all its implications and to accord it its due

importance. It is well known that the Germans have never done this, and they have never, therefore, had an *earthly* basis for history and consequently never an historian. The French and the English, even if they have conceived the relation of this fact with so-called history only in an extremely one-sided fashion, particularly as long as they remained in the toils of political ideology, have

nevertheless made the first attempts to give the writing of history a materialistic basis by being the first to write histories of civil society, of commerce and industry.

The second point is that the satisfaction of the first need (the action of satisfying, and the instrument of satisfaction which has been acquired) leads to new needs; and this production of new needs is the first historical act.

Note

1 In *The German Ideology* the word “*Verkehr*” is used in a very wide sense, encompassing the material and spiritual intercourse of separate individuals, social groups and entire countries. Marx and Engels show that material intercourse, and above all the intercourse of men with each other in the production process, is the basis of every other form of intercourse.

The terms “*Verkehrstorn*” (form of intercourse), “*Verkehrsweise*” (mode of intercourse) and “*Verkehrs- verhältnisse*”

(relations, or conditions, of intercourse) which we encounter in *The German Ideology* are used by Marx and Engels to express the concept “relations of production” which during that period was taking shape in their mind.

The ordinary dictionary meanings of “*Verkehr*” are traffic, intercourse, commerce. In this translation the word “*Verkehr*” has been mostly rendered as “intercourse” and occasionally as “association” or “commerce”. – [Ed.]

From Friedrich Engels, *Dialectics of Nature*

The part played by labour in the transition from ape to man

Labour is the source of all wealth, the political economists assert. And it really is the source – next to nature, which supplies it with the material that it converts into wealth. But it is even infinitely more than this. It is the prime basic condition for all human existence, and this to such an extent that, in a sense, we have to say that labour created man himself.

Many hundreds of thousands of years ago, during an epoch, not yet definitely determinable, of that period of the earth’s history known to geologists as the Tertiary period, most likely towards the end of it, a particularly highly-developed race of anthropoid apes lived somewhere in the tropical zone – probably on a great continent that has now sunk to the bottom of the Indian Ocean. Darwin has given us an approximate description of these ancestors of ours. They were completely covered with hair, they had beards and pointed ears, and they lived in bands in the trees.

Climbing assigns different functions to the hands and the feet, and when their mode of life involved locomotion on level ground, these apes gradually got out of the habit of using their hands [in walking – *Ti*.] and adopted

a more and more erect posture. This was *the decisive step in the transition from ape to man*.

All extant anthropoid apes can stand erect and move about on their feet alone, but only in case of urgent need and in a very clumsy way. Their natural gait is in a half-erect posture and includes the use of the hands. The majority rest the knuckles of the fist on the ground and, with legs drawn up, swing the body through their long arms, much as a cripple moves on crutches. In general, all the transition stages from walking on all fours to walking on two legs are still to be observed among the apes today. The latter gait, however, has never become more than a makeshift for any of them.

It stands to reason that if erect gait among our hairy ancestors became first the rule and then, in time, a necessity, other diverse functions must, in the meantime, have devolved upon the hands. Already among the apes there is some difference in the way the hands and the feet are employed. In climbing, as mentioned above, the hands and feet have different uses. The hands are used mainly for gathering and holding food in the same way as the fore paws of the lower mammals are used. Many apes use their hands to build themselves nests in the trees, or even to construct roofs between the branches to protect themselves against the weather, as the chimpanzee, for example, does. With their hands they grasp sticks to defend themselves against enemies, and with their hands they bombard their enemies with fruits and stones. In

captivity they use their hands for a number of simple operations copied from human beings. It is in this that one sees the great gulf between the undeveloped hand of even the most man-like apes and the human hand that has been highly perfected by hundreds of thousands of years of labour. The number and general arrangement of the bones and muscles are the same in both hands, but the hand of the lowest savage can perform hundreds of operations that no simian hand can imitate – no simian hand has ever fashioned even the crudest stone knife.

The first operations for which our ancestors gradually learned to adapt their hands during the many thousands of years of transition from ape to man could have been only very simple ones. The lowest savages, even those in whom regression to a more animal-like condition with a simultaneous physical degeneration can be assumed, are nevertheless far superior to these transitional beings. Before the first flint could be fashioned into a knife by human hands, a period of time probably elapsed in comparison with which the historical period known to us appears insignificant. But the decisive step had been taken, *the hand had become free* and could henceforth attain ever greater dexterity; the greater flexibility thus acquired was inherited and increased from generation to generation.

Thus the hand is not only the organ of labour, *it is also the product of labour*. Labour, adaptation to ever new operations, the inheritance of muscles, ligaments, and, over longer periods of time, bones that had undergone special development and the ever-renewed employment of this inherited finesse in new, more and more complicated operations, have given the human hand the high degree of perfection required to conjure into being the pictures of a Raphael, the statues of a Thorwaldsen, the music of a Paganini.

But the hand did not exist alone, it was only one member of an integral, highly complex organism. And what benefited the hand, benefited also the whole body it served; and this in two ways.

In the first place, the body benefited from the law of correlation of growth, as Darwin called it. This law states that the specialised forms of separate parts of an organic being are always bound up with certain forms of other parts that apparently have no connection with them. Thus all animals that have red blood cells without cell nuclei, and in which the head is attached to the first vertebra by means of a double articulation (condyles), also without exception possess lacteal glands for suckling their young. Similarly, cloven hoofs in mammals are regularly associated with the possession of a multiple stomach

for rumination. Changes in certain forms involve changes in the form of other parts of the body, although we cannot explain the connection. Perfectly white cats with blue eyes are always, or almost always, deaf. The gradually increasing perfection of the human hand, and the commensurate adaptation of the feet for erect gait, have undoubtedly, by virtue of such correlation, reacted on other parts of the organism. However, this action has not as yet been sufficiently investigated for us to be able to do more here than to state the fact in general terms.

Much more important is the direct, demonstrable influence of the development of the hand on the rest of the organism. It has already been noted that our simian ancestors were gregarious; it is obviously impossible to seek the derivation of man, the most social of all animals, from non-gregarious immediate ancestors. Mastery over nature began with the development of the hand, with labour, and widened man's horizon at every new advance. He was continually discovering new, hitherto unknown properties in natural objects. On the other hand, the development of labour necessarily helped to bring the members of society closer together by increasing cases of mutual support and joint activity, and by making clear the advantage of this joint activity to each individual. In short, men in the making arrived at the point where *they had something to say* to each other. Necessity created the organ; the undeveloped larynx of the ape was slowly but surely transformed by modulation to produce constantly more developed modulation, and the organs of the mouth gradually learned to pronounce one articulate sound after another.

Comparison with animals proves that this explanation of the origin of language from and in the process of labour is the only correct one. The little that even the most highly-developed animals need to communicate to each other does not require articulate speech. In a state of nature, no animal feels handicapped by its inability to speak or to understand human speech. It is quite different when it has been tamed by man. The dog and the horse, by association with man, have developed such a good ear for articulate speech that they easily learn to understand any language within their range of concept. Moreover they have acquired the capacity for feelings such as affection for man, gratitude, etc., which were previously foreign to them. Anyone who has had much to do with such animals will hardly be able to escape the conviction that in many cases they *now* feel their inability to speak as a defect, although, unfortunately, it is one that can no longer be remedied because their vocal organs are

too specialised in a definite direction. However, where vocal organs exist, within certain limits even this inability disappears. The buccal organs of birds are as different from those of man as they can be, yet birds are the only animals that can learn to speak; and it is the bird with the most hideous voice, the parrot, that speaks best of all. Let no one object that the parrot does not understand what it says. It is true that for the sheer pleasure of talking and associating with human beings, the parrot will chatter for hours at a stretch, continually repeating its whole vocabulary. But within the limits of its range of concepts it can also learn to understand what it is saying. Teach a parrot swear words in such a way that it gets an idea of their meaning (one of the great amusements of sailors returning from the tropics); tease it and you will soon discover that it knows how to use its swear words just as correctly as a Berlin coster-monger. The same is true of begging for titbits.

First labour, after it and then with it speech – these were the two most essential stimuli under the influence of which the brain of the ape gradually changed into that of man, which for all its similarity is far larger and more perfect. Hand in hand with the development of the brain went the development of its most immediate instruments – the senses. Just as the gradual development of speech is inevitably accompanied by a corresponding refinement of the organ of hearing, so the development of the brain as a whole is accompanied by a refinement of all the senses. The eagle sees much farther than man, but the human eye discerns considerably more in things than does the eye of the eagle. The dog has a far keener sense of smell than man, but it does not distinguish a hundredth part of the odours that for man are definite signs denoting different things. And the sense of touch, which the ape hardly possesses in its crudest initial form, has been developed only side by side with the development of the human hand itself, through the medium of labour.

The reaction on labour and speech of the development of the brain and its attendant senses, of the increasing clarity of consciousness, power of abstraction and of conclusion, gave both labour and speech an ever-renewed impulse to further development. This development did not reach its conclusion when man finally became distinct from the ape, but on the whole made further powerful progress, its degree and direction varying among different peoples and at different times, and here and there even being interrupted by local or temporary regression. This further development has been strongly urged forward, on the one

hand, and guided along more definite directions, on the other, by a new-element which came into play with the appearance of fully-fledged man, namely, *society*.

Hundreds of thousands of years – of no greater significance in the history of the earth than one second in the life of man¹ – certainly elapsed before human society arose out of a troupe of tree-climbing monkeys. Yet it did finally appear. And what do we find once more as the characteristic difference between the troupe of monkeys and human society? *Labour*. The ape herd was satisfied to browse over the feeding area determined for it by geographical conditions or the resistance of neighbouring herds; it undertook migrations and struggles to win new feeding grounds, but it was incapable of extracting from them more than they offered in their natural state, except that it unconsciously fertilised the soil with its own excrement. As soon as all possible feeding grounds were occupied, there could be no further increase in the ape population; the number of animals could at best remain stationary. But all animals waste a great deal of food, and, in addition, destroy in the germ the next generation of the food supply. Unlike the hunter, the wolf does not spare the doe which would provide it with the young the next year; the goats in Greece, that eat away the young bushes before they grow to maturity, have eaten bare all the mountains of the country. This “predatory economy” of animals plays an important part in the gradual transformation of species by forcing them to adapt themselves to other than the usual food, thanks to which their blood acquires a different chemical composition and the whole physical constitution gradually alters, while species that have remained unadapted die out. There is no doubt that this predatory economy contributed powerfully to the transition of our ancestors from ape to man. In a race of apes that far surpassed all others in intelligence and adaptability, this predatory economy must have led to a continual increase in the number of plants used for food and to the consumption of more and more edible parts of food plants. In short, food became more and more varied, as did also the substances entering the body with it, substances that were the chemical premises for the transition to man. But all that was not yet labour in the proper sense of the word. Labour begins with the making of tools. And what are the most ancient tools that we find – the most ancient judging by the heirlooms of prehistoric man that have been discovered, and by the mode of life of the earliest historical peoples and of the rawest of contemporary savages? They are hunting and fishing implements, the

former at the same time serving as weapons. But hunting and fishing presuppose the transition from an exclusively vegetable diet to the concomitant use of meat, and this is another important step in the process of transition from ape to man. A *meat diet* contained in an almost ready state the most essential ingredients required by the organism for its metabolism. By shortening the time required for digestion, it also shortened the other vegetative bodily processes that correspond to those of plant life, and thus gained further time, material and desire for the active manifestation of animal life proper. And the farther man in the making moved from the vegetable kingdom the higher he rose above the animal. Just as becoming accustomed to a vegetable diet side by side with meat converted wild cats and dogs into the servants of man, so also adaptation to a meat diet, side by side with a vegetable diet, greatly contributed towards giving bodily strength and independence to man in the making. The meat diet, however, had its greatest effect on the brain, which now received a far richer flow of the materials necessary for its nourishment and development, and which, therefore, could develop more rapidly and perfectly from generation to generation. With all due respect to the vegetarians man did not come into existence without a meat diet, and if the latter, among all peoples known to us, has led to cannibalism at some, time or other (the forefathers of the Berliners, the Weletabians or Wilzians, used to eat their parents as late as the tenth century), that is of no consequence to us today.

The meat diet led to two new advances of decisive importance – the harnessing of fire and the domestication of animals. The first still further shortened the digestive process, as it provided the mouth with food already, as it were, half-digested; the second made meat more copious by opening up a new, more regular source of supply in addition to hunting, and moreover provided, in milk and its products, a new article of food at least as valuable as meat in its composition. Thus both these advances were, in themselves, new means for the emancipation of man. It would lead us too far afield to dwell here in detail on their indirect effects notwithstanding the great importance they have had for the development of man and society.

Just as man learned to consume everything edible, he also learned to live in any climate. He spread over the whole of the habitable world, being the only animal fully able to do so of its own accord. The other animals that have become accustomed to all climates – domestic animals and vermin – did not become so independently, but

only in the wake of man. And the transition from the uniformly hot climate of the original home of man to colder regions, where the year was divided into summer and winter, created new requirements – shelter and clothing as protection against cold and damp, and hence new spheres of labour, new forms of activity, which further and further separated man from the animal.

By the combined functioning of hands, speech organs and brain, not only in each individual but also in society, men became capable of executing more and more complicated operations, and were able to set themselves, and achieve, higher and higher aims. The work of each generation itself became different, more perfect and more diversified. Agriculture was added to hunting and cattle raising; then came spinning, weaving, metalworking, pottery and navigation. Along with trade and industry, art and science finally appeared. Tribes developed into nations and states. Law and politics arose, and with them that fantastic reflection of human things in the human mind – religion. In the face of all these images, which appeared in the first place to be products of the mind and seemed to dominate human societies, the more modest productions of the working hand retreated into the background, the more so since the mind that planned the labour was able, at a very early stage in the development of society (for example, already in the primitive family), to have the labour that had been planned carried out by other hands than its own. All merit for the swift advance of civilisation was ascribed to the mind, to the development and activity of the brain. Men became accustomed to explain their actions as arising out of thoughts instead of their needs (which in any case are reflected and perceived in the mind); and so in the course of time there emerged that idealistic world outlook which, especially since the fall of the world of antiquity, has dominated men's minds. It still rules them to such a degree that even the most materialistic natural scientists of the Darwinian school are still unable to form any clear idea of the origin of man, because under this ideological influence they do not recognise the part that has been played therein by labour.

Animals, as has already been pointed out, change the environment by their activities in the same way, even if not to the same extent, as man does, and these changes, as we have seen, in turn react upon and change those who made them. In nature nothing takes place in isolation. Everything affects and is affected by every other thing, and it is mostly because this manifold motion and interaction is forgotten that our natural scientists are

prevented from gaining a clear insight into the simplest things. We have seen how goats have prevented the regeneration of forests in Greece; on the island of St. Helena, goats and pigs brought by the first arrivals have succeeded in exterminating its old vegetation almost completely, and so have prepared the ground for the spreading of plants brought by later sailors and colonists. But animals exert a lasting effect on their environment unintentionally and, as far as the animals themselves are concerned, accidentally. The further removed men are from animals, however, the more their effect on nature assumes the character of premeditated, planned action directed towards definite preconceived ends. The animal destroys the vegetation of a locality without realising what it is doing. Man destroys it in order to sow field crops on the soil thus released, or to plant trees or vines which he knows will yield many times the amount planted. He transfers useful plants and domestic animals from one country to another and thus changes the flora and fauna of whole continents. More than this. Through artificial breeding both plants and animals are so changed by the hand of man that they become unrecognisable. The wild plants from which our grain varieties originated are still being sought in vain. There is still some dispute about the wild animals from which our very different breeds of dogs or our equally numerous breeds of horses are descended.

It goes without saying that it would not occur to us to dispute the ability of animals to act in a planned, premeditated fashion. On the contrary, a planned mode of action exists in embryo wherever protoplasm, living albumen, exists and reacts, that is, carries out definite, even if extremely simple, movements as a result of definite external stimuli. Such reaction takes place even where there is yet no cell at all, far less a nerve cell. There is something of the planned action in the way insect-eating plants capture their prey, although they do it quite unconsciously. In animals the capacity for conscious, planned action is proportional to the development of the nervous system, and among mammals it attains a fairly high level. While fox-hunting in England one can daily observe how unerringly the fox makes use of its excellent knowledge of the locality in order to elude its pursuers, and how well it knows and turns to account all favourable features of the ground that cause the scent to be lost. Among our domestic animals, more highly developed thanks to association with man, one can constantly observe acts of cunning on exactly the same level as those of children. For, just as the development history of

the human embryo in the mother's womb is only an abbreviated repetition of the history, extending over millions of years, of the bodily evolution of our animal ancestors, starting from the worm, so the mental development of the human child is only a still more abbreviated repetition of the intellectual development of these same ancestors, at least of the later ones. But all the planned action of all animals has never succeeded in impressing the stamp of their will upon the earth. That was left for man.

In short, the animal merely *uses* its environment, and brings about changes in it simply by its presence; man by his changes makes it serve his ends, *masters* it. This is the final, essential distinction between man and other animals, and once again it is labour that brings about this distinction.²

Let us not, however, flatter ourselves overmuch on account of our human victories over nature. For each such victory nature takes its revenge on us. Each victory, it is true, in the first place brings about the results we expected, but in the second and third places it has quite different, unforeseen effects which only too often cancel the first. The people who, in Mesopotamia, Greece, Asia Minor and elsewhere, destroyed the forests to obtain cultivable land, never dreamed that by removing along with the forests the collecting centres and reservoirs of moisture they were laying the basis for the present forlorn state of those countries. When the Italians of the Alps used up the pine forests on the southern slopes, so carefully cherished on the northern slopes, they had no inkling that by doing so they were cutting at the roots of the dairy industry in their region; they had still less inkling that they were thereby depriving their mountain springs of water for the greater part of the year, and making it possible for them to pour still more furious torrents on the plains during the rainy seasons. Those who spread the potato in Europe were not aware that with these farinaceous tubers they were at the same time spreading scrofula. Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature – but that we, with flesh, blood and brain, belong to nature, and exist in its midst, and that all our mastery of it consists in the fact that we have the advantage over all other creatures of being able to learn its laws and apply them correctly.

And, in fact, with every day that passes we are acquiring a better understanding of these laws and getting to perceive both the more immediate and the more remote consequences of our interference with the traditional

course of nature. In particular, after the mighty advances made by the natural sciences in the present century, we are more than ever in a position to realise, and hence to control, even the more remote natural consequences of at least our day-to-day production activities. But the more this progresses the more will men not only feel but also know their oneness with nature, and the more impossible will become the senseless and unnatural idea of a contrast between mind and matter, man and nature, soul and body, such as arose after the decline of classical antiquity in Europe and obtained its highest elaboration in Christianity.

It required the labour of thousands of years for us to learn a little of how to calculate the more remote *natural* effects of our actions in the field of production, but it has been still more difficult in regard to the more remote *social* effects of these actions. We mentioned the potato and the resulting spread of scrofula. But what is scrofula compared to the effect which the reduction of the workers to a potato diet had on the living conditions of the masses of the people in whole countries, or compared to the famine the potato blight brought to Ireland in 1847, which consigned to the grave a million Irishmen, nourished solely or almost exclusively on potatoes, and forced the emigration overseas of two million more? When the Arabs learned to distil spirits, it never entered their heads that by so doing they were creating one of the chief weapons for the annihilation of the aborigines of the then still undiscovered American continent. And when afterwards Columbus discovered this America, he did not know that by doing so he was laying the basis for the Negro slave trade and giving a new lease of life to slavery, which in Europe had long ago been done away with. The men who in the seventeenth and eighteenth centuries laboured to create the steam-engine had no idea that they were preparing the instrument which more than any other was to revolutionise social relations throughout the world. Especially in Europe, by concentrating wealth in the hands of a minority and dispossessing the huge majority, this instrument was destined at first to give social and political domination to the bourgeoisie, but later, to give rise to a class struggle between bourgeoisie and proletariat which can end only in the overthrow of the bourgeoisie and the abolition of all class antagonisms. But in this sphere, too, by long and often cruel experience and by collecting and analysing historical material, we are gradually learning to get a clear view of the indirect, more remote social effects of our production activity, and so are afforded an opportunity to control and regulate these effects as well.

This regulation, however, requires something more than mere knowledge. It requires a complete revolution in our hitherto existing mode of production, and simultaneously a revolution in our whole contemporary social order.

All hitherto existing modes of production have aimed merely at achieving the most immediately and directly useful effect of labour. The further consequences, which appear only later and become effective through gradual repetition and accumulation, were totally neglected. The original common ownership of land corresponded, on the one hand, to a level of development of human beings in which their horizon was restricted in general to what lay immediately available, and presupposed, on the other hand, a certain superfluity of land that would allow some latitude for correcting the possible bad results of this primeval type of economy. When this surplus land was exhausted, common ownership also declined. All higher forms of production, however, led to the division of the population into different classes and thereby to the antagonism of ruling and oppressed classes. Thus the interests of the ruling class became the driving factor of production, since production was no longer restricted to providing the barest means of subsistence for the oppressed people. This has been put into effect most completely in the capitalist mode of production prevailing today in Western Europe. The individual capitalists, who dominate production and exchange, are able to concern themselves only with the most immediate useful effect of their actions. Indeed, even this useful effect – inasmuch as it is a question of the usefulness of the article that is produced or exchanged – retreats far into the background, and the sole incentive becomes the profit to be made on selling.³

Classical political economy, the social science of the bourgeoisie, in the main examines only social effects of human actions in the fields of production and exchange that are actually intended. This fully corresponds to the social organisation of which it is the theoretical expression. As individual capitalists are engaged in production and exchange for the sake of the immediate profit, only the nearest, most immediate results must first be taken into account. As long as the individual manufacturer or merchant sells a manufactured or purchased commodity with the usual coveted profit, he is satisfied and does not concern himself with what afterwards becomes of the commodity and its purchasers. The same thing applies to the natural effects of the same actions. What cared the Spanish planters in Cuba, who burned down forests

on the slopes of the mountains and obtained from the ashes sufficient fertiliser for *one* generation of very highly profitable coffee trees – what cared they that the heavy tropical rainfall afterwards washed away the unprotected upper stratum of the soil, leaving behind only bare rock! In relation to nature, as to society, the present mode of production is predominantly concerned only about the immediate, the most tangible result; and then surprise is expressed that the more remote effects of actions directed to this end turn out to be quite

different, are mostly quite the opposite in character; that the harmony of supply and demand is transformed into the very reverse opposite, as shown by the course of each ten years' industrial cycle – even Germany has had a little preliminary experience of it in the “crash”; that private ownership based on one's own labour must of necessity develop into the expropriation of the workers, while all wealth becomes more and more concentrated in the hands of non-workers; that [...]⁴

Notes

- 1 A leading authority in this respect, Sir William Thomson, has calculated that *little more than a hundred million years* could have elapsed since the time when the earth had cooled sufficiently for plants and animals to be able to live on it. [Note by Engels.]
- 2 In the margin of the manuscript is written in pencil: “Ennoblement.” – [Ed.]
- 3 The MS ends here. What follows was written on a separate sheet of paper with a note in a different hand to the effect that it was the last page of the first draft. – [Ed.]
- 4 Here the manuscript breaks off. – [Ed.]

From Karl Marx and Friedrich Engels, *Basic Writings on Politics and Philosophy*

Engels: On authority

A number of socialists have latterly launched a regular crusade against what they call the *principle* of authority. It suffices to tell them that this or that act is *authoritarian* for it to be condemned. This summary mode of procedure is being abused to such an extent that it has become necessary to look into the matter somewhat more closely. Authority, in the sense in which the word is used here, means the imposition of the will of another upon ours; on the other hand, authority presupposes subordination. Now since these two words sound bad and the relationship which they represent is disagreeable to the subordinated party, the question is to ascertain whether there is any way of dispensing with it, whether – given the conditions of present-day society – we could not create another social system, in which this authority would be given no scope any longer and would consequently have to disappear. On examining the economic, industrial, and agricultural conditions which form the basis of present-day bourgeois society,

we find that they tend more and more to replace isolated action by combined action of individuals. Modern industry with its big factories and mills, where hundreds of workers supervise complicated machines driven by steam, has superseded the small workshops of the separate producers; the carriages and wagons of the highways have been replaced by railway trains, just as the small schooners and sailing feluccas have been by steamboats. Even agriculture falls increasingly under the dominion of the machine and of steam, which slowly but relentlessly put in the place of the small proprietors big capitalists, who with the aid of hired workers cultivate vast stretches of land. Everywhere combined action, the complication of processes dependent upon each other, displaces independent action by individuals. But whoever mentions combined action speaks of organization; now is it possible to have organization without authority?

Supposing a social revolution dethroned the capitalists, who now exercise their authority over the production and circulation of wealth. Supposing, to adopt entirely the point of view of the anti-authoritarians, that the land and the instruments of labor had become the collective property of the workers who use them. Will authority have disappeared or will it only have changed its form? Let us see.

Let us take by way of example a cotton-spinning mill. The cotton must pass through at least six successive operations before it is reduced to the state of thread, and these operations take place for the most part in different rooms. Furthermore, keeping the machines going requires an engineer to look after the steam engine, mechanics to make the current repairs, and many other laborers, whose business it is to transfer the products from one room to another, and so forth. All these workers, men, women, and children, are obliged to begin and finish their work at the hours fixed by the authority of the steam, which cares nothing for individual autonomy. The workers must, therefore, first come to an understanding on the hours of work; and these hours, once they are fixed, must be observed by all, without any exception. Thereafter particular questions arise in each room and at every moment concerning the mode of production, distribution of materials, etc., which must be settled at once on pain of seeing all production immediately stopped; whether they are settled by decision of a delegate placed at the head of each branch of labor or, if possible, by a majority vote, the will of the single individual will always have to subordinate itself, which means that questions are settled in an authoritarian way. The automatic machinery of a big factory is much more despotic than the small capitalists who employ workers ever have been. At least with regard to the hours of work one may write upon the portals of these factories: *Lasciate ogni autonomia, voi che entrate!*¹ If man, by dint of his knowledge and inventive genius, has subdued the forces of nature, the latter avenge themselves upon him by subjecting him, in so far as he employs them, to a veritable despotism, independent of all social organization. Wanting to abolish authority in large-scale industry is tantamount to wanting to abolish industry itself, to destroy the power loom in order to return to the spinning wheel.

Let us take another example – the railway. Here, too, the co-operation of an infinite number of individuals is absolutely necessary, and this cooperation must be practiced during precisely fixed hours, so that no accidents may happen. Here, too, the first condition of the job is a dominant will that settles all subordinate questions, whether this will is represented by a single delegate or a committee charged with the execution of the resolutions of the majority of persons interested. In either case there is very pronounced authority. Moreover, what would happen to the first train dispatched if the authority of the railway employees over the honorable passengers were abolished?

But the necessity of authority, and of imperious authority at that, will nowhere be found more evident than on board a ship on the high seas. There, in time of danger, the lives of all depend on the instantaneous and absolute obedience of all to the will of one.

When I submitted arguments like these to the most rabid anti-authoritarians, the only answer they were able to give me was the following: Yes, that's true, but here it is not a case of authority which we confer on our delegates, *but of a commission entrusted!* These gentlemen think that when they have changed the names of things they have changed the things themselves. This is how these profound thinkers mock at the whole world.

We have thus seen that, on the one hand, a certain authority, no matter how delegated, and, on the other hand, a certain subordination are things which, independent of all social organization, are imposed upon us together with the material conditions under which we produce and make products circulate.

We have seen, besides, that the material conditions of production and circulation inevitably develop with large-scale industry and large-scale agriculture, and increasingly tend to enlarge the scope of this authority. Hence it is absurd to speak of the principle of authority as being absolutely evil and of the principle of autonomy as being absolutely good. Authority and autonomy are relative things, whose spheres vary with the various phases of the development of society. If the autonomists confined themselves to saying that the social organization of the future would restrict authority solely to the limits within which the conditions of production render it inevitable, we could understand each other; but they are blind to all facts that make the thing necessary and they passionately fight the word.

Why do the anti-authoritarians not confine themselves to crying out against political authority, the state? All socialists are agreed that the political state, and with it political authority, will disappear as a result of the coming social revolution, that is, that public functions will lose their political character and be transformed into the simple administrative functions of watching over the true interests of society. But the anti-authoritarians demand that the authoritarian political state be abolished at one stroke, even before the social conditions that gave birth to it have been destroyed. They demand that the first act of the social revolution shall be the abolition of authority. Have these gentlemen ever seen a revolution? A revolution is certainly the most authoritarian thing there is; it is the act whereby one part of the

population imposes its will upon the other part by means of rifles, bayonets, and cannon – authoritarian means, if such there be at all; and if the victorious party does not want to have fought in vain, it must maintain this rule by means of the terror which its arms inspire in the reactionaries. Would the Paris Commune have lasted a single day if it had not made use of this authority of the armed people against the bourgeois? Should we not,

on the contrary, reproach it for not having used it freely enough?

Therefore, either one of two things: either the anti-authoritarians don't know what they are talking about, in which case they are creating nothing but confusion, or they do know, and in that case they are betraying the movement of the proletariat. In either case they serve the reaction.

Note

1 [Leave, ye that enter in, all autonomy behind!]

Part II

Philosophy, Modern Science, and Technology

Positivist and Postpositivist Philosophies of Science

Introduction

Perhaps in keeping with the popular idea that philosophy simply begins by critically evaluating some marked-off “field” of inquiry (e.g., ethics, art, mind, law, language), many investigations of technology, too, have defined themselves by identifying technological topics and practices that seem to raise philosophical “issues.” As the selections in Parts II and III suggest, however, this approach has become increasingly unpopular, in part because it tends to result in inquiries that remain silent about what counts as “technology” in the first place, and in part because the crucial question of the relation between technology and science is never asked. The latter failure is especially significant, because many of the current debates over technology rest upon oversimplified or outdated conceptions of science. Optimistic and “pro-technology” writings often presuppose fairly crude, positivistic visions of science and oversimplified conceptions of the objectivity of scientific knowledge. Social constructionist and “critical” writings on technology often assume equally crude, anti-positivistic conceptions of science and tend to reduce scientific knowledge claims to mere functions of societal or cultural “consensus.” With the decline of the influence of positivism on the philosophy of science in recent decades, however, there have emerged a number of sophisticated reinterpretations of science and scientific knowledge. After the first selection, the readings in this section are

representative of these recent developments; and it will become plain in the sections that follow that these post- and non-positivist philosophies of science have opened up new and more nuanced possibilities for the evaluation of technology and its place in culture.

During the first two-thirds of the twentieth century, logical positivism and its more qualified successor, logical empiricism, dominated the philosophy of science, particularly in England and North America. Viewed epistemologically, logical positivism famously and explicitly combines Bacon’s empiricism with twentieth-century developments in mathematical logic. In addition, because this kind of epistemology appears to entail hostility toward speculative theorizing and is often accompanied by an emotivist position in ethics, it has been widely assumed that logical positivists and logical empiricists do not espouse any general historical theory concerning scientific and general intellectual progress. Indeed, several members of the movement, following John Stuart Mill’s lead, explicitly reject the classical positivism of Comte, first, for failing to develop a formal, rational reconstruction of the scientific method and second, for embracing a speculative philosophy of history based on an empirically suspect “law of three stages” of intellectual development. In fact, however, the twentieth-century positivists’ allegedly anti-speculative and purely epistemic stance is shown to be something of a myth. Like Comte, only silently, the Vienna Circle manifesto “The Scientific Conception of the World” exhibits the same

militant opposition to traditional religious and metaphysical reasoning, the same conviction of the superiority of scientific rationality, and the same assumption that social and political progress depend upon the acquisition and technical-social engineering application of scientific knowledge. The influence of these assumptions in the debates over the use and importance of technology will, of course, emerge in many of the later selections. For the moment, it might be noted that both Comte and Marx, for all the differences in their projected political programs, share with twentieth-century positivists the same optimistic and progressivistic picture of a world improved through the employment of scientific knowledge. Marx, we recall, envisioned the rise of a “scientific” socialism.

Beginning the late 1950s and early 1960s, new approaches to the philosophy of science arose in Anglo-American philosophy, influenced by Wittgenstein’s later writings and by a burgeoning interest in the history of science. Together with Kuhn’s *Structure of Scientific Revolutions* (1962), a whole spate of works by those self-identifying as “postpositivist” philosopher of science (e.g., Stephen Toulmin, Norwood Russell Hanson, Michael Scriven, Michael Polanyi, Mary Hesse, and Paul Feyerabend) displayed interests in history, psychology, the logic of discovery, and theoretical modeling, none of which had been considered part of “real” philosophy of science by the logical positivists. Together, their whole generation demonstrated that the very idea of a philosophical investigation of science had changed. Kuhn’s book was by far the most influential – not only among philosophers, but in the sociology of science and even with the general public – in comparison to the works of other post-positivists. His concept of a “paradigm” – that is, a worldview that guides the understanding of scientific activity, above all in its theorizing, but often also in relation to experimental technique, the ideal of a good theory, and even regarding metaphysical assumptions about fundamental entities or processes – became a buzzword in fields from architecture to business administration, psychotherapy, and self-help groups. (In their Princeton home, the Kuhns hung a crocheted sampler stitched with “God Bless Our Little Paradigm,” honoring the role this notion played in paying for the house.) Part of Kuhn’s appeal was that he not only demonstrated the relevance of the history of science for any philosophical understanding of science, but portrayed that history as resembling the history of art and religion, where a succession of overarching visions or styles replace one another. Ironically, historians of art and religion in turn borrowed

Kuhnian imagery to purchase second-hand the “scientific” prestige long denied them by positivists. In either case, the door was now wide open for future philosophers (some of them represented in other selections in this anthology) to treat both science and technology as human practices with historical and social contexts.

In the current selection, Kuhn discusses the “anomaly,” a notion that did not become as popular as, for example, his conceptions of “preparadigmatic science” (where various schools compete without any agreed-upon ideals or methodology), “normal science” (where scientists fill in details, solve puzzles, and extend lines of research within an unquestioned ruling paradigm), and “revolutionary science” (where a new paradigm seems to threaten an old one, philosophical arguments about the contending paradigms become important, and their adherents frequently talk past each other). Yet an anomaly, as Kuhn describes it, illustrates especially well the overall nature of his position. It is, he notes, a violation of the “paradigm-induced expectations that govern normal science.” It appears as an unexplained empirical difference between what is observed and what is theoretically expected. According to the standard positivist account, anomalies should be occasions for abandoning the theories that fail to explain them. But in fact, Kuhn notes, this is not what typically happens, and the reason is that, contrary to positivist orthodoxy, theories are never taken literally, or strictly, or as if they were like perfectly well-formed propositions. Hence, unexplained cases of various sorts are always being tolerated, no matter how strongly held the relevant theory. Yet there has to be a limit to this tolerance, or else no theory would ever be abandoned, but only endlessly modified by the addition of ad hoc hypotheses and redefinitions. And of course, this also is not what happens.

There is a long history of puzzlement over the anomaly problem. Kuhn himself never arrived at an entirely clear account, and soon after the appearance of *Structure*, amidst the heated philosophical controversies over the book and in the face of its unintended popular association with the political radicalism and counterculture of the 1960s, Kuhn retreated from any further consideration of such problems. Nevertheless, the implications of his account ultimately proved devastating to the logical positivist approach to science. Not only had he challenged its formalized reconstruction of scientific reasoning by “contextualizing” the whole process; he also showed that the basic idea that science is in the business of verifying or refuting theories is empirically inaccurate. To put it briefly, Kuhn’s account of the overthrow of a paradigm

shows that it is not so much an accumulation of counter-examples or refutations as it is an accumulation of anomalies. Moreover, Kuhn's work not only led to the demise of logical positivism, it also helped launch the sociology of scientific knowledge movement of the British Bath and Edinburgh schools (see Pickering and Latour in Part III). Kuhn himself did not make the social contextualization of scientific practice a central issue; indeed he only mentions in passing that external social factors figure in paradigm shifts (e.g., the demand for better colanders in the time of Copernicus). Yet in retrospect, the social, historical, and cultural implications of his work fairly leap off the page for those not invested in constraining the philosophy of science and technology to the formal analysis of its reasoning. Hence, the theme Kuhn barely broached and then dropped like a hot potato was eagerly grasped by others. For if inductive support and logical refutation did not account for changes in theories, then the obvious place to turn for explanations of these changes would be to all the extra-logical features of scientific practice.

In his treatment of the famous problem of scientific "realism," Ian Hacking displays several features of the postpositivist turn away from traditional philosophy of science. For all its nuanced exploration over literally centuries, the problem boils down to this. If knowledge is possible, must we not have assurances that at least some of what we say about the world "really represents" it? For both logical positivists and for Kuhn, the solution to this problem, in or out of science, must come from our discovering how to certify the representativeness of at least some of our theories. Hence their focus is, respectively, on the nature and history of theories, their construction, and their certification. Hacking, however, does not share this assumption. Citing Bacon, he reminds us that it is experimental interference with the course of nature that leads to scientific theorizing, not the reverse. Hacking's aim is to turn the philosophical conversation toward experimentation and away from an epistemological focus on theory, explanation, and prediction. Scientists, he asserts, are realists about entities, not about theories. It is the use of entities to manipulate other entities rather than the role of entities in a theory that leads experimental physicists to believe in the reality of objects like the electron. It is a tool for doing, not thinking. Hence, instead of treating the electron in the traditional philosophical way, as a puzzling, unobservable "theoretical entity," we should think of scientific investigations that employ electron microscopes, where our confidence that electrons are "real" is a function of their making visible to us

something even more "hypothetical" and unobservable than electrons. (Indeed, he says, "I blush" at the way we usually throw around words like "observe" and "see." Dewey should have taught us by now to recognize such rigid designation of these terms as just another version of philosophy's mythological "Spectator Theory of Knowledge.") In short, he concludes, "We are completely convinced of the reality of electrons when we regularly set out to build – and often enough succeed in building – new kinds of devices that use various well understood causal properties of electrons to interfere in other more hypothetical parts of nature."

Adopting scientific (or "entity") realism also puts to rest another philosophically created dilemma, namely, the apparently changing "reference" for theoretical entities over time. To clarify this issue, Hacking appeals to Hilary Putnam's "referential theory of meaning." As in a dictionary, where "how" a word denotes "what" it does can be vague or precise, stereotypical or technical, and change over time, so in science, "how" we think about some physical entity often changes while reference to "the entity" remains constant. Hence, it is not necessary that, historically, all scientists have been consistent (or even right!) about what "electron" means. "Once upon a time," he says, it even "made good sense to doubt that there are electrons." In the nineteenth century, many scientists and philosophers justifiably regarded atoms as fictional entities, for although the concept of the atom could be used successfully in theoretical explanations and predictions, there was no way to experimentally manipulate them. In the early twentieth century, however, atoms came to be treated as real because they could be used to investigate other entities. (A more recent example that Hacking describes in detail is the use of electrons in investigating neutral bosons. At least at the time that Hacking was writing, neutral bosons, on the other hand, were considered hypothetical insofar as they could not be manipulated to experiment on other "still more hypothetical" entities.) Of course, admits Hacking, it always remains permissible for philosophers, perched high above the laboratory technician and the field researcher, to see nothing here but pure instrumentalism. Yet if actual scientists were not realists about the entities that they use in order to investigate other hypotheses or hypothetical entities, "their enterprise would be incoherent."

It is probably fair to say that Hacking has fewer followers than readers. Critics have complained that his "realism about unobservables" remains an incurably

elusive idea, and some argue that if the final test for scientific realism is scientific practice, then recent developments in theoretical physics suggest that even his kind of realism is losing ground to a more robust anti-realism. Nevertheless, in several important respects Hacking's postpositivism is widely recognized as strongly foreshadowing developments to come. For one thing, as he turns away from the positivist emphasis on scientific theorizing toward experimental practice, he also implicitly drops his angle of vision from the universal and ahistorically conceived epistemic "problems" of the old orthodoxy to the level of actual scientific practices, where so much more is at stake than formulating warrantable assertions and making predictions, and where no one imagines that that something like physical science could be, as Richard Rorty puts it, a "natural kind" (see Rouse, below). Together with Kuhn's historical contextualization of scientific thinking, Hacking's emphasis on experimentation encourages the recasting of traditional philosophy of science into the social and cultural study of science as a human practice represented in numerous other selections. Moreover, the new focus on science as a practice encourages making connections with other philosophical topics that the positivist tradition could make seem irrelevant by limiting philosophy of science to the analysis of "the structure of scientific explanation." Thus Don Ihde (see Chapter 46) praises Hacking's "instrumental realism" for tying science much more closely to technology than previous twentieth-century views. For in Hacking, technology appears not as the vehicle for applying scientific knowledge, but as it functions in (and often even makes possible) scientific research. For Ihde and the postphenomenologists, as well as Latour and other social constructivists, this seems to justify their use of the term "technoscience" as a replacement for "science *and* technology." Finally, although the writings of Kuhn, Toulmin, and other early postpositivist philosophers are still strongly marked by polemics against their predecessors, the feminist philosophies of science that began to emerge about 10 years later more often simply begin where these thinkers left off. For if Toulmin and Kuhn and others are right – that is, if scientific theories are neither direct, Baconian-empiricist reports of the facts nor purely neutral, logical empiricist-like formal machines for making scientific predictions – if, instead, they are explanatory systems grounded in idealizing presuppositions and global paradigms that are often neither explicit nor articulated, then it is important to ask what kinds of attitudes, worldviews, and biases are likely to

enter even the best scientific theories and methodologies. In particular, feminist philosophers have argued for the existence of a "masculine" bias toward understanding scientific research – one that privileges the detached, experimental manipulation of objects and thereby fosters the neglect of aspects of nature that might nevertheless be revealed to science through other approaches. Nancy Tuana's recent survey of feminist philosophy of science identifies the influence of such masculine orientations and describes feminist alternatives on topics ranging from primate research and theories of human evolution to general attitudes toward the scientific epistemology (where, e.g., "neutrality" is nothing of the kind). She argues that the social studies of science movement is showing us not only how to develop more inclusive conceptions of scientific practice, but how to ask questions – philosophical questions, not "merely" psychological or sociological questions the logical empiricists tried to reduce them to – questions "that reflect the location of science within society and the relationships between power and knowledge."

In tracing out the demise of mid-twentieth-century philosophy of science, especially in the United States, it is worth remembering that before logical positivism came to dominate North American philosophy, an indigenous philosophy of pragmatism had already developed a richer alternative conception of the scientific method. The classical American pragmatists (e.g., William James, C.S. Peirce, and Dewey) did not share the positivists' Baconian/British empiricist conception of experience, which they regarded as poverty-stricken. "British Empiricism," James famously quipped, "is not very empirical." For these pragmatists, "experience" can be something as broad and complex as the reflective discovery of a mental habit or social dilemma, or something as narrow and measurable as the passive registration of sense data. Not surprisingly, given this experiential pluralism, they displayed much greater tolerance toward the idea that what the "scientific method" is and does cannot be reduced to one standard description.

With the waning of the influence of classical American pragmatism, especially after World War II, only its more narrowly instrumentalist, naturalistic, and manipulative strains were taken seriously and absorbed into American logical empiricism, which was inclined to view all scientific inquiry on the model of nineteenth-century experiments in physics. Pragmatism's richer social and contextual notions of scientific research were largely ignored by the Anglo-American mainstream until

the early 1980s, when postpositivists like Rorty and Putnam began to draw again upon the work of James and Dewey in order to express their growing displeasure with the narrow and dated character of the positivist epistemologies they had inherited, and when the work of Dewey himself began to experience something of a revival (see Hickman, Chapter 34).

In the meantime, in Germany and much of Continental Europe, logical empiricism enjoyed a much shorter and less dominant run. By the first two decades of the twentieth century, an influential alternative approach to the understanding of the methods of science had already been developed. Drawing first on Dilthey's argument for separate epistemologies in "natural" and "human" science, and later on Husserl's phenomenological conception of irreducibly different "regions" of reality and on Heidegger's conception of philosophy as hermeneutics (i.e., as the ontologically appropriate interpretation of the lived-through "meaning" of what we encounter and how we encounter it), "hermeneutical-phenomenological" philosophy of science was originally conceived specifically as an alternative to the positivists' formal, "rationally reconstructive" mono-methodological picture of science and scientific theory. This alternative, it was argued, was necessary especially in the historical and social human sciences, where the focus is often on unique individuals and where even generalizing accounts of human phenomena are more concerned with understanding what actions "mean" to people than with finding what "causes" them or with making predictions about future actions. Eventually, however, the scope of hermeneutics was widened to accommodate a philosophical reconsideration of all science, not just human science, and by the end of the last century a hermeneutics of natural science and of science generally had been extensively developed. Patrick Heelen and Jay Schulkin's article gives a particularly lucid exposition of these developments, as well as a very helpful comparison of the hermeneutical conception of science with that of pragmatism.

The social and contextual aspects of science are also stressed by the French philosopher and sociologist of science, Bruno Latour, who complains that the very idea of an opposition or separation of "science" from its "society" involves a false dichotomy. Though Latour is represented in more detail later in this collection (see Chapter 25), some features of his work and that of the recent French tradition generally need to be mentioned here to provide background for the remaining selections in this section. Especially important is Bruno's insistence that there is as

much society within science as without. In his earlier work, Latour presents a kind of anthropology of scientific laboratories, but more recently he has moved toward developing a generalized actor network theory (ANT). Latour's work, highly influential in science studies in the United States, popularizes (often without crediting) Michel Foucault's power-network interpretations of human activities (see Chapter 54) and the deconstructive techniques of Jacques Derrida. He employs the latter to undermine numerous oppositions assumed in traditional studies of science and technology – for example, that between science and technology. Using the term coined by Gaston Bachelard in the 1960s, "technoscience," and transforming the subtle and difficult prose of Derrida into a jokey and cartoon-filled presentation, Latour proceeds by recounting scientific and technological case studies. His approach, like that of the social constructivists excerpted elsewhere in this anthology, has been criticized in the so-called science wars for rejecting the reality of the objects of science. Latour wittily rejects this accusation as a red herring and insightfully suggests that the contemporary science wars replay in a crude fashion the debates of Plato's *Gorgias* between Truth and political power.

Finally, the post-Kuhnian, pragmatic, phenomenological, and hermeneutic approaches to science raise questions, not only about the place of science within the larger culture (explored by Rouse) but about the relation of Western science to traditional or indigenous science in the non-Western world. If there are no clear demarcations between science and non-science as both the logical positivists and Karl Popper insisted, then indigenous knowledge cannot be sharply demarcated from science, and science itself might better come to be seen as particularly powerful form of "local knowledge," involving tacit skills, traditions, and rituals. The final two selections of this section, by Sandra Harding and Shigehisa Kuriyama, succinctly raise a number of issues concerning the claim of Western science to universality and superiority.

In the excerpt from *Engaging Science: How to Understand Its Practices Philosophically*, Joseph Rouse introduces another distinctive alternative to positivist philosophy of science, namely, "cultural studies of science," which he characterizes as a loose, multidisciplinary association of research programs, with diverse contributions coming from history, philosophy, social science, political and feminist theory, and literary criticism. Born in the late 1980s and early 1990s, when the demise of positivist philosophy of science was already well under way,

cultural studies is defended by Rouse for having followed a somewhat different trajectory from that of the two other movements already mentioned. Postpositivism (in the narrower sense often used by historians of the period) came in the wake of Kuhn and is comprised of “proponents of *internalist* history and philosophy of science” – by which Rouse means to stress that they tend to be revisionists, bent on finding a better and more contextualized way to do what their predecessors had done poorly, namely, analyze the nature of scientific knowledge, its procedures, and its warrantability or legitimation, so to speak “from within.” Rouse traces the second movement – that is, social constructivism – back to Bloor’s “Strong Programme” in the sociology of science, stressing that by focusing on the contingent and informal character of actual scientific practice, it made itself an opponent to postpositivism’s continuation of the traditional internal vs. external distinction for characterizing the content vs. context of scientific reasoning. Yet as Rouse sees it, for all their differences, both movements still debate – as reverse images of each other – the same three basic problems of positivist orthodoxy, namely, establishing the rational authority of scientific claims, settling the realist–antirealist dispute regarding claims about the natural world, and defending the normativity of philosophy’s own pronouncements about science. Postpositivism still thinks all three problems can be solved; social constructivism argues that they cannot. But cultural studies, says Rouse, regards the debate itself as badly framed.

After this preliminary differentiation of cultural studies of science from the two other movements, Rouse presents three historical vignettes designed to acknowledge both cultural studies’ indebtedness to (but ultimate displeasure with) social constructivism, and also their solidarity with the long tradition of politically motivated self-criticism among scientists themselves. Finally, he identifies six common themes in terms of which he explains what makes cultural studies of science distinctive – which, he concludes, is really their fundamental rejection of the whole philosophical framework silently taken for granted by both postpositivists and social constructivists. First, cultural studies are anti-essentialist about science. Here, he says, they have learned from social constructivism, whose research shows conclusively the irreducible historical variability of the character of scientific reasoning, its methods, norms, and goals. Moreover, the social constructivists are right that this variability is not merely “external,” as if it were only a variability about the public

meaning of science while “science itself” continues timelessly trying to do the same thing. Second, however, cultural studies of science are not “explanatory” in the way that social constructivists, who after all see themselves as scientists of science, tend to view their own accounts. Like all scientists, they tend to assume that theirs is the definitive perspective, and as a result, social constructivists reify their interpretations of science in two ways – first by perpetuating the objectivistic attitude of the positivists who also thought they were providing the authoritative interpretation of the sciences as they “really” are; and second, by allowing this delusion about their own authoritativeness to discourage reflection on the contingent, sociocultural circumstances of their own standpoint and concept selection. Third, cultural studies stress the “local, material, and discursive character” of scientific practice, which marks their dissatisfaction with the tendency of both positivist and postpositivist philosophies of science to picture scientific practice as if it were “a body of free-floating ideas” detachable from the technical instruments, materials, network of researchers, special vocabularies and forms of communication, and even unwritten rules for disseminating acquired information that are always a part of actual scientific practice. (This emphasis is, of course, also shared by those philosophers of technology, for example phenomenologists and pragmatists, for whom the “materiality” of technologically mediated situations is a central concern.) Fourth, cultural studies defends what Rouse calls the “openness of scientific practices,” by which he means the process of continual give-and-take between scientific activities and the larger society. Rouse complains that this theme is underplayed both by Kuhnians and by social constructivists, all of whom focus so much on scientific practices themselves that they tend to see only the way these practices relate to the social whole, not the other way around.

Rouse’s fifth and sixth themes, taken together, outline the general philosophical benefits to be gained by taking a cultural studies stance toward science. Thus, fifth, regarding the traditional questions about the legitimation of theories, realism, and value-neutrality, cultural studies take a “subversive” rather than antagonistic stance, for the simple reason that (as we can see in the case of social constructivism) antagonists must accept the same basic ontological and epistemological rules of the game as the other parties to the debate. Above all, says Rouse, in these debates lurks the ghost of the traditional

idea of finding a “global solution” to the issues – as we can see in the postpositivist interest in making normative statements about Science *Überhaupt*, and in the social constructivists’ equally self-deceiving conviction that they can first limit themselves to being “just descriptive” and then later go on, having already demonstrated their supposed “epistemic sovereignty,” to make authoritative recommendations. Thus sixth, says Rouse, cultural studies reject the implicitly ahistorical attitude to which both postpositivism and social constructivism still seem to aspire. Proponents of cultural studies see themselves as being just as “performative” – that is, just as much a part of the technoscientific process – as what they study, and thus as “participating in constructing reliable and authoritative knowledge of the world by critically engaging with the sciences’ practices of making meaning.” Engagement, of course, we cannot help; that it should be “critical” means that continual reflection on what one is doing as a socially and culturally engaged proponent of cultural studies is part of one’s responsibility.

Taken in the context of the previous readings, Sandra Harding’s essay makes it plain just how important and far-reaching are the implications of recognizing not just the cultural but the multicultural character of scientific practice. Harding begins, deliberately in the spirit of post-Kuhnian philosophy, by reminding us that science, taken as a complex configuration of practices, is in fact just as multicultural as the arts and humanities. Indeed, she says, the first thing to notice is that “our” allegedly “universal” science is no such thing. It is very specifically modern and “Western,” although some of its roots are neither European nor Western. In other works, Harding considers the political and social consequences of the common habit of treating Western science as the universal, neutral, and thus superior way of obtaining “knowledge” (no adjective). Here, however, she pursues the more limited goal of drawing on post-colonial studies to discredit the default position of simply defining “science” as what “we Europeans” have been doing since Descartes and Bacon. In light of what she establishes in this regard, she raises two further questions. Is European science the only practice to define its alleged universality “internally” – that is, to see it as successful because “it works,” in the sense that it accomplishes what is expected of it – or could there be other culturally specific “sciences” that also “work” and are thus “universal” in the same sense? This second question, of course,

throws us back on another obvious one, namely, in what sense is modern Western science context-bound and culturally European (or European-American)?

Harding acknowledges that a multicultural standpoint on science is inescapably controversial, from the perspective of both “conventional science theorists” (she means pre-Kuhnian philosophers of science for whom all the extra-epistemological material she obtains from science studies is not part of Real Philosophy) and those who are perhaps more open to multicultural investigation but do not share Harding’s own circumstances (e.g., someone from China or Japan who might suspect her repeated references to the “West” as betraying an orientalist prejudice). Although she simply acknowledges the first objection in passing, she admits that the second has no easy answer. Mostly, she just settles for identifying numerous issues about standpoint that she has considered at greater length elsewhere, but two issues she addresses directly. First, concerning the allegation of Eurocentrism for starting with “our” alleged “universal” science, she simply acknowledges that this is actually the central question of the essay; hence, second, she admits that she necessarily addresses her question from a determinate position – that of an economically privileged insider’s perspective – and expresses hope that somehow she might nevertheless speak about it for

all people – regardless of their ethnicity, “race,” nationality, class, gender, or other significant features of their location in local and global social relations – who are concerned to rethink critically those social relations past and present and the role of the sciences in them, and who wish to bring about more effective links between scientific projects and those of advancing democratic social relations.

The passage is quoted in full here, both to highlight her list of problems that must be faced by anyone who admits they cannot possess a completely detached and neutral standpoint, and because Kuriyama criticizes Harding’s treatment of it in his comments.

In any case, Harding criticizes the “conventional view” of European science as universal and neutral by identifying numerous concrete ways in which it reflects its specifically cultural origins and its obviously not so “strictly scientific” goals. Of course, she notes, many defenders of the superiority of Western science will admit that it has borrowed from other cultures, but that is hardly the point. Not only are the borrowings

more extensive and even non-Western than such easy admissions acknowledge but many of the borrowings are not recognized at all. Harding reviews some of these (e.g., Chinese inventions, Arabic variations on ancient Greek science, Indian and Arabic mathematics, principles of pre-Columbian American botany and agriculture); but she argues that the real point is not just lack of acknowledgment but a tendency to trivialize the achievements of “other scientific traditions” by praising them only for what they gave “us.”

Regarding her second question, Harding asks if “other traditions” could rightly be said to “work.” In support of a positive reply, she notes first that a number of supposedly Western discoveries were made earlier in non-Western traditions. Moreover, she claims that there is no strict rule to distinguish Western “science” from natural knowledge in other cultures. Indeed, many features of Western science belie the claim that Western science is distinctive. In addition, there is much disagreement about the origins of Western science – that is, whether there were unique assumptions about the physical world or social relations in which milieu Western science arose – since just the ideas of a “pure” scientific method and an all-comprehending rationality alone seem insufficient to explain its development. Finally, Harding joins many Third World writers in pointing to the conspicuous connection between the rise of Western science, military conquest, economic expansion, and colonialism.

Thus, Harding joins Tuana and many others in arguing for a culturally Western rather than a historically universal conception of modern science. Research plans have often obviously been linked to European expansionism; and distinctive attitudes toward the “disenchantment” (i.e., removing spirits from our conceptions) of nature, the quest for worldly power over it, the belief that nature’s laws were originally laid down by a personal (and Biblical) god – all of these are clearly (at least) hemispheric conditions. Even “our” idea of value-neutrality and the sharp separation of facts from values are not notions generally shared by other cultures. Hence, the vaunted “universality” of Western science seems more to be a product of the conquest and domination of other cultures (and also to some extent an expression of its androcentric, religious, and locally bourgeois interests) than it is its formal insistence on explanatory successes. Every scientific epistemology seems in fact to be political. Is there not, we might ask, a Foucault-like kernel of

truth in the ancient belief in word magic: Those who name the world get to control it?

One controversial claim that Harding repeats several times, however, reveals what critics of Harding’s work argue is its major weakness. There might well be, she says, alternative laws of nature to those developed by Western science. Yet her efforts to defend this view have struck many as operating at so high a level of abstraction (e.g., “alternative” in what sense and for what purposes?) that it is difficult to know how to evaluate the claim, let alone decide its plausibility. As some critics have put it, Harding has never worked out the “meta-theoretical” details of her standpoint, and this shows up above all in her tendency to focus on multiple cultures and perspectives in their multiplicity without offering any recommendations concerning how they are to be compared and evaluated. Shigehisa Kuriyama, a historian of Chinese medicine, is one such critic. Though he expresses sympathy with Harding’s intentions, he complains about multiculturalism’s tendency to describe too many things from too high an altitude. What we need, he says, is the detailed and sensitive comparison of many cultures, together with some standards for the comparisons. One need not be a traditional essentialist to criticize Harding for not providing any. To take one example, Harding’s characterization of science as knowledge of the “natural world” neglects that fact that most cultures do not distinguish “natural” from the supernatural or the artifactual in the way Western science and common culture do. (One interesting implication of Kuriyama’s objection: Does it apply also to all those phenomenologists and postphenomenologists who speak about technological “embodiment” as if there were a descriptive level at which being embodied is not yet “cultural”? Is there?)

Kuriyama also worries that Harding’s multiculturalism obscures the difficulty of borrowing across separate traditions. Although she does list many of the extra-epistemological factors involved in any scientific practice, she is silent about the difficulties in speaking, exchanging information, and making plans of action cross-culturally that will be inevitable even in a relatively stylized practice like scientific research. “Knowledge,” as Kuriyama puts it (using the example of acupuncture and Western puzzlement over its “medical” status), “can travel poorly.” At the very least, we need some help with questions like what makes a science a “science” (given the world’s wildly different current conceptions of “knowledge”); or what it means to say that all science seeks “systematic

knowledge of the natural world” (when the very idea of “natural” is distinctively modern and Western and currently contested even there); or to say that science must “work” (when it is only in the developed West where one quite spontaneously assumes that this is a pragmatic and instrumentalist idea).

Finally, Kuriyama worries that, however well intentioned, multiculturalism’s repeated emphasis on uncovering Western bias – by multiculturalists who, like Harding, are by and large Western – risks reinforcing Western self-absorption. What are we to say when praise for the

marvels of Egyptian trigonometry, the Chinese compass, or Native American botany is offered primarily in light of how it contributed to Western science? How “multicultural” is this? Perhaps Kuriyama’s observation – that for a genuinely pluralistic appreciation of knowledge (or, by implication, anything else) about different cultures, there is no substitute for detailed study, by many people, over a long period of time – echoes Rouse’s “critically engaged” conception of cultural studies. For “by itself,” says Kuriyama, even “the most thoroughgoing critique of Western universalism contributes nothing.”

The Scientific Conception of the World: The Vienna Circle

Rudolf Carnap, Hans Hahn, and Otto Neurath

*Dedicated to Moritz Schlick*¹

Preface

At the beginning of 1929 Moritz Schlick received a very tempting call to Bonn. After some vacillation he decided to remain in Vienna. On this occasion, for the first time it became clear to him and us that there is such a thing as the “Vienna Circle” of the scientific conception of the world, which goes on developing this mode of thought in a collaborative effort. This circle has no rigid organization; it consists of people of an equal and basic scientific attitude; each individual endeavours to fit in, each puts common lies in the foreground, none wishes to disturb the links through idiosyncrasies. In many cases one can deputise for another, the work of one can be carried on by another.

The Vienna Circle aims at making contact with those similarly oriented and at influencing those who stand further off. Collaboration in the Ernst Mach Society is the expression of this endeavour; Schlick is the chairman of this society and several members of Schlick’s circle belong to the committee.

On 15–16 September 1929, the Ernst Mach Society, with the Society for Empirical Philosophy (Berlin), will hold a conference in Prague, on the epistemology of the exact sciences, in conjunction with the conference of the German Physical Society and the German Association of

Mathematicians which will take place there at the same time. Besides technical questions, questions of principle are to be discussed. It was decided that on the occasion of this conference the present pamphlet on the Vienna Circle of the scientific conception of the world was to be published. It is to be handed to Schlick in October 1929 when he returns from his visiting professorship at Stanford University, California, as token of gratitude and joy at his remaining in Vienna. The second part of the pamphlet contains a bibliography compiled in collaboration with those concerned. It is to give a survey of the area of problems in which those who belong to, or are near to, the Vienna Circle are working.

Vienna, August 1929

For the Ernst Mach Society
Hans Hahn, Otto Neurath, Rudolf Carnap

1 The Vienna Circle of the Scientific Conception of the World

1.1 Historical background

Many assert that metaphysical and theologizing thought is again on the increase today, not only in life but also in science. Is this a general phenomenon or merely a change

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restricted to certain circles? The assertion itself is easily confirmed if one looks at the topics of university courses and at the titles of philosophic publications. But likewise the opposite spirit of enlightenment and *anti-metaphysical factual research* is growing stronger today, in that it is becoming conscious of its existence and task. In some circles the mode of thought grounded in experience and averse to speculation is stronger than ever, being strengthened precisely by the new opposition that has arisen.

In the research work of all branches of empirical science this *spirit of a scientific conception of the world* is alive. However only a very few leading thinkers give it systematic thought or advocate its principles, and but rarely are they in a position to assemble a circle of like-minded colleagues around them. We find anti-metaphysical endeavours especially in England, where the tradition of the great empiricists is still alive; the investigations of Russell and Whitehead on logic and the analysis of reality have won international significance. In the U.S.A. these endeavours take on the most varied forms; in a certain sense James belongs to this group too. The new Russia definitely is seeking for a scientific world conception, even if partly leaning on older materialistic currents. On the continent of Europe, a concentration of productive work in the direction of a scientific world conception is to be found especially in Berlin (Reichenbach, Petzoldt, Grelling, Dubislav and others) and in Vienna.

That Vienna was specially suitable ground for this development is historically understandable. In the second half of the nineteenth century, liberalism was long the dominant political current. Its world of ideas stems from the enlightenment, from empiricism, utilitarianism and the free trade movement of England. In Vienna's liberal movement, scholars of world renown occupied leading positions. Here an anti-metaphysical spirit was cultivated, for instance, by men like Theodor Gomperz who translated the works of J. S. Mill, Suess, Jodl and others.

Thanks to this spirit of enlightenment, Vienna has been leading in a scientifically oriented people's education. With the collaboration of Victor Adler and Friedrich Jodl, the society for popular education was founded and carried forth; "popular university courses" and the "people's college" were set up by the well-known historian Ludo Hartmann whose anti-metaphysical attitude and materialist conception of history expressed itself in all his actions. The same spirit also inspired the movement of the "Free School" which was the forerunner of today's school reform.

In this liberal atmosphere lived Ernst Mach (born 1838) who was in Vienna as student and as *privat-dozent* (1861–64). He returned to Vienna only at an advanced age when a special chair of the philosophy of the inductive sciences was created for him (1895). He was especially intent on cleansing empirical science, and in the first place, physics, of metaphysical notions. We recall his critique of absolute space which made him a forerunner of Einstein, his struggle against the metaphysics of the thing-in-itself and of the concept of substance, and his investigations of the construction of scientific concepts from ultimate elements, namely sense data. In some points the development of science has not vindicated his views, for instance in his opposition to atomic theory and in his expectation that physics would be advanced through the physiology of the senses. The essential points of his conception however were of positive use in the further development of science. Mach's chair was later occupied by Ludwig Boltzmann (1902–06) who held decidedly empiricist views.

The activity of the physicists Mach and Boltzmann in a philosophical professorship makes it conceivable that there was a lively dominant interest in the epistemological and logical problems that are linked with the foundations of physics. These problems concerning foundations also led toward a renewal of logic. The path towards these objectives had also been cleared in Vienna from quite a different quarter by Franz Brentano (during 1874–80 professor of philosophy' in the theological faculty, and later lecturer in the philosophical faculty). As a Catholic priest Brentano understood scholasticism; he started directly from the scholastic logic and from Leibniz's endeavours to reform logic, while leaving aside Kant and the idealist system-builders. Brentano and his students time and again showed their understanding of men like Bolzano (*Wissenschaftslehre*, 1837) and others who were working toward a rigorous new foundation of logic. In particular Alois Höfler (1853–1922) put this side of Brentano's philosophy in the foreground before a forum in which, through Mach's and Boltzmann's influence, the adherents of the scientific world conception were strongly represented. In the Philosophical Society at the University of Vienna numerous discussions took place under Höfler's direction, concerning questions of the foundation of physics and allied epistemological and logical problems. The Philosophical Society published *Prefaces and Introductions to Classical Works on Mechanics* (1899), as well as the individual papers of Bolzano (edited by Höfler and Hahn, 1914 and 1921). In Brentano's

Viennese circle there was the young Alexius von Meinong (1870–82, later professor in Graz), whose theory of objects (1907) has certainly some affinity to modern theories of concepts and whose pupil Ernst Mally (Graz) also worked in the field of logistics. The early writings of Hans Pichler (1909) also belong to these circles.

Roughly at the same time as Mach, his contemporary and friend Josef Popper-Lynkeus worked in Vienna. Beside his physical and technical achievements we mention his large-scale, if unsystematic philosophical reflections (1899) and his rational economic plan (*A General Peacetime Labour Draft*, 1878). He consciously served the spirit of enlightenment, as is also evident from his book on Voltaire. His rejection of metaphysics was shared by many other Viennese sociologists, for example Rudolf Goldscheid. It is remarkable that in the field of political economy, too, there was in Vienna a strictly scientific method, used by the marginal utility school (Carl Menger, 1871); this method took root in England, France and Scandinavia, but not in Germany. Marxist theory likewise was cultivated and extended with special emphasis in Vienna (Otto Bauer, Rudolf Hilferding, Max Adler and others).

These influences from various sides had the result, especially since 1900, that there was in Vienna a sizeable number of people who frequently and assiduously discussed more general problems in close connection with empirical sciences. Above all these were epistemological and methodological problems of physics, for instance Poincaré's conventionalism, Duhem's conception of the aim and structure of physical theories (his translator was the Viennese Friedrich Adler, a follower of Mach, at that time *privatdozent* in Zürich); also questions about the foundations of mathematics, problems of axiomatics, logistic and the like. The following were the main strands from the history of science and philosophy that came together here, marked by those of their representatives whose works were mainly read and discussed:

- (1) Positivism and empiricism: Hume, Enlightenment, Comte, J. S. Mill, Richard Avenarius, Mach.
- (2) Foundations, aims and methods of empirical science (hypotheses in physics, geometry, etc.): Helmholtz, Riemann, Mach, Poincaré, Enriques, Duhem, Boltzmann, Einstein.
- (3) Logistic and its application to reality: Leibniz, Peano, Frege, Schröder, Russell, Whitehead, Wittgenstein.
- (4) Axiomatics: Pasch, Peano, Vailati, Pieri, Hilbert.
- (5) Hedonism and positivist sociology: Epicurus, Hume, Bentham, J. S. Mill, Comte, Feuerbach, Marx, Spencer, Müller-Lyer, Popper-Lynkeus, Carl Menger (the elder).

1.2 The circle around Schlick

In 1922 Moritz Schlick was called from Kiel to Vienna. His activities fitted well into the historical development of the Viennese scientific atmosphere. Himself originally a physicist, he awakened to new life the tradition that had been started by Mach and Boltzmann and, in a certain sense, carried on by the anti-metaphysically inclined Adolf Stöhr. (In Vienna successively: Mach, Boltzmann, Stöhr, Schlick; in Prague: Mach, Einstein, Philipp Frank.)

Around Schlick, there gathered in the course of time a circle whose members united various endeavours in the direction of a scientific conception of the world. This concentration produced a fruitful mutual inspiration. Not one of the members is a so-called "pure" philosopher; all of them have done work in a special field of science. Moreover they come from different branches of science and originally from different philosophic attitudes. But over the years a growing uniformity appeared; this too was a result of the specifically scientific attitude: "What can be said at all, can be said clearly" (Wittgenstein); if there are differences of opinion, it is in the end possible to agree, and therefore agreement is demanded. It became increasingly clearer that a position not only free from metaphysics, but opposed to metaphysics was the common goal of all.

The attitudes toward questions of life also showed a noteworthy agreement, although these questions were not in the foreground of themes discussed within the Circle. For these attitudes are more closely related to the scientific world-conception than it might at first glance appear from a purely theoretical point of view. For instance, endeavours toward a new organization of economic and social relations, toward the unification of mankind, toward a reform of school and education, all show an inner link with the scientific world-conception; it appears that these endeavours are welcomed and regarded with sympathy by the members of the Circle, some of whom indeed actively further them.

The Vienna Circle does not confine itself to collective work as a closed group. It is also trying to make contact with the living movements of the present, so far as they are well disposed toward the scientific world-conception and turn away from metaphysics and theology. The Ernst

Mach Society is today the place from which the Circle speaks to a wider public. This society, as stated in its program, wishes to “further and disseminate the scientific world-conception. It will organize lectures and publications about the present position of the scientific world-conception, in order to demonstrate the significance of exact research for the social sciences and the natural sciences. In this way intellectual tools should be formed for modern empiricism, tools that are also needed in forming public and private life.” By the choice of its name, the society wishes to describe its basic orientation: science free of metaphysics. This, however, does not mean that the society declares itself in programmatic agreement with the individual doctrines of Mach. The Vienna Circle believes that in collaborating with the Ernst Mach Society it fulfils a demand of the day: we have to fashion intellectual tools for everyday life, for the daily life of the scholar but also for the daily life of all those who in some way join in working at the conscious reshaping of life. The vitality that shows itself in the efforts for a rational transformation of the social and economic order, permeates the movement for a scientific world-conception too. It is typical of the present situation in Vienna that when the Ernst Mach Society was founded in November 1928, Schlick was chosen chairman; round him the common work in the field of the scientific world-conception had concentrated most strongly.

Schlick and Philipp Frank jointly edit the collection of *Monographs on the Scientific World-Conception* [*Schriften zur wissenschaftlichen Welt-auffassung*] in which members of the Vienna Circle preponderate.

2 The Scientific World Conception

The scientific world conception is characterized not so much by these of its own, but rather by its basic attitude, its points of view and direction of research. The goal ahead is *unified science*. The endeavour is to link and harmonize the achievements of individual investigators in their various fields of science. From this aim follows the emphasis on *collective efforts*, and also the emphasis on what can be grasped intersubjectively; from this springs the search for a neutral system of formulae, for a symbolism freed from the slag of historical languages; and also the search for a total system of concepts. Neatness and clarity are striven for, and dark distances and unfathomable depths rejected. In science there are no “depths”; there is surface everywhere: all experience forms a

complex network, which cannot always be surveyed and can often be grasped only in parts. Everything is accessible to man; and man is the measure of all things. Here is an affinity with the Sophists, not with the Platonists; with the Epicureans, not with the Pythagoreans; with all those who stand for earthly being and the here and now. The scientific world-conception knows *no unsolvable riddle*. Clarification of the traditional philosophical problems leads us partly to unmask them as pseudo-problems, and partly to transform them into empirical problems and thereby subject them to the judgment of experimental science. The task of philosophical work lies in this clarification of problems and assertions, not in the propounding of special “philosophical” pronouncements. The method of this clarification is that of *logical analysis*; of it, Russell says (*Our Knowledge of the External World*, p. 4) that it “has gradually crept into philosophy through the critical scrutiny of mathematics ... It represents, I believe, the same kind of advance as was introduced into physics by Galileo: the substitution of piecemeal, detailed and verifiable results for large untested generalities recommended only by a certain appeal to imagination.”²

It is *the method of logical analysis* that essentially distinguishes recent empiricism and positivism from the earlier version that was more biological-psychological in its orientation. If someone asserts “there is a God”, “the primary basis of the world is the unconscious,” “there is an entelechy which is the leading principle in the living organism,” we do not say to him: “what you say is false;” but we ask him: “what do you mean by these statements?” Then it appears that there is a sharp boundary between two kinds of statements. To one belong statements as they are made by empirical science; their meaning can be determined by logical analysis or, more precisely, through reduction to the simplest statements about the empirically given. The other statements, to which belong those cited above, reveal themselves as empty of meaning if one takes them in the way that metaphysicians intend. One can, of course, often re-interpret them as empirical statements; but then they lose the content of feeling which is usually essential to the metaphysician. The metaphysician and the theologian believe, thereby misunderstanding themselves, that their statements say something, or that they denote a state of affairs. Analysis, however, shows that these statements say nothing but merely express a certain mood and spirit. To express such feelings for life can be a significant task. But the proper medium for doing so is art, for instance lyric poetry or music. It is dangerous to

choose the linguistic garb of a theory instead: a theoretical content is simulated where none exists. If a metaphysician or theologian wants to retain the usual medium of language, then he must himself realise and bring out clearly that he is giving not description but expression, not theory or communication of knowledge, but poetry or myth. If a mystic asserts that he has experiences that lie above and beyond all concepts, one cannot deny this. But the mystic cannot talk about it, for talking implies capture by concepts and reduction to scientifically classifiable states of affairs.

The scientific world-conception rejects metaphysical philosophy. But how can we explain the wrong paths of metaphysics? This question may be posed from several points of view: psychological, sociological and logical. Research in a psychological direction is still in its early stages; the beginnings of more penetrating explanation may perhaps be seen in the investigations of Freudian psychoanalysis. The state of sociological investigation is similar; we may mention the theory of the “ideological superstructure;” here the field remains open to worthwhile further research.

More advanced is the clarification of *the logical origins of metaphysical aberration*, especially through the works of Russell and Wittgenstein. In metaphysical theory, and even in the very form of the questions, there are two basic logical mistakes: too narrow a tie to the form of *traditional languages* and a confusion about the logical achievement of thought. Ordinary language for instance uses the same part of speech, the substantive, for things (“apple”) as well as for qualities (“hardness”), relations (“friendship”), and processes (“sleep”); therefore it misleads one into a thing-like conception of functional concepts (hypostasis, substantialization). One can quote countless similar examples of linguistic misleading, that have been equally fatal to philosophers.

The second basic error of metaphysics consists in the notion that *thinking* can either lead to knowledge out of its own resources without using any empirical material; or at least arrive at new contents by an inference from given states of affair. Logical investigation, however, leads to the result that all thought and inference consists of nothing but a transition from statements to other statements that contain nothing that was not already in the former (tautological transformation). It is therefore not possible to develop a metaphysic from “pure thought.”

In such a way logical analysis overcomes not only metaphysics in the proper, classical sense of the word, especially scholastic metaphysics and that of the systems

of German idealism, but also the hidden metaphysics of Kantian and modern *apriorism*. The scientific world-conception knows no unconditionally valid knowledge derived from pure reason, no “synthetic judgments a priori” of the kind that lie at the basis of Kantian epistemology and even more of all pre- and post-Kantian ontology and metaphysics. The judgments of arithmetic, geometry, and certain fundamental principles of physics, that Kant took as examples of a priori knowledge will be discussed later. It is precisely in the rejection of the possibility of synthetic knowledge a priori that the basic thesis of modern empiricism lies. The scientific world-conception knows only empirical statements about things of all kinds, and analytic statements of logic and mathematics.

In rejecting overt metaphysics and the concealed variety of apriorism, all adherents of the scientific world-conception are at one. Beyond this, the Vienna Circle maintain the view that the statements of (critical) *realism* and *idealism* about the reality or non-reality of the external world and other minds are of a metaphysical character, because they are open to the same objections as are the statements of the old metaphysics: they are meaningless, because unverifiable and without content. For us, *something is “real” through being incorporated into the total structure of experience.*

Intuition which is especially emphasised by metaphysicians as a source of knowledge, is not rejected as such by the scientific world-conception. However, rational justification has to pursue all intuitive knowledge step by step. The seeker is allowed any method; but what has been found must stand up to testing. The view which attributes to intuition a superior and more penetrating power of knowing, capable of leading beyond the contents of sense experience and not to be confined by the shackles of conceptual thought – this view is rejected.

We have characterised the *scientific world-conception* essentially by *two features*. *First* it is *empiricist and positivist*: there is knowledge only from experience, which rests on what is immediately given. This sets the limits for the content of legitimate science. *Second*, the scientific world-conception is marked by application of a certain method, namely *logical analysis*. The aim of scientific effort is to reach the goal, unified science, by applying logical analysis to the empirical material. Since the meaning of every statement of science must be statable by reduction to a statement about the given, likewise the meaning of any concept, whatever branch of science it may belong to, must be statable by step-wise reduction

to other concepts, down to the concepts of the lowest level which refer directly to the given. If such an analysis were carried through for all concepts, they would thus be ordered into a reductive system, a “constitutive system.” Investigations towards such a constitutive system, the “constitutive theory,” thus form the framework within which logical analysis is applied by the scientific world-conception. Such investigations show very soon that traditional Aristotelian scholastic logic is quite inadequate for this purpose. Only modern symbolic logic (“logistic”) succeeds in gaining the required precision of concept definitions and of statements, and in formalizing the intuitive process of inference of ordinary thought, that is to bring it into a rigorous automatically controlled form by means of a symbolic mechanism. Investigations into constitutive theory show that the lowest layers of the constitutive system contain concepts of the experience and qualities of the individual psyche; in the layer above are physical objects; from these are constituted other minds and lastly the objects of social science. The arrangement of the concepts of the various branches of science into the constitutive system can already be discerned in outline today, but much remains to be done in detail. With the proof of the possibility and the outline of the shape of the total system of concepts, the relation of all statements to the given and with it the general structure of *unified science* become recognizable too.

A scientific description can contain only the *structure* (form of order) of objects, not their “essence.” What unites men in language are structural formulae; in them the content of the common knowledge of men presents itself. Subjectively experienced qualities – redness, pleasure – are as such only experiences, not knowledge; physical optics admits only what is in principle understandable by a blind man too.

3 Fields of Problems

3.1 Foundations of arithmetic

In the writings and discussions of the Vienna Circle many different problems are treated, stemming from various branches of science. Attempts are made to arrange the various lines of problems systematically and thereby to clarify the situation.

The problems concerning the foundations of arithmetic have become of special historical significance for the development of the scientific world-conception

because they gave impulse to the development of a new logic. After the very fruitful developments of mathematics in the 18th and 19th century during which more attention was given to the wealth of new results than to subtle examination of their conceptual foundations, this examination became unavoidable if mathematics were not to lose the traditionally celebrated certainty of its structure. This examination became even more urgent when certain contradictions, the “paradoxes of set theory,” arose. It was soon recognized that these were not just difficulties in a special part of mathematics, but rather they were general logical contradictions, “antinomies,” which pointed to essential mistakes in the foundations of traditional logic. The task of eliminating these contradictions gave a very strong impulse to the further development of logic. Here efforts for *clarification of the concept of number* met with those for an *internal reform of logic*. Since Leibniz and Lambert, the idea had come up again and again to master reality through a greater precision of concepts and inferential processes, and to obtain this precision by means of a symbolism fashioned after mathematics. After Boole, Venn and others, especially Frege (1884), Schröder (1890) and Peano (1895) worked on this problem. On the basis of these preparatory efforts *Whitehead and Russell* (1910) were able to establish a coherent system of logic in symbolic form (“logistic”), not only avoiding the contradictions of traditional logic, but far exceeding that logic in intellectual wealth and practical applicability. From this logical system they derived the concepts of arithmetic and analysis, thereby giving mathematics a secure foundation in logic.

Certain difficulties however remained in this attempt at overcoming the foundation crisis of arithmetic (and set theory) and have so far not found a definitively satisfactory solution. At present three different views confront each other in this field; besides the “logicism” of Russell and Whitehead, there is Hilbert’s “formalism” which regards arithmetic as a playing with formulae according to certain rules, and Brouwer’s “intuitionism” according to which arithmetic knowledge rests on a not further reducible intuition of duality and unity [*Zwei-einheit*]. The debates are followed with great interest in the Vienna Circle. Where the decision will lead in the end cannot yet be foreseen; in any case, it will also imply a decision about the structure of logic; hence the importance of this problem for the scientific world-conception. Some hold that the three views are not so far apart as it seems. They surmise that essential features of all three will come closer in the course of future development

and probably, using the far-reaching ideas of Wittgenstein, will be united in the ultimate solution.

The conception of mathematics as tautological in character, which is based on the investigations of Russell and Wittgenstein, is also held by the Vienna Circle. It is to be noted that this conception is opposed not only to apriorism and intuitionism, but also to the older empiricism (for instance of J. S. Mill), which tried to derive mathematics and logic in an experimental-inductive manner as it were.

Connected with the problems of arithmetic and logic are the investigations into the nature of the *axiomatic method* in general (concepts of completeness, independence, monomorphism, unambiguity and so on) and on the establishment of axiom-systems for certain branches of mathematics.

3.2 Foundations of physics

Originally the Vienna Circle's strongest interest was in the method of empirical science. Inspired by ideas of Mach, Poincaré, and Duhem, the problems of mastering reality through scientific systems, especially through *systems of hypotheses and axioms*, were discussed. A system of axioms, cut loose from all empirical application, can at first be regarded as a system of implicit definitions; that is to say, the concepts that appear in the axioms are fixed, or as it were defined, not from their content but only from their mutual relations through the axioms. Such a system of axioms attains a meaning for reality only by the addition of further definitions, namely the "coordinating definitions," which state what objects of reality are to be regarded as members of the system of axioms. The development of empirical science, which is to represent reality by means of as uniform and simple a net of concepts and judgments as possible, can now proceed in one of two ways, as history shows. The changes imposed by new experience can be made either in the axioms or in the coordinating definitions. Here we touch the problem of conventions, particularly treated by Poincaré.

The methodological problem of the application of axiom systems to reality may in principle arise for any branch of science. That these investigations have thus far been fruitful almost solely for physics, however, can be understood from the present stage of historical development of science: in regard to precision and refinement of concepts, physics is far ahead of the other branches of science.

Epistemological analysis of the leading concepts of natural science has freed them more and more from *metaphysical admixtures* which had clung to them from ancient time.

In particular, Helmholtz, Mach, Einstein, and others have cleansed the concepts of *space, time, substance, causality, and probability*. The doctrines of absolute space and time have been overcome by the theory of relativity; space and time are no longer absolute containers but only ordering manifolds for elementary processes. Material substance has been dissolved by atomic theory and field theory. Causality was divested of the anthropomorphic character of "influence" or "necessary connection" and reduced to a relation among conditions, a functional coordination. Further, in place of the many laws of nature which were considered to be strictly valid, statistical laws have appeared; following the quantum theory there is even doubt whether the concept of strictly causal lawfulness is applicable to phenomena in very small space-time regions. The concept of probability is reduced to the empirically graspable concept of relative frequency.

Through the application of the *axiomatic method* to these problems, the empirical components always separate from the merely conventional ones, the content of statements from definitions. No room remains for a priori synthetic judgments. That knowledge of the world is possible rests not on human reason impressing its form on the material, but on the material being ordered in a certain way. The kind and degree of this order cannot be known beforehand. The world might be ordered much more strictly than it is; but it might equally be ordered much less without jeopardising the possibility of knowledge. Only step by step can the advancing research of empirical science teach us in what degree the world is regular. The method of induction, the inference from yesterday to tomorrow, from here to there, is of course only valid if regularity exists. But this method does not rest on some a priori presupposition of this regularity. It may be applied wherever it leads to fruitful results, whether or not it be adequately founded; it never yields certainty. However, epistemological reflection demands that an inductive inference should be given significance only insofar as it can be tested empirically. The scientific world-conception will not condemn the success of a piece of research because it has been gathered by means that are inadequate, logically unclear or empirically unfounded. But it will always strive at testing with clarified aids, and demand an indirect or direct reduction to experience.

3.3 Foundations of geometry

Among the questions about the foundations of physics, the problem of *physical space* has received special significance in recent decades. The investigations of Gauss

(1816), Bolyai (1823), Lobatchevski (1835) and others led to *non-Euclidean geometry*, to a realisation that the hitherto dominant classical geometric system of Euclid was only one of an infinite set of systems, all of equal logical merit. This raised the question, which of these geometries was that of actual space. Gauss had wanted to resolve this question by measuring the angles of a large triangle. This made *physical geometry* into an empirical science, a branch of physics. The problems were further studied particularly by Riemann (1868), Helmholtz (1868) and Poincaré (1904). Poincaré especially emphasized the link of physical geometry with all other branches of physics: the question concerning the nature of actual space can be answered only in connection with a total system of physics. Einstein then found such a total system, which answered the question in favour of a certain non-Euclidean system.

Through this development, physical geometry became more and more clearly separated from pure *mathematical geometry*. The latter gradually became more and more formalized through further development of logical analysis. First it was arithmetized, that is, interpreted as the theory of a certain number system. Next it was axiomatized, that is, represented by means of a system of axioms that conceives the geometrical elements (points, etc.) as undefined objects, and fixes only their mutual relations. Finally geometry was logicized, namely represented as a theory of certain structural relations. Thus geometry became the most important field of application for the axiomatic method and for the general theory of relations. In this way, it gave the strongest impulse to the development of the two methods which in turn became so important for the development of logic itself, and thereby again for the scientific world-conception.

The relations between mathematical and physical geometry naturally led to the problem of the application of axiom systems to reality which, as mentioned, played a big role in the more general investigations about the foundations of physics.

3.4 Problems of the foundations of biology and psychology

Metaphysicians have always been fond of singling out biology as a special field. This came out in the doctrine of a special life force, the theory of *vitalism*. The modern representatives of this theory endeavour to bring it from the unclear, confused form of the past into a conceptually clear formulation. In place of the life force,

we have “dominants” (Reinke, 1899) or “entelechies” (Driesch, 1905). Since these concepts do not satisfy the requirement of reducibility to the given, the scientific world-conception rejects them as metaphysical. The same holds true of so-called “psycho-vitalism” which puts forward an intervention of the soul, a “role of leadership of the mental in the material.” If, however, one digs out of this metaphysical vitalism the empirically graspable kernel, there remains the thesis that the processes of organic nature proceed according to laws that cannot be reduced to physical laws. A more precise analysis shows that this thesis is equivalent to the assertion that certain fields of reality are not subject to a uniform and pervasive regularity.

It is understandable that the scientific world-conception can show more definite confirmation for its views in those fields which have already achieved conceptual precision than in others: in physics more than in psychology. The linguistic forms which we still use in psychology today have their origin in certain ancient metaphysical notions of the soul. The formation of concepts in psychology is made difficult by these defects of language: metaphysical burdens and logical incongruities. Moreover there are certain factual difficulties. The result is that hitherto most of the concepts used in psychology are inadequately defined; of some, it is not known whether they have meaning or only simulate meaning through usage. So, in this field nearly everything in the way of epistemological analysis still remains to be done; of course, analysis here is more difficult than in physics. The attempt of behaviorist psychology to grasp the psychic through the behavior of bodies, which is at a level accessible to perception, is, in its principled attitude, close to the scientific world-conception.

3.5 Foundations of the social sciences

As we have specially considered with respect to physics and mathematics, every branch of science is led to recognise that, sooner or later in its development, it must conduct an epistemological examination of its foundations, a logical analysis of its concepts. So too with the social sciences, and in the first place with history and economics. For about a hundred years, a process of elimination of metaphysical admixtures has been operating in these fields. Of course the purification has not yet reached the same degree as in physics; on the other hand, the task of cleansing is less urgent perhaps. For it seems that even in the heyday of metaphysics and theology, the

metaphysical strain was not particularly strong here; maybe this is because the concepts in this field, such as war and peace, import and export, are closer to direct perception than concepts like atom and ether. It is not too difficult to drop concepts like “folk spirit” and instead to choose, as our object, groups of individuals of a certain kind. Scholars from the most diverse trends, such as Quesnay, Adam Smith, Ricardo, Comte, Marx, Menger, Walras, Müller-Lyer, have worked in the sense of the empiricist, anti-metaphysical attitude. The object of history and economics are people, things and their arrangement.

4 Retrospect and Prospect

The modern scientific world-conception has developed from work on the problems just mentioned. We have seen how in physics, the endeavours to gain tangible results, at first even with inadequate or still insufficiently clarified scientific tools, found itself forced more and more into methodological investigations. Out of this developed the method of forming hypotheses and, further, the axiomatic method and logical analysis; there by concept formation gained greater clarity and strength. The same methodological problems were met also in the development of foundations research in physical geometry, mathematical geometry and arithmetic, as we have seen. It is mainly from all these sources that the problems arise with which representatives of the scientific world-conception particularly concern themselves at present. Of course it is still clearly noticeable from which of the various problem areas the individual members of the Vienna Circle come. This often results in differences in lines of interests and points of view, which in turn lead to differences in conception. But it is characteristic that an endeavour toward precise formulation, application of an exact logical language and symbolism, and accurate differentiation between the theoretical content of a thesis and its mere attendant notions, diminish the separation. Step by step the common fund of conceptions is increased, forming the nucleus of a scientific world-conception around which the outer layers gather with stronger subjective divergence.

Looking back we now see clearly what is the *essence of the new scientific world-conception* in contrast with traditional philosophy. No special “philosophic assertions” are established, assertions are merely clarified; and at that

assertions of empirical science, as we have seen when we discussed the various problem areas. Some representatives of the scientific world-conception no longer want to use the term “philosophy” for their work at all, so as to emphasise the contrast with the philosophy of (metaphysical) systems even more strongly. Whichever term may be used to describe such investigations, this much is certain: *there is no such thing as philosophy as a basic or universal science alongside or above the various fields of the one empirical science*; there is no way to genuine knowledge other than the way of experience; there is no realm of ideas that stands over or beyond experience. Nevertheless the work of “philosophic” or “foundational” investigations remains important in accord with the scientific world-conception. For the logical clarification of scientific concepts, statements and methods liberates one from inhibiting prejudices. Logical and epistemological analysis does not wish to set barriers to scientific enquiry; on the contrary, analysis provides science with as complete a range of formal possibilities as is possible, from which to select what best fits each empirical finding (example: non-Euclidean geometries and the theory of relativity).

The representatives of the scientific world-conception resolutely stand on the ground of simple human experience. They confidently approach the task of removing the metaphysical and theological debris of millennia. Or, as some have it: returning, after a metaphysical interlude, to a unified picture of this world which had, in a sense, been at the basis of magical beliefs, free from theology, in the earliest times.

The increase of metaphysical and theologizing leanings which shows itself today in many associations and sects, in books and journals, in talks and university lectures, seems to be based on the fierce social and economic struggles of the present: one group of combatants, holding fast to traditional social forms, cultivates traditional attitudes of metaphysics and theology whose content has long since been superseded; while the other group, especially in central Europe, faces modern times, rejects these views and takes its stand on the ground of empirical science. This development is connected with that of the modern process of production, which is becoming ever more rigorously mechanised and leaves ever less room for metaphysical ideas. It is also connected with the disappointment of broad masses of people with the attitude of those who preach traditional metaphysical and theological doctrines. So it is that in many countries the masses now reject these doctrines much more consciously than ever

before, and along with their socialist attitudes tend to lean towards a down-to-earth empiricist view. In previous times, *materialism* was the expression of this view; meanwhile, however, modern empiricism has shed a number of inadequacies and has taken a strong shape in the *scientific world-conception*.

Thus, the scientific world-conception is close to the life of the present. Certainly it is threatened with hard struggles and hostility. Nevertheless there are many who do not despair but, in view of the present sociological situation, look forward with hope to the course of events to come. Of course not every single adherent of the

scientific world-conception will be a fighter. Some, glad of solitude, will lead a withdrawn existence on the icy slopes of logic; some may even disdain mingling with the masses and regret the “trivialized” form that these matters inevitably take on spreading. However, their achievements too will take a place among the historic developments. We witness the spirit of the scientific world-conception penetrating in growing measure the forms of personal and public life, in education, upbringing, architecture, and the shaping of economic and social life according to rational principles. *The scientific world-conception serves life, and life receives it.*

Notes

1 [The pamphlet *Wissenschaftliche Weltauffassung, Der Wiener Kreis* does not give an author's name on the title page – unless one considers “Der Wiener Kreis” as author, being printed in smaller type. This pamphlet is the product of teamwork; Neurath did the writing, Hahn and Carnap edited the text with him; other members of the Circle were asked for their comments and contri-

butions. (H. Feigl mentions F. Waismann and himself, see: “Wiener Kreis in America” in *Perspectives in American History, II*, 1968.) [...] In fact, the name Wiener Kreis (Vienna Circle) was invented and suggested by Neurath. [...] – M. N.]

2 [Note: In his text, Russell wrote about “logical atomism”, not specifically of “logical analysis” – Trans.]

Paradigms and Anomalies in Science

Thomas Kuhn

The Priority of Paradigms

To discover the relation between rules, paradigms, and normal science, consider first how the historian isolates the particular loci of commitment that have just been described as accepted rules. Close historical investigation of a given specialty at a given time discloses a set of recurrent and quasi-standard illustrations of various theories in their conceptual, observational, and instrumental applications. These are the community's paradigms, revealed in its textbooks, lectures, and laboratory exercises. By studying them and by practicing with them, the members of the corresponding community learn their trade. The historian, of course, will discover in addition a penumbral area occupied by achievements whose status is still in doubt, but the core of solved problems and techniques will usually be clear. Despite occasional ambiguities, the paradigms of a mature scientific community can be determined with relative ease.

The determination of shared paradigms is not, however, the determination of shared rules. That demands a second step and one of a somewhat different kind. When undertaking it, the historian must compare the community's paradigms with each other and with its current research reports. In doing so, his object is to discover what isolable elements, explicit or implicit, the

members of that community may have *abstracted* from their more global paradigms and deployed as rules in their research. Anyone who has attempted to describe or analyze the evolution of a particular scientific tradition will necessarily have sought accepted principles and rules of this sort. Almost certainly, as the preceding section indicates, he will have met with at least partial success. But, if his experience has been at all like my own, he will have found the search for rules both more difficult and less satisfying than the search for paradigms. Some of the generalizations he employs to describe the community's shared beliefs will present no problems. Others, however, including some of those used as illustrations above, will seem a shade too strong. Phrased in just that way, or in any other way he can imagine, they would almost certainly have been rejected by some members of the group he studies. Nevertheless, if the coherence of the research tradition is to be understood in terms of rules, some specification of common ground in the corresponding area is needed. As a result, the search for a body of rules competent to constitute a given normal research tradition becomes a source of continual and deep frustration.

Recognizing that frustration, however, makes it possible to diagnose its source. Scientists can agree that a Newton, Lavoisier, Maxwell, or Einstein has produced an apparently permanent solution to a group of outstanding

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problems and still disagree, sometimes without being aware of it, about the particular abstract characteristics that make those solutions permanent. They can, that is, agree in their *identification* of a paradigm without agreeing on, or even attempting to produce, a full *interpretation* or *rationalization* of it. Lack of a standard interpretation or of an agreed reduction to rules will not prevent a paradigm from guiding research. Normal science can be determined in part by the direct inspection of paradigms, a process that is often aided by but does not depend upon the formulation of rules and assumptions. Indeed, the existence of a paradigm need not even imply that any full set of rules exists.¹

Inevitably, the first effect of those statements is to raise problems. In the absence of a competent body of rules, what restricts the scientist to a particular normal-scientific tradition? What can the phrase 'direct inspection of paradigms' mean? Partial answers to questions like these were developed by the the late Ludwig Wittgenstein, though in a very different context. Because that context is both more elementary and more familiar, it will help to consider his form of the argument first. What need we know, Wittgenstein asked, in order that we apply terms like 'chair', or 'leaf', or 'game' unequivocally and without provoking argument?²

That question is very old and has generally been answered by saying that we must know, consciously or intuitively, what a chair, or leaf, or game *is*. We must, that is, grasp some set of attributes that all games and that only games have in common. Wittgenstein, however, concluded that, given the way we use language and the sort of world to which we apply it, there need be no such set of characteristics. Though a discussion of *some* of the attributes shared by a *number* of games or chairs or leaves often helps us learn how to employ the corresponding term, there is no set of characteristics that is simultaneously applicable to all members of the class and to them alone. Instead, confronted with a previously unobserved activity, we apply the term 'game' because what we are seeing bears a close "family resemblance" to a number of the activities that we have previously learned to call by that name. For Wittgenstein, in short, games, and chairs, and leaves are natural families, each constituted by a network of overlapping and crisscross resemblances. The existence of such a network sufficiently accounts for our success in identifying the corresponding object or activity. Only if the families we named overlapped and merged gradually into one another – only, that is, if there were no *natural* families – would our success in identifying and naming

provide evidence for a set of common characteristics corresponding to each of the class names we employ.

Something of the same sort may very well hold for the various research problems and techniques that arise within a single normal-scientific tradition. What these have in common is not that they satisfy some explicit or even some fully discoverable set of rules and assumptions that gives the tradition its character and its hold upon the scientific mind. Instead, they may relate by resemblance and by modeling to one or another part of the scientific corpus which the community in question already recognizes as among its established achievements. Scientists work from models acquired through education and through subsequent exposure to the literature often without quite knowing or needing to know what characteristics have given these models the status of community paradigms. And because they do so, they need no full set of rules. The coherence displayed by the research tradition in which they participate may not imply even the existence of an underlying body of rules and assumptions that additional historical or philosophical investigation might uncover. That scientists do not usually ask or debate what makes a particular problem or solution legitimate tempts us to suppose that, at least intuitively, they know the answer. But it may only indicate that neither the question nor the answer is felt to be relevant to their research. Paradigms may be prior to, more binding, and more complete than any set of rules for research that could be unequivocally abstracted from them.

So far this point has been entirely theoretical: paradigms *could* determine normal science without the intervention of discoverable rules. Let me now try to increase both its clarity and urgency by indicating some of the reasons for believing that paradigms actually do operate in this manner. The first, which has already been discussed quite fully, is the severe difficulty of discovering the rules that have guided particular normal-scientific traditions. That difficulty is very nearly the same as the one the philosopher encounters when he tries to say what all games have in common. The second, to which the first is really a corollary, is rooted in the nature of scientific education. Scientists, it should already be clear, never learn concepts, laws, and theories in the abstract and by themselves. Instead, these intellectual tools are from the start encountered in a historically and pedagogically prior unit that displays them with and through their applications. A new theory is always announced together with applications to some concrete range of natural phenomena; without them

it would not be even a candidate for acceptance. After it has been accepted, those same applications or others accompany the theory into the textbooks from which the future practitioner will learn his trade. They are not there merely as embroidery or even as documentation. On the contrary, the process of learning a theory depends upon the study of applications, including practice problem-solving both with a pencil and paper and with instruments in the laboratory. If, for example, the student of Newtonian dynamics ever discovers the meaning of terms like 'force,' 'mass,' 'space,' and 'time,' he does so less from the incomplete though sometimes helpful definitions in his text than by observing and participating in the application of these concepts to problem-solution.

That process of learning by finger exercise or by doing continues throughout the process of professional initiation. As the student proceeds from his freshman course to and through his doctoral dissertation, the problems assigned to him become more complex and less completely precedented. But they continue to be closely modeled on previous achievements as are the problems that normally occupy him during his subsequent independent scientific career. One is at liberty to suppose that somewhere along the way the scientist has intuitively abstracted rules of the game for himself, but there is little reason to believe it. Though many scientists talk easily and well about the particular individual hypotheses that underlie a concrete piece of current research, they are little better than laymen at characterizing the established bases of their field, its legitimate problems and methods. If they have learned such abstractions at all, they show it mainly through their ability to do successful research. That ability can, however, be understood without recourse to hypothetical rules of the game.

These consequences of scientific education have a converse that provides a third reason to suppose that paradigms guide research by direct modeling as well as through abstracted rules. Normal science can proceed without rules only so long as the relevant scientific community accepts without question the particular problem-solutions already achieved. Rules should therefore become important and the characteristic unconcern about them should vanish whenever paradigms or models are felt to be insecure. That is, moreover, exactly what does occur. The preparadigm period, in particular, is regularly marked by frequent and deep debates over legitimate methods, problems, and standards of solution, though these serve rather to define schools than to produce

agreement. We have already noted a few of these debates in optics and electricity, and they played an even larger role in the development of seventeenth-century chemistry and of early nineteenth-century geology.³ Furthermore, debates like these do not vanish once and for all with the appearance of a paradigm. Though almost non-existent during periods of normal science, they recur regularly just before and during scientific revolutions, the periods when paradigms are first under attack and then subject to change. The transition from Newtonian to quantum mechanics evoked many debates about both the nature and the standards of physics, some of which still continue.⁴ There are people alive today who can remember the similar arguments engendered by Maxwell's electromagnetic theory and by statistical mechanics.⁵ And earlier still, the assimilation of Galileo's and Newton's mechanics gave rise to a particularly famous series of debates with Aristotelians, Cartesians, and Leibnizians about the standards legitimate to science.⁶ When scientists disagree about whether the fundamental problems of their field have been solved, the search for rules gains a function that it does not ordinarily possess. While paradigms remain secure, however, they can function without agreement over rationalization or without any attempted rationalization at all.

A fourth reason for granting paradigms a status prior to that of shared rules and assumptions can conclude this section. The introduction to this essay suggested that there can be small revolutions as well as large ones, that some revolutions affect only the members of a professional subspecialty, and that for such groups even the discovery of a new and unexpected phenomenon may be revolutionary. The next section will introduce selected revolutions of that sort, and it is still far from clear how they can exist. If normal science is so rigid and if scientific communities are so close-knit as the preceding discussion has implied, how can a change of paradigm ever affect only a small subgroup? What has been said so far may have seemed to imply that normal science is a single monolithic and unified enterprise that must stand or fall with any one of its paradigms as well as with all of them together. But science is obviously seldom or never like that. Often, viewing all fields together, it seems instead a rather ramshackle structure with little coherence among its various parts. Nothing said to this point should, however, conflict with that very familiar observation. On the contrary, substituting paradigms for rules should make the diversity of scientific fields and specialties easier to understand. Explicit rules,

when they exist, are usually common to a very broad scientific group, but paradigms need not be. The practitioners of widely separated fields, say astronomy and taxonomic botany, are educated by exposure to quite different achievements described in very different books. And even men who, being in the same or in closely related fields, begin by studying many of the same books and achievements may acquire rather different paradigms in the course of professional specialization.

Consider, for a single example, the quite large and diverse community constituted by all physical scientists. Each member of that group today is taught the laws of, say, quantum mechanics, and most of them employ these laws at some point in their research or teaching. But they do not all learn the same applications of these laws, and they are not therefore all affected in the same ways by changes in quantum-mechanical practice. On the road to professional specialization, a few physical scientists encounter only the basic principles of quantum mechanics. Others study in detail the paradigm applications of these principles to chemistry, still others to the physics of the solid state, and so on. What quantum mechanics means to each of them depends upon what courses he has had, what texts he has read, and which journals he studies. It follows that, though a change in quantum-mechanical law will be revolutionary for all of these groups, a change that reflects only on one or another of the paradigm applications of quantum mechanics need be revolutionary only for the members of a particular professional subspecialty. For the rest of the profession and for those who practice other physical sciences, that change need not be revolutionary at all. In short, though quantum mechanics (or Newtonian dynamics, or electromagnetic theory) is a paradigm for many scientific groups, it is not the same paradigm for them all. Therefore, it can simultaneously determine several traditions of normal science that overlap without being coextensive. A revolution produced within one of these traditions will not necessarily extend to the others as well.

One brief illustration of specialization's effect may give this whole series of points additional force. An investigator who hoped to learn something about what scientists took the atomic theory to be asked a distinguished physicist and an eminent chemist whether a single atom of helium was or was not a molecule. Both answered without hesitation, but their answers were not the same. For the chemist the atom of helium was a molecule because it behaved like one with respect to the kinetic theory of gases. For the physicist, on the other hand, the helium atom was not a

molecule because it displayed no molecular spectrum.⁷ Presumably both men were talking of the same particle, but they were viewing it through their own research training and practice. Their experience in problem-solving told them what a molecule must be. Undoubtedly their experiences had had much in common, but they did not, in this case, tell the two specialists the same thing. As we proceed we shall discover how consequential paradigm differences of this sort can occasionally be.

Anomaly and the Emergence of Scientific Discoveries

Normal science, the puzzle-solving activity we have just examined, is a highly cumulative enterprise, eminently successful in its aim, the steady extension of the scope and precision of scientific knowledge. In all these respects it fits with great precision the most usual image of scientific work. Yet one standard product of the scientific enterprise is missing. Normal science does not aim at novelties of fact or theory and, when successful, finds none. New and unsuspected phenomena are, however, repeatedly uncovered by scientific research, and radical new theories have again and again been invented by scientists. History even suggests that the scientific enterprise has developed a uniquely powerful technique for producing surprises of this sort. If this characteristic of science is to be reconciled with what has already been said, then research under a paradigm must be a particularly effective way of inducing paradigm change. That is what fundamental novelties of fact and theory do. Produced inadvertently by a game played under one set of rules, their assimilation requires the elaboration of another set. After they have become parts of science, the enterprise, at least of those specialists in whose particular field the novelties lie, is never quite the same again.

We must now ask how changes of this sort can come about, considering first discoveries, or novelties of fact, and then inventions, or novelties of theory. That distinction between discovery and invention or between fact and theory will, however, immediately prove to be exceedingly artificial. Its artificiality is an important clue to several of this essay's main theses. Examining selected discoveries in the rest of this section, we shall quickly find that they are not isolated events but extended episodes with a regularly recurrent structure. Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the

paradigm-induced expectations that govern normal science. It then continues with a more or less extended exploration of the area of anomaly. And it closes only when the paradigm theory has been adjusted so that the anomalous has become the expected. Assimilating a new sort of fact demands a more than additive adjustment of theory, and until that adjustment is completed – until the scientist has learned to see nature in a different way – the new fact is not quite a scientific fact at all.

To see how closely factual and theoretical novelty are intertwined in scientific discovery examine a particularly famous example, the discovery of oxygen. At least three different men have a legitimate claim to it, and several other chemists must, in the early 1770's, have had enriched air in a laboratory vessel without knowing it.⁸ The progress of normal science, in this case of pneumatic chemistry, prepared the way to a breakthrough quite thoroughly. The earliest of the claimants to prepare a relatively pure sample of the gas was the Swedish apothecary, C. W. Scheele. We may, however, ignore his work since it was not published until oxygen's discovery had repeatedly been announced elsewhere and thus had no effect upon the historical pattern that most concerns us here.⁹ The second in time to establish a claim was the British scientist and divine, Joseph Priestley, who collected the gas released by heated red oxide of mercury as one item in a prolonged normal investigation of the "airs" evolved by a large number of solid substances. In 1774 he identified the gas thus produced as nitrous oxide and in 1775, led by further tests, as common air with less than its usual quantity of phlogiston. The third claimant, Lavoisier, started the work that led him to oxygen after Priestley's experiments of 1774 and possibly as the result of a hint from Priestley. Early in 1775 Lavoisier reported that the gas obtained by heating the red oxide of mercury was "air itself entire without alteration [except that] ... it comes out more pure, more respirable,"¹⁰ By 1777, probably with the assistance of a second hint from Priestley, Lavoisier had concluded that the gas was a distinct species, one of the two main constituents of the atmosphere, a conclusion that Priestley was never able to accept.

This pattern of discovery raises a question that can be asked about every novel phenomenon that has ever entered the consciousness of scientists. Was it Priestley or Lavoisier, if either, who first discovered oxygen? In any case, when was oxygen discovered? In that form the question could be asked even if only one claimant had existed. As a ruling about priority and date, an answer

does not at all concern us. Nevertheless, an attempt to produce one will illuminate the nature of discovery, because there is no answer of the kind that is sought. Discovery is not the sort of process about which the question is appropriately asked. The fact that it is asked – the priority for oxygen has repeatedly been contested since the 1780's is a symptom of something askew in the image of science that gives discovery so fundamental a role. Look once more at our example. Priestley's claim to the discovery of oxygen is based upon his priority in isolating a gas that was later recognized as a distinct species. But Priestley's sample was not pure, and, if holding impure oxygen in one's hands is to discover it, that had been done by everyone who ever bottled atmospheric air. Besides, if Priestley was the discoverer, when was the discovery made? In 1774 he thought he had obtained nitrous oxide, a species he already knew; in 1775 he saw the gas as dephlogisticated air, which is still not oxygen or even, for phlogistic chemists, a quite unexpected sort of gas. Lavoisier's claim may be stronger, but it presents the same problems. If we refuse the palm to Priestley, we cannot award it to Lavoisier for the work of 1775 which led him to identify the gas as the "air itself entire." Presumably we wait for the work of 1776 and 1777 which led Lavoisier to see not merely the gas but what the gas was. Yet even this award could be questioned, for in 1777 and to the end of his life Lavoisier insisted that oxygen was an atomic "principle of acidity" and that oxygen gas was formed only when that "principle" united with caloric, the matter of heat.¹¹ Shall we therefore say that oxygen had not yet been discovered in 1777? Some may be tempted to do so. But the principle of acidity was not banished from chemistry until after 1810, and caloric lingered until the 1860's. Oxygen had become a standard chemical substance before either of those dates.

Clearly we need a new vocabulary and concepts for analyzing events like the discovery of oxygen. Though undoubtedly correct, the sentence, "Oxygen was discovered," misleads by suggesting that discovering something is a single simple act assimilable to our usual (and also questionable) concept of seeing. That is why we so readily assume that discovering, like seeing or touching, should be unequivocally attributable to an individual and to a moment in time. But the latter attribution is always impossible, and the former often is as well. Ignoring Scheele, we can safely say that oxygen had not been discovered before 1774, and we would probably also say that it had been discovered by 1777 or shortly

thereafter. But within those limits or others like them, any attempt to date the discovery must inevitably be arbitrary because discovering a new sort of phenomenon is necessarily a complex event, one which involves recognizing both *that* something is and *what* it is. Note, for example, that if oxygen were dephlogisticated air for us, we should insist without hesitation that Priestley had discovered it, though we would still not know quite when. But if both observation and conceptualization, fact and assimilation to theory, are inseparably linked in discovery, then discovery is a process and must take time. Only when all the relevant conceptual categories are prepared in advance, in which case the phenomenon would not be of a new sort, can discovering *that* and discovering *what* occur effortlessly, together, and in an instant.

Grant now that discovery involves an extended, though not necessarily long, process of conceptual assimilation. Can we also say that it involves a change in paradigm? To that question, no general answer can yet be given, but in this case at least, the answer must be yes. What Lavoisier announced in his papers from 1777 on was not so much the discovery of oxygen as the oxygen theory of combustion. That theory was the keystone for a reformulation of chemistry so vast that it is usually called the chemical revolution. Indeed, if the discovery of oxygen had not been an intimate part of the emergence of a new paradigm for chemistry, the question of priority from which we began would never have seemed so important. In this case as in others, the value placed upon a new phenomenon and thus upon its discoverer varies with our estimate of the extent to which the phenomenon violated paradigm-induced anticipations. Notice, however, since it will be important later, that the discovery of oxygen was not by itself the cause of the change in chemical theory. Long before he played any part in the discovery of the new gas, Lavoisier was convinced both that something was wrong with the phlogiston theory and that burning bodies absorbed some part of the atmosphere. That much he had recorded in a sealed note deposited with the Secretary of the French Academy in 1772.¹² What the work on oxygen did was to give much additional form and structure to Lavoisier's earlier sense that something was amiss. It told him a thing he was already prepared to discover – the nature of the substance that combustion removes from the atmosphere. That advance awareness of difficulties must be a significant part of what enabled Lavoisier to see in experiments like Priestley's a gas that Priestley had

been unable to see there himself. Conversely, the fact that a major paradigm revision was needed to see what Lavoisier saw must be the principal reason why Priestley was, to the end of his long life, unable to see it.

Two other and far briefer examples will reinforce much that has just been said and simultaneously carry us from an elucidation of the nature of discoveries toward an understanding of the circumstances under which they emerge in science. In an effort to represent the main ways in which discoveries can come about, these examples are chosen to be different both from each other and from the discovery of oxygen. The first, X-rays, is a classic case of discovery through accident, a type that occurs more frequently than the impersonal standards of scientific reporting allow us easily to realize. Its story opens on the day that the physicist Roentgen interrupted a normal investigation of cathode rays because he had noticed that a barium platino-cyanide screen at some distance from his shielded apparatus glowed when the discharge was in process. Further investigations – they required seven hectic weeks during which Roentgen rarely left the laboratory – indicated that the cause of the glow came in straight lines from the cathode ray tube, that the radiation cast shadows, could not be deflected by a magnet, and much else besides. Before announcing his discovery, Roentgen had convinced himself that his effect was not due to cathode rays but to an agent with at least some similarity to light.¹³

Even so brief an epitome reveals striking resemblances to the discovery of oxygen: before experimenting with red oxide of mercury, Lavoisier had performed experiments that did not produce the results anticipated under the phlogiston paradigm; Roentgen's discovery commenced with the recognition that his screen glowed when it should not. In both cases the perception of anomaly – of a phenomenon, that is, for which his paradigm had not readied the investigator – played an essential role in preparing the way for perception of novelty. But, again in both cases, the perception that something had gone wrong was only the prelude to discovery. Neither oxygen nor X-rays emerged without a further process of experimentation and assimilation. At what point in Roentgen's investigation, for example, ought we say that X-rays had actually been discovered? Not, in any case, at the first instant, when all that had been noted was a glowing screen. At least one other investigator had seen that glow and, to his subsequent chagrin, discovered nothing at all.¹⁴ Nor, it is almost as clear, can the moment of discovery be pushed forward to a point during the last week of investigation, by which

time Roentgen was exploring the properties of the new radiation he had *already* discovered. We can only say that X-rays emerged in Würzburg between November 8 and December 28, 1895.

In a third area, however, the existence of significant parallels between the discoveries of oxygen and of X-rays is far less apparent. Unlike the discovery of oxygen, that of X-rays was not, at least for a decade after the event, implicated in any obvious upheaval in scientific theory. In what sense, then, can the assimilation of that discovery be said to have necessitated paradigm change? The case for denying such a change is very strong. To be sure, the paradigms subscribed to by Roentgen and his contemporaries could not have been used to predict X-rays. (Maxwell's electromagnetic theory had not yet been accepted everywhere, and the particulate theory of cathode rays was only one of several current speculations.) But neither did those paradigms, at least in any obvious sense, prohibit the existence of X-rays as the phlogiston theory had prohibited Lavoisier's interpretation of Priestley's gas. On the contrary, in 1895 accepted scientific theory and practice admitted a number of forms of radiation – visible, infrared, and ultraviolet. Why could not X-rays have been accepted as just one more form of a well-known class of natural phenomena? Why were they not, for example, received in the same way as the discovery of an additional chemical element? New elements to fill empty places in the periodic table were still being sought and found in Roentgen's day. Their pursuit was a standard project for normal science, and success was an occasion only for congratulations, not for surprise.

X-rays, however, were greeted not only with surprise but with shock. Lord Kelvin at first pronounced them an elaborate hoax.¹⁵ Others, though they could not doubt the evidence, were clearly staggered by it. Though X-rays were not prohibited by established theory, they violated deeply entrenched expectations. Those expectations, I suggest, were implicit in the design and interpretation of established laboratory procedures. By the 1890's cathode ray equipment was widely deployed in numerous European laboratories. If Roentgen's apparatus had produced X-rays, then a number of other experimentalists must for some time have been producing those rays without knowing it. Perhaps those rays, which might well have other unacknowledged sources too, were implicated in behavior previously explained without reference to them. At the very least, several sorts of long familiar apparatus would in the future have to be shielded

with lead. Previously completed work on normal projects would now have to be done again because earlier scientists had failed to recognize and control a relevant variable. X-rays, to be sure, opened up a new field and thus added to the potential domain of normal science. But they also, and this is now the more important point, changed fields that had already existed. In the process they denied previously paradigmatic types of instrumentation their right to that title.

In short, consciously or not, the decision to employ a particular piece of apparatus and to use it in a particular way carries an assumption that only certain sorts of circumstances will arise. There are instrumental as well as theoretical expectations, and they have often played a decisive role in scientific development. One such expectation is, for example, part of the story of oxygen's belated discovery. Using a standard test for "the goodness of air," both Priestley and Lavoisier mixed two volumes of their gas with one volume of nitric oxide, shook the mixture over water, and measured the volume of the gaseous residue. The previous experience from which this standard procedure had evolved assured them that with atmospheric air the residue would be one volume and that for any other gas (or for polluted air) it would be greater. In the oxygen experiments both found a residue close to one volume and identified the gas accordingly. Only much later and in part through an accident did Priestley renounce the standard procedure and try mixing nitric oxide with his gas in other proportions. He then found that with quadruple the volume of nitric oxide there was almost no residue at all. His commitment to the original test procedure – a procedure sanctioned by much previous experience – had been simultaneously a commitment to the non-existence of gases that could behave as oxygen did.¹⁶

Illustrations of this sort could be multiplied by reference, for example, to the belated identification of uranium fission. One reason why that nuclear reaction proved especially difficult to recognize was that men who knew what to expect when bombarding uranium chose chemical tests aimed mainly at elements from the upper end of the periodic table.¹⁷ Ought we conclude from the frequency with which such instrumental commitments prove misleading that science should abandon standard tests and standard instruments? That would result in an inconceivable method of research. Paradigm procedures and applications are as necessary to science as paradigm laws and theories, and they have the same effects. Inevitably they restrict the phenomenological field accessible for scientific investigation at any given

time. Recognizing that much, we may simultaneously see an essential sense in which a discovery like X-rays necessitates paradigm change – and therefore change in both procedures and expectations – for a special segment of the scientific community. As a result, we may also understand how the discovery of X-rays could seem to open a strange new world to many scientists and could thus participate so effectively in the crisis that led to twentieth-century physics.

Our final example of scientific discovery, that of the Leyden jar, belongs to a class that may be described as theory-induced. Initially, the term may seem paradoxical. Much that has been said so far suggests that discoveries predicted by theory in advance are parts of normal science and result in no *new sort* of fact. I have, for example, previously referred to the discoveries of new chemical elements during the second half of the nineteenth century as proceeding from normal science in that way. But not all theories are paradigm theories. Both during pre-paradigm periods and during the crises that lead to large-scale changes of paradigm, scientists usually develop many speculative and unarticulated theories that can themselves point the way to discovery. Often, however, that discovery is not quite the one anticipated by the speculative and tentative hypothesis. Only as experiment and tentative theory are together articulated to a match does the discovery emerge and the theory become a paradigm.

The discovery of the Leyden jar displays all these features as well as the others we have observed before. When it began, there was no single paradigm for electrical research. Instead, a number of theories, all derived from relatively accessible phenomena, were in competition. None of them succeeded in ordering the whole variety of electrical phenomena very well. That failure is the source of several of the anomalies that provide background for the discovery of the Leyden jar. One of the competing schools of electricians took electricity to be a fluid, and that conception led a number of men to attempt bottling the fluid by holding a water-filled glass vial in their hands and touching the water to a conductor suspended from an active electrostatic generator. On removing the jar from the machine and touching the water (or a conductor connected to it) with his free hand, each of these investigators experienced a severe shock. Those first experiments did not, however, provide electricians with the Leyden jar. That device emerged more slowly, and it is again impossible to say just when its discovery was completed. The initial attempts to store electrical fluid

worked only because investigators held the vial in their hands while standing upon the ground. Electricians had still to learn that the jar required an outer as well as an inner conducting coating and that the fluid is not really stored in the jar at all. Somewhere in the course of the investigations that showed them this, and which introduced them to several other anomalous effects, the device that we call the Leyden jar emerged. Furthermore, the experiments that led to its emergence, many of them performed by Franklin, were also the ones that necessitated the drastic revision of the fluid theory and thus provided the first full paradigm for electricity.¹⁸

To a greater or lesser extent (corresponding to the continuum from the shocking to the anticipated result), the characteristics common to the three examples above are characteristic of all discoveries from which new sorts of phenomena emerge. Those characteristics include: the previous awareness of anomaly, the gradual and simultaneous emergence of both observational and conceptual recognition, and the consequent change of paradigm categories and procedures often accompanied by resistance. There is even evidence that these same characteristics are built into the nature of the perceptual process itself. In a psychological experiment that deserves to be far better known outside the trade, Bruner and Postman asked experimental subjects to identify on short and controlled exposure a series of playing cards. Many of the cards were normal, but some were made anomalous, e.g., a red six of spades and a black four of hearts. Each experimental run was constituted by the display of a single card to a single subject in a series of gradually increased exposures. After each exposure the subject was asked what he had seen, and the run was terminated by two successive correct identifications.¹⁹

Even on the shortest exposures many subjects identified most of the cards, and after a small increase all the subjects identified them all. For the normal cards these identifications were usually correct, but the anomalous cards were almost always identified, without apparent hesitation or puzzlement, as normal. The black four of hearts might, for example, be identified as the four of either spades or hearts. Without any awareness of trouble, it was immediately fitted to one of the conceptual categories prepared by prior experience. One would not even like to say that the subjects had seen something different from what they identified. With a further increase of exposure to the anomalous cards, subjects did begin to hesitate and to display awareness of anomaly. Exposed, for example, to the red six of spades, some would say: That's the six of spades, but there's something

wrong with it – the black has a red border. Further increase of exposure resulted in still more hesitation and confusion until finally, and sometimes quite suddenly, most subjects would produce the correct identification without hesitation. Moreover, after doing this with two or three of the anomalous cards, they would have little further difficulty with the others. A few subjects, however, were never able to make the requisite adjustment of their categories. Even at forty times the average exposure required to recognize normal cards for what they were, more than 10 percent of the anomalous cards were not correctly identified. And the subjects who then failed often experienced acute personal distress. One of them exclaimed: “I can’t make the suit out, whatever it is. It didn’t even look like a card that time. I don’t know what color it is now or whether it’s a spade or a heart. I’m not even sure now what a spade looks like. My God!”²⁰ In the next section we shall occasionally see scientists behaving this way too.

Either as a metaphor or because it reflects the nature of the mind, that psychological experiment provides a wonderfully simple and cogent schema for the process of scientific discovery. In science, as in the playing card experiment, novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation. Initially, only the anticipated and usual are experienced even under circumstances where anomaly is later to be observed. Further acquaintance, however, does result in awareness of something wrong or does relate the effect to something that has gone wrong before. That awareness of anomaly opens a period in which conceptual categories are adjusted until the initially anomalous has become the anticipated. At this point the discovery has been completed. I have already urged that that process or one very much like it is involved in the emergence of all fundamental scientific novelties. Let me now point out that, recognizing the process, we can at last begin to see why normal science, a pursuit not directed to novelties and tending at first to suppress them, should nevertheless be so effective in causing them to arise.

In the development of any science, the first received paradigm is usually felt to account quite successfully for most of the observations and experiments easily accessible to that science’s practitioners. Further development, therefore, ordinarily calls for the construction of elaborate equipment, the development of an esoteric vocabulary and skills, and a refinement of concepts that increasingly lessens their resemblance to their usual common-sense prototypes. That professionalization leads, on the one hand, to an immense restriction of the scientist’s vision and to a considerable resistance to paradigm change. The science has become increasingly rigid. On the other hand, within those areas to which the paradigm directs the attention of the group, normal science leads to a detail of information and to a precision of the observation-theory match that could be achieved in no other way. Furthermore, that detail and precision-of-match have a value that transcends their not always very high intrinsic interest. Without the special apparatus that is constructed mainly for anticipated functions, the results that lead ultimately to novelty could not occur. And even when the apparatus exists, novelty ordinarily emerges only for the man who, knowing *with precision* what he should expect, is able to recognize that something has gone wrong. Anomaly appears only against the background provided by the paradigm. The more precise and far-reaching that paradigm is, the more sensitive an indicator it provides of anomaly and hence of an occasion for paradigm change. In the normal mode of discovery, even resistance to change has a use that will be explored more fully in the next section. By ensuring that the paradigm will not be too easily surrendered, resistance guarantees that scientists will not be lightly distracted and that the anomalies that lead to paradigm change will penetrate existing knowledge to the core. The very fact that a significant scientific novelty so often emerges simultaneously from several laboratories is an index both to the strongly traditional nature of normal science and to the completeness with which that traditional pursuit prepares the way for its own change.

Notes

- 1 Michael Polanyi has brilliantly developed a very similar theme, arguing that much of the scientist’s success depends upon “tacit knowledge,” i.e., upon knowledge that is acquired through practice and that cannot be articulated explicitly. See his *Personal Knowledge* (Chicago, 1958), particularly chaps. v and vi.
- 2 Ludwig Wittgenstein, *Philosophical Investigations*, trans. G. E. M. Anscombe (New York, 1953), pp. 31–36. Wittgenstein, however, says almost nothing about the sort of world necessary to support the naming procedure he outlines. Part of the point that follows cannot therefore be attributed to him.

- 3 For chemistry, see H. Metzger, *Les doctrines chimiques en France du début du XVII^e à la fin du XVIII^e siècle* (Paris, 1923), pp. 24–27, 146–49; and Marie Boas, *Robert Boyle and Seventeenth-Century Chemistry* (Cambridge, 1958), chap. ii. For geology, see Walter F. Cannon “The Uniformitarian-Catastrophist Debate,” *Isis*, LI (1960), 38–55; and C. C. Gillispie, *Genesis and Geology* (Cambridge, Mass., 1951), chaps. iv–v.
- 4 For controversies over quantum mechanics, see Jean Ullmo, *La crise de la physique quantique* (Paris, 1950), chap. ii.
- 5 For statistical mechanics, see René Dugas, *La théorie physique au sens de Boltzmann et ses prolongements modernes* (Neuchâtel, 1959), pp. 158–84, 206–19. For the reception of Maxwell’s work, see Max Planck, “Maxwell’s Influence in Germany,” In *James Clerk Maxwell: A Commemoration Volume, 1831–1931* (Cambridge, 1931), pp. 45–65, esp. pp. 58–63; and Silvanus P. Thompson, *The Life of William Thomson Baron Kelvin of Largs* (London, 1910), II, 1021–27.
- 6 For a sample of the battle with the Aristotelians, see A. Koyré, “A Documentary History of the Problem of Fall from Kepler to Newton,” *Transactions of the American Philosophical Society*, XLV (1955), 329–95. For the debates with the Cartesians and Leibnizians, see Pierre Brunet, *L’introduction des théories de Newton en France au XVIII^e siècle* (Paris, 1931); and A. Koyré, *From the Closed World to the Infinite Universe* (Baltimore, 1957), chap. xi.
- 7 The investigator was James K. Senior, to whom I am indebted for a verbal report. Some related issues are treated in his paper, “The Vernacular of the Laboratory,” *Philosophy of Science*, XXV (1958), 163–68.
- 8 For the still classic discussion of oxygen’s discovery, see A. N. Meldrum, *The Eighteenth-Century Revolution in Science – the First Phase* (Calcutta, 1930), chap. v. An indispensable recent review, including an account of the priority controversy, is Maurice Daumas, *Lavoisier, théoricien et expérimentateur* (Paris, 1955), chaps. ii–iii. For a fuller account and bibliography, see also T. S. Kuhn, “The Historical Structure of Scientific Discovery,” *Science*, CXXXVI (June 1, 1962), 760–64.
- 9 See, however, Uno Bocklund, “A Lost Letter from Scheele to Lavoisier,” *Lychnos*, 1957–58, pp. 39–62, for a different evaluation of Scheele’s role.
- 10 J. B. Conant, *The Overthrow of the Phlogiston Theory: The Chemical Revolution of 1775–1789* (“Harvard Case Histories in Experimental Science,” Case 2; Cambridge, Mass., 1950), p. 23. This very useful pamphlet reprints many of the relevant documents.
- 11 H. Metzger, *La philosophie de la matière chez Lavoisier* (Paris, 1935); and Daumas op. cit., chap. vii.
- 12 The most authoritative account of the origin of Lavoisier’s discontent is Henry Guerlac, *Lavoisier – the Crucial Year: The Background and Origin of His First Experiments on Combustion in 1772* (Ithaca, N.Y., 1961).
- 13 L. W. Taylor, *Physics, the Pioneer Science* (Boston, 1941), pp. 790–94; and T. W. Chalmers, *Historic Researches* (London, 1949), pp. 218–19.
- 14 E. T. Whittaker, *A History of the Theories of Aether and Electricity*, I (2d ed.; London, 1951), 358, n. 1. Sir George Thomson has informed me of a second near miss. Alerted by unaccountably fogged photographic plates, Sir William Crookes was also on the track of the discovery.
- 15 Silvanus P. Thompson, *The Life of Sir William Thomson Baron Kelvin of Largs* (London, 1910), II, 1125.
- 16 Conant, op. cit., pp. 18–20.
- 17 K. K. Darrow, “Nuclear Fission,” *Bell System Technical Journal*, XIX (1940), 267–89. Krypton, one of the two main fission products, seems not to have been identified by chemical means until after the reaction was well understood. Barium, the other product, was almost identified chemically at a late stage of the investigation because, as it happened, that element had to be added to the radioactive solution to precipitate the heavy element for which nuclear chemists were looking. Failure to separate that added barium from the radioactive product finally led, after the reaction had been repeatedly investigated for almost five years, to the following report: “As chemists we should be led by this research ... to change all the names in the preceding [reaction] schema and thus write Ba, La, Ce instead of Ra, Ac, Th. But as ‘nuclear chemists,’ with close affiliations to physics, we cannot bring ourselves to this leap which would contradict all previous experience of nuclear physics. It may be that a series of strange accidents renders our results deceptive” (Otto Hahn and Fritz Strassman, “Über den Nachweis und das Verhalten der bei der Bestrahlung des Urans mittels Neutronen entstehenden Erdalkalimetalle,” *Die Naturwissenschaften*, XXVII [1939], 15).
- 18 For various stages in the Leyden jar’s evolution, see I. B. Cohen, *Franklin and Newton: An Inquiry into Speculative Newtonian Experimental Science and Franklin’s Work in Electricity as an Example Thereof* (Philadelphia, 1956), pp. 385–86, 400–406, 452–67, 506–7. The last stage is described by Whittaker, op. cit., pp. 50–52.
- 19 J. S. Bruner and Leo Postman, “On the Perception of Incongruity: A Paradigm,” *Journal of Personality*, XVIII (1949), 206–23.
- 20 *Ibid.*, p. 218. My colleague Postman tells me that, though knowing all about the apparatus and display in advance, he nevertheless found looking at the incongruous cards acutely uncomfortable.

Experimentation and Scientific Realism

Ian Hacking

Experimental physics provides the strongest evidence for scientific realism. Entities that in principle cannot be observed are regularly manipulated to produce new phenomena and to investigate other aspects of nature. They are tools, instruments not for thinking but for doing.

The philosopher's standard "theoretical entity" is the electron. I shall illustrate how electrons have become experimental entities, or experimenter's entities. In the early stages of our discovery of an entity, we may test hypotheses about it. Then it is merely an hypothetical entity. Much later, if we come to understand some of its causal powers and to use it to build devices that achieve well understood effects in other parts of nature, then it assumes quite a different status.

Discussions about scientific realism or anti-realism usually talk about theories, explanation and prediction. Debates at that level are necessarily inconclusive. Only at the level of experimental practice is scientific realism unavoidable. But this realism is not about theories and truth. The experimentalist need only be a realist about the entities used as tools.

A Plea for Experiments

No field in the philosophy of science is more systematically neglected than experiment. Our grade school teachers may have told us that scientific method is

experimental method, but histories of science have become histories of theory. Experiments, the philosophers say, are of value only when they test theory. Experimental work, they imply, has no life of its own. So we lack even a terminology to describe the many varied roles of experiment. Nor has this one-sidedness done theory any good, for radically different types of theory are used to think about the same physical phenomenon (e.g., the magneto-optical effect). The philosophers of theory have not noticed this and so misreport even theoretical inquiry.¹

Different sciences at different times exhibit different relationships between "theory" and "experiment." One chief role of experiment is the creation of phenomena. Experimenters bring into being phenomena that do not naturally exist in a pure state. These phenomena are the touchstones of physics, the keys to nature and the source of much modern technology. Many are what physicists after the 1870s began to call "effects": the photo-electric effect, the Compton effect, and so forth. A recent high-energy extension of the creation of phenomena is the creation of "events," to use the jargon of the trade. Most of the phenomena, effects and events created by the experimenter are like plutonium: they do not exist in nature except possibly on vanishingly rare occasions.²

In this paper I leave aside questions of methodology, history, taxonomy and the purpose of experiment in natural science. I turn to the purely philosophical issue of

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scientific realism. Call it simply “realism” for short. There are two basic kinds: realism about entities and realism about theories. There is no agreement on the precise definition of either. Realism about theories says we try to form true theories about the world, about the inner constitution of matter and about the outer reaches of space. This realism gets its bite from optimism; we think we can do well in this project, and have already had partial success.

Realism about entities – and I include processes, states, waves, currents, interactions, fields, black holes and the like among entities – asserts the existence of at least some of the entities that are the stock in trade of physics.³

The two realisms may seem identical. If you believe a theory, do you not believe in the existence of the entities it speaks about? If you believe in some entities, must you not describe them in some theoretical way that you accept? This seeming identity is illusory. The vast majority of experimental physicists are realists about entities without a commitment to realism about theories. The experimenter is convinced of the existence of plenty of “inferred” and “unobservable” entities. But no one in the lab believes in the literal truth of present theories about those entities. Although various properties are confidently ascribed to electrons, most of these properties can be embedded in plenty of different inconsistent theories about which the experimenter is agnostic. Even people working on adjacent parts of the same large experiment will use different and mutually incompatible accounts of what an electron is. That is because different parts of the experiment will make different uses of electrons, and the models that are useful for making calculations about one use may be completely haywire for another use.

Do I describe a merely sociological fact about experimentalists? It is not surprising, it will be said, that these good practical people are realists. They need that for their own self-esteem. But the self-vindicating realism of experimenters shows nothing about what actually exists in the world. In reply I repeat the distinction between realism about entities and realism about theories and models. Anti-realism about models is perfectly coherent. Many research workers may in fact hope that their theories and even their mathematical models “aim at the truth,” but they seldom suppose that any particular model is more than adequate for a purpose. By and large most experimenters seem to be instrumentalists about the models they use. The models are products of the intellect, tools for thinking and calculating. They are essential for writing up grant proposals to obtain further

funding. They are rules of thumb used to get things done. Some experimenters are instrumentalists about theories and models, while some are not. That is a sociological fact. But experimenters are realists about the entities that they use in order to investigate other hypotheses or hypothetical entities. That is not a sociological fact. Their enterprise would be incoherent without it. But their enterprise is not incoherent. It persistently creates new phenomena that become regular technology. My task is to show that realism about entities is a necessary condition for the coherence of most experimentation in natural science.

Our Debt to Hilary Putnam

It was once the accepted wisdom that a word like “electron” gets its meaning from its place in a network of sentences that state theoretical laws. Hence arose the infamous problems of incommensurability and theory change. For if a theory is modified, how could a word like “electron” retain its previous meaning? How could different theories about electrons be compared, since the very word “electron” would differ in meaning from theory to theory?

Putnam saves us from such questions by inventing a referential model of meaning. He says that meaning is a vector, refreshingly like a dictionary entry. First comes the syntactic marker (part of speech). Next the semantic marker (general category of thing signified by the word). Then the stereotype (cliches about the natural kind, standard examples of its use and present day associations. The stereotype is subject to change as opinions about the kind are modified). Finally there is the actual reference of the word, the very stuff, or thing, it denotes if it denotes anything. (Evidently dictionaries cannot include this in their entry, but pictorial dictionaries do their best by inserting illustrations whenever possible.)⁴

Putnam thought we can often guess at entities that we do not literally point to. Our initial guesses may be jejune or inept, and not every naming of an invisible thing or stuff pans out. But when it does, and we frame better and better ideas, then Putnam says that although the stereotype changes, we refer to the same kind of thing or stuff all along. We and Dalton alike spoke about the same stuff when we spoke of (inorganic) acids. J. J. Thomson, Lorentz, Bohr and Millikan were, with their different theories and observations, speculating about the same kind of thing, the electron.

There is plenty of unimportant vagueness about when an entity has been successfully “dubbed,” as Putnam puts it. “Electron” is the name suggested by G. Johnstone Stoney in 1891 as the name for a natural unit of electricity. He had drawn attention to this unit in 1874. The name was then applied in 1897 by J. J. Thomson to the subatomic particles of negative charge of which cathode rays consist. Was Johnstone Stoney referring to the electron? Putnam’s account does not require an unequivocal answer. Standard physics books say that Thomson discovered the electron. For once I might back theory and say Lorentz beat him to it. What Thomson did was to measure the electron. He showed its mass is 1/1800 that of hydrogen. Hence it is natural to say that Lorentz merely postulated the particle of negative charge, while Thomson, determining its mass, showed that there is some such real stuff beaming off a hot cathode.

The stereotype of the electron has regularly changed, and we have at least two largely incompatible stereotypes, the electron as cloud and the electron as particle. One fundamental enrichment of the idea came in the 1920s. Electrons, it was found, have angular momentum, or “spin.” Experimental work by Stern and Gerlach first indicated this, and then Goudsmit and Uhlenbeck provided the theoretical understanding of it in 1925. Whatever we think about Johnstone Stoney, others – Lorentz, Bohr, Thomson and Goudsmit – were all finding out more about the same kind of thing, the electron.

We need not accept the fine points of Putnam’s account of reference in order to thank him for providing a new way to talk about meaning. Serious discussions of inferred entities need no longer lock us into pseudo-problems of incommensurability and theory change. Twenty-five years ago the experimenter who believed that electrons exist, without giving much credence to any set of laws about electrons, would have been dismissed as philosophically incoherent. We now realize it was the philosophy that was wrong, not the experimenter. My own relationship to Putnam’s account of meaning is like the experimenter’s relationship to a theory. I don’t literally believe Putnam, but I am happy to employ his account as an alternative to the unpalatable account in fashion some time ago.

Putnam’s philosophy is always in flux. At the time of this writing, July 1981, he rejects any “metaphysical realism” but allows “internal realism.”²⁵ The internal realist acts, in practical affairs, as if the entities occurring in his working theories did in fact exist. However, the

direction of Putnam’s metaphysical anti-realism is no longer scientific. It is not peculiarly about natural science. It is about chairs and livers too. He thinks that the world does not naturally break up into our classifications. He calls himself a transcendental idealist. I call him a transcendental nominalist. I use the word “nominalist” in the old fashioned way, not meaning opposition to “abstract entities” like sets, but meaning the doctrine that there is no nonmental classification in nature that exists over and above our own human system of naming.

There might be two kinds of Putnamian internal realist – the instrumentalist and the scientific realist. The former is, in practical affairs where he uses his present scheme of concepts, a realist about livers and chairs, but he thinks that electrons are mental constructs only. The latter thinks that livers, chairs, and electrons are probably all in the same boat, that is, real at least within the present system of classification. I take Putnam to be an internal scientific realist rather than an internal instrumentalist. The fact that either doctrine is compatible with transcendental nominalism and internal realism shows that our question of scientific realism is almost entirely independent of Putnam’s present philosophy.

Interfering

Francis Bacon, the first and almost last philosopher of experiments, knew it well: the experimenter sets out “to twist the lion’s tail.” Experimentation is interference in the course of nature; “nature under constraint and vexed; that is to say, when by art and the hand of man she is forced out of her natural state, and squeezed and moulded.”²⁶ The experimenter is convinced of the reality of entities some of whose causal properties are sufficiently well understood that they can be used to interfere *elsewhere* in nature. One is impressed by entities that one can use to test conjectures about other more hypothetical entities. In my example, one is sure of the electrons that are used to investigate weak neutral currents and neutral bosons. This should not be news, for why else are we (non-sceptics) sure of the reality of even macroscopic objects, but because of what we do with them, what we do to them, and what they do to us?

Interference and intervention are the the stuff of reality. This is true, for example, at the borderline of observability. Too often philosophers imagine that microscopes carry conviction because they help us see better. But that is only part of the story. On the contrary, what counts is what we

can do to a specimen under a microscope, and what we can see ourselves doing. We stain the specimen, slice it, inject it, irradiate it, fix it. We examine it using different kinds of microscopes that employ optical systems that rely on almost totally unrelated facts about light. Microscopes carry conviction because of the great array of interactions and interferences that are possible. When we see something that turns out not to be stable under such play, we call it an artefact and say it is not real.⁷

Likewise, as we move down in scale to the truly un-seeable, it is our power to use unobservable entities that make us believe they are there. Yet I blush over these words “see” and “observe.” John Dewey would have said that a fascination with seeing-with-the-naked-eye is part of the Spectator Theory of Knowledge that has bedeviled philosophy from earliest times. But I don’t think Plato or Locke or anyone before the nineteenth century was as obsessed with the sheer opacity of objects as we have been since. My own obsession with a technology that manipulates objects is, of course a twentieth-century counterpart to positivism and phenomenology. Their proper rebuttal is not a restriction to a narrower domain of reality, namely to what can be positivistically “seen” (with the eye), but an extension to other modes by which people can extend their consciousness.

Making

Even if experimenters are realists about entities, it does not follow that they are right. Perhaps it is a matter of psychology: the very skills that make for a great experimenter go with a certain cast of mind that objectifies whatever it thinks about. Yet this will not do. The experimenter cheerfully regards neutral bosons as merely hypothetical entities, while electrons are real. What is the difference?

There are an enormous number of ways to make instruments that rely on the causal properties of electrons in order to produce desired effects of unsurpassed precision. I shall illustrate this. The argument – it could be called the experimental argument for realism – is not that we infer the reality of electrons from our success. We do not make the instruments and then infer the reality of the electrons, as when we test a hypothesis, and then believe it because it passed the test. That gets the time-order wrong. By now we design apparatus relying on a modest number of home truths about electrons to produce some other phenomenon that we wish to investigate.

That may sound as if we believe in the electrons because we predict how our apparatus will behave. That too is misleading. We have a number of general ideas about how to prepare polarized electrons, say. We spend a lot of time building prototypes that don’t work. We get rid of innumerable bugs. Often we have to give up and try another approach. Debugging is not a matter of theoretically explaining or predicting what is going wrong. It is partly a matter of getting rid of “noise” in the apparatus. “Noise” often means all the events that are not understood by any theory. The instrument must be able to isolate, physically, the properties of the entities that we wish to use, and damp down all the other effects that might get in our way. *We are completely convinced of the reality of electrons when we regularly set out to build – and often enough succeed in building – new kinds of devices that use various well understood causal properties of electrons to interfere in other more hypothetical parts of nature.*

It is not possible to grasp this without an example. Familiar historical examples have usually become encrusted by false theory-oriented philosophy or history. So I shall take something new. This is a polarizing electron gun whose acronym is PEGGY II. In 1978 it was used in a fundamental experiment that attracted attention even in *The New York Times*. In the next section I describe the point of making PEGGY II. So I have to tell some new physics. You can omit this and read only the engineering section that follows. Yet it must be of interest to know the rather easy-to-understand significance of the main experimental results, namely, (1) parity is not conserved in scattering of polarized electrons from deuterium, and (2) more generally, parity is violated in weak neutral current interactions.⁸

Methodological Remark

In the following section I retail a little current physics; in the section after that I describe how a machine has been made. It is the latter that matters to my case, not the former. Importantly, even if present quantum electrodynamics turns out to need radical revision, the machine, called PEGGY II, will still work. I am concerned with how it was made to work, and why. I shall sketch far more sheer engineering than is seen in philosophy papers. My reason is that the engineering is incoherent unless electrons are taken for granted. One cannot say this by merely reporting, “Oh, they made an electron gun for shooting polarized electrons.” An immense practical knowledge of how

to manipulate electrons, of what sorts of things they will do reliably and how they tend to misbehave – that is the kind of knowledge which grounds the experimenter’s realism about electrons. You cannot grasp this kind of knowledge in the abstract, for it is practical knowledge. So I must painfully introduce the reader to some laboratory physics. Luckily it is a lot of fun.

Parity and Weak Neutral Currents

There are four fundamental forces in nature, not necessarily distinct. Gravity and electromagnetism are familiar. Then there are the strong and weak forces, the fulfillment of Newton’s program, in the *Optics*, which taught that all nature would be understood by the interaction of particles with various forces that were effective in attraction or repulsion over various different distance (i.e., with different rates of extinction).

Strong forces are 100 times stronger than electromagnetism but act only for a miniscule distance, at most the diameter of a proton. Strong forces act on “hadrons,” which include protons, neutrons, and more recent particles, but not electrons or any other members of the class of particles called “leptons.”

The weak forces are only 1/10,000 times as strong as electromagnetism, and act over a distance 1/100 times smaller than strong forces. But they act on both hadrons and leptons, including electrons. The most familiar example of a weak force may be radioactivity.

The theory that motivates such speculation is quantum electrodynamics. It is incredibly successful, yielding many predictions better than one part in a million, a miracle in experimental physics. It applies over distances ranging from diameters of the earth to 1/100 the diameter of the proton. This theory supposes that all the forces are “carried” by some sort of particle. Photons do the job in electromagnetism. We hypothesize “gravitons” for gravity.

In the case of interactions involving weak forces, there are charged currents. We postulate that particles called bosons carry these weak forces.⁹ For charged currents, the bosons may be positive or negative. In the 1970s there arose the possibility that there could be weak “neutral” currents in which no charge is carried or exchanged. By sheer analogy with the vindicated parts of quantum electrodynamics, neutral bosons were postulated as the carriers in weak interactions.

The most famous discovery of recent high energy physics is the failure of the conservation of parity. Contrary

to the expectations of many physicists and philosophers, including Kant,¹⁰ nature makes an absolute distinction between right-handedness and left-handedness. Apparently this happens only in weak interactions.

What we mean by right- or left-handed in nature has an element of convention. I remarked that electrons have spin. Imagine your right hand wrapped around a spinning particle with the fingers pointing in the direction of spin. Then your thumb is said to point in the direction of the spin vector. If such particles are traveling in a beam, consider the relation between the spin vector and the beam. If all the particles have their spin vector in the same direction as the beam, they have right-handed (linear) polarization, while if the spin vector is opposite to the beam direction, they have left-handed (linear) polarization.

The original discovery of parity violation showed that one kind of product of a particle decay, a so-called *muon neutrino*, exists only in left-handed polarization and never in right-handed polarization.

Parity violations have been found for weak *charged* interactions. What about weak *neutral* currents? The remarkable Weinberg-Salam model for the four kinds of force was proposed independently by Stephen Weinberg in 1967 and A. Salam in 1968. It implies a minute violation of parity in weak neutral interactions. Given that the model is sheer speculation, its success has been amazing, even awe inspiring. So it seemed worthwhile to try out the predicted failure of parity for weak neutral interactions. That would teach us more about those weak forces that act over so minute a distance.

The prediction is: Slightly more left-handed polarized electrons hitting certain targets will scatter, than right-handed electrons. Slightly more! The difference in relative frequency of the two kinds of scattering is one part in 10,000, comparable to a difference in probability between 0.50005 and 0.49995. Suppose one used the standard equipment available at the Stanford Linear Accelerator in the early 1970s, generating 120 pulses per second, each pulse providing one electron event. Then you would have to run the entire SLAC beam for 27 years in order to detect so small a difference in relative frequency. Considering that one uses the same beam for lots of experiments simultaneously, by letting different experiments use different pulses, and considering that no equipment remains stable for even a month, let alone 27 years, such an experiment is impossible. You need enormously more electrons coming off in each pulse. We need between 1000 and 10,000 more electrons per pulse

than was once possible. The first attempt used an instrument now called PEGGY I. It had, in essence, a high-class version of J.J. Thomson's hot cathode. Some lithium was heated and electrons were boiled off. PEGGY II uses quite different principles.

PEGGY II

The basic idea began when C. Y. Prescott noticed, (by "chance"!) an article in an optics magazine about a crystalline substance called Gallium Arsenide. GaAs has a number of curious properties that make it important in laser technology. One of its quirks is that when it is struck by circularly polarized light of the right frequencies, it emits a lot of linearly polarized electrons. There is a good rough and ready quantum understanding of why this happens, and why half the emitted electrons will be polarized, $\frac{3}{4}$ polarized in one direction and $\frac{1}{4}$ polarized in the other.

PEGGY II uses this fact, plus the fact that GaAs emits lots of electrons due to features of its crystal structure. Then comes some engineering. It takes work to liberate an electron from a surface. We know that painting a surface with the right substance helps. In this case, a thin layer of Cesium and Oxygen is applied to the crystal. Moreover the less air pressure around the crystal, the more electrons will escape for a given amount of work. So the bombardment takes place in a good vacuum at the temperature of liquid nitrogen.

We need the right source of light. A laser with bursts of red light (7100 Ångstroms) is trained on the crystal. The light first goes through an ordinary polarizer, a very old-fashioned prism of calcite, or Iceland spar.¹¹ This gives longitudinally polarized light. We want circularly polarized light to hit the crystal. The polarized laser beam now goes through a cunning modern device, called a Pockel's cell. It electrically turns linearly polarized photons into circularly polarized ones. Being electric, it acts as a very fast switch. The direction of circular polarization depends on the direction of current in the cell. Hence the direction of polarization can be varied randomly. This is important, for we are trying to detect a minute asymmetry between right and left handed polarization. Randomizing helps us guard against any systematic "drift" in the equipment.¹² The randomization is generated by a radioactive decay device, and a computer records the direction of polarization for each pulse.

A circularly polarized pulse hits the GaAs crystal, resulting in a pulse of linearly polarized electrons. A beam of such pulses is maneuvered by magnets into the accelerator for the next bit of the experiment. It passes through a device that checks on a proportion of polarization along the way. The remainder of the experiment requires other devices and detectors of comparable ingenuity, but let us stop at PEGGY II.

Bugs

Short descriptions make it all sound too easy, so let us pause to reflect on debugging. Many of the bugs are never understood. They are eliminated by trial and error. Let us illustrate three different kinds: (1) The essential technical limitations that in the end have to be factored into the analysis of error. (2) Simpler mechanical defects you never think of until they are forced on you. (3) Hunches about what might go wrong.

- (1) Laser beams are not as constant as science fiction teaches, and there is always an irremediable amount of "jitter" in the beam over any stretch of time.
- (2) At a more humdrum level the electrons from the GaAs crystal are back-scattered and go back along the same channel as the laser beam used to hit the crystal. Most of them are then deflected magnetically. But some get reflected from the laser apparatus and get back into the system. So you have to eliminate these new ambient electrons. This is done by crude mechanical means, making them focus just off the crystal and so wander away.
- (3) Good experimenters guard against the absurd. Suppose that dust particles on an experimental surface lie down flat when a polarized pulse hits it, and then stand on their heads when hit by a pulse polarized in the opposite direction? Might that have a systematic effect, given that we are detecting a minute asymmetry? One of the team thought of this in the middle of the night and came down next morning frantically using antidust spray. They kept that up for a month, just in case.¹³

Results

Some 10^{11} events were needed to obtain a result that could be recognized above systematic and statistical error. Although the idea of systematic error presents

interesting conceptual problems, it seems to be unknown to philosophers. There were systematic uncertainties in the detection of right- and left-handed polarization, there was some jitter, and there were other problems about the parameters of the two kinds of beam. These errors were analyzed and linearly added to the statistical error. To a student of statistical inference this is real seat-of-the-pants analysis with no rationale whatsoever. Be that as it may, thanks to PEGGY II the number of events was big enough to give a result that convinced the entire physics community.¹⁴ Left-handed polarized electrons were scattered from deuterium slightly more frequently than right-handed electrons. This was the first convincing example of parity-violation in a weak neutral current interaction.

Comment

The making of PEGGY II was fairly non-theoretical. Nobody worked out in advance the polarizing properties of GaAs – that was found by a chance encounter with an unrelated experimental investigation. Although elementary quantum theory of crystals explains the polarization effect, it does not explain the properties of the actual crystal used. No one has been able to get a real crystal to polarize more than 37 percent of the electrons, although in principle 50 percent should be polarized.

Likewise although we have a general picture of why layers of cesium and oxygen will “produce negative electron affinity,” i.e., make it easier for electrons to escape, we have no quantitative understanding of why this increases efficiency to a score of 37 percent.

Nor was there any guarantee that the bits and pieces would fit together. To give an even more current illustration, future experimental work, briefly described later in this paper, makes us want even more electrons per pulse than PEGGY II could give. When the parity experiment was reported in *The New York Times*, a group at Bell Laboratories read the newspaper and saw what was going on. They had been constructing a crystal lattice for totally unrelated purposes. It uses layers of GaAs and a related aluminum compound. The structure of this lattice leads one to expect that virtually all the electrons emitted would be polarized. So we might be able to double the efficiency of PEGGY II. But at present (July 1981) that nice idea has problems. The new lattice should also be coated in work-reducing paint. But the cesium

oxygen stuff is applied at high temperature. Then the aluminum tends to ooze into the neighboring layer of GaAs, and the pretty artificial lattice becomes a bit uneven, limiting its fine polarized-electron-emitting properties. So perhaps this will never work.¹⁵ The group are simultaneously reviving a souped up new thermionic cathode to try to get more electrons. Maybe PEGGY II would have shared the same fate, never working, and thermionic devices would have stolen the show.

Note, incidentally, that the Bell people did not need to know a lot of weak neutral current theory to send along their sample lattice. They just read *The New York Times*.

Moral

Once upon a time it made good sense to doubt that there are electrons. Even after Millikan had measured the charge on the electron, doubt made sense. Perhaps Millikan was engaging in “inference to the best explanation.” The charges on his carefully selected oil drops were all small integral multiples of a least charge. He inferred that this is the real least charge in nature, and hence it is the charge on the electron, and hence there are electrons, particles of least charge. In Millikan’s day most (but not all) physicists did become increasingly convinced by one or more theories about the electron. However it is always admissible, at least for philosophers, to treat inferences to the best explanation in a purely instrumental way, without any commitment to the existence of entities used in the explanation.¹⁶ But it is now seventy years after Millikan, and we no longer have to infer from explanatory success. Prescott et al., don’t explain phenomena with electrons. They know a great deal about how to use them.

The group of experimenters do not know what electrons are, exactly. Inevitably they think in terms of particles. There is also a cloud picture of an electron which helps us think of complex wavefunctions of electrons in a bound state. The angular momentum and spin vector of a cloud make little sense outside a mathematical formalism. A beam of polarized clouds is fantasy so no experimenter uses that model – not because of doubting its truth, but because other models help more with the calculations. Nobody thinks that electrons “really” are just little spinning orbs about which you could, with a small enough hand, wrap the fingers and find the direction of spin along the thumb. There is instead a family of causal properties in terms of which

gifted experimenters describe and deploy electrons in order to investigate something else, e.g., weak neutral currents and neutral bosons. We know an enormous amount about the behavior of electrons. We also know what does not matter to electrons. Thus we know that bending a polarized electron beam in magnetic coils does not affect polarization in any significant way. We have hunches, too strong to ignore although too trivial to test independently: e.g., dust might dance under changes of directions of polarization. Those hunches are based on a hard-won sense of the kinds of things electrons are. It does not matter at all to this hunch whether electrons are clouds or particles.

The experimentalist does not believe in electrons because, in the words retrieved from mediaeval science by Duhem, they “save the phenomena.” On the contrary, we believe in them because we use them to *create* new phenomena, such as the phenomenon of parity violation in weak neutral current interactions.

When Hypothetical Entities Become Real

Note the complete contrast between electrons and neutral bosons. Nobody can yet manipulate a bunch of neutral bosons, if there are any. Even weak neutral currents are only just emerging from the mists of hypothesis. By 1980 a sufficient range of convincing experiments had made them the object of investigation. When might they lose their hypothetical status and become common place reality like electrons? When we use them to investigate something else.

I mentioned the desire to make a better gun than PEGGY II. Why? Because we now “know” that parity is violated in weak neutral interactions. Perhaps by an even more grotesque statistical analysis than that involved in the parity experiment, we can isolate just the weak interactions. That is, we have a lot of interactions, including say electromagnetic ones. We can censor these in various ways, but we can also statistically pick out a class of weak interactions as precisely those where parity is not conserved. This would possibly give us a road to quite deep investigations of matter and anti-matter. To do the statistics one needs even more electrons per pulse than PEGGY II could hope to generate. If such a project were to succeed, we should be beginning to use weak neutral currents as a manipulable tool for looking at something else. The next step towards a realism about such currents would have been made.

The message is general and could be extracted from almost any branch of physics. Dudley Shapere has recently used “observation” of the sun’s hot core to illustrate how physicists employ the concept of observation. They collect neutrinos from the sun in an enormous disused underground mine that has been filled with the old cleaning fluid (i.e., Carbon Tetrachloride). We would know a lot about the inside of the sun if we knew how many solar neutrinos arrive on the earth. So these are captured in the cleaning fluid; a few will form a new radioactive nucleus. The number that do this can be counted. Although the extent of neutrino manipulation is much less than electron manipulation in the PEGGY II experiment, here we are plainly using neutrinos to investigate something else. Yet not many years ago, neutrinos were about as hypothetical as an entity could get. After 1946 it was realized that when mesons disintegrate, giving off, among other things, highly energized electrons, one needed an extra nonionizing particle to conserve momentum and energy. At that time this postulated “neutrino” was thoroughly hypothetical, but now it is routinely used to examine other things.

Changing Times

Although realisms and anti-realisms are part of the philosophy of science well back into Greek prehistory, our present versions mostly descend from debates about atomism at the end of the nineteenth century. Anti-realism about atoms was partly a matter of physics: the energeticists thought energy was at the bottom of everything, not tiny bits of matter. It also was connected with the positivism of Comte, Mach, Pearson and even J. S. Mill. Mill’s young associate Alexander Bain states the point in a characteristic way, apt for 1870:

Some hypotheses consist of assumptions as to the minute structure and operations of bodies. From the nature of the case these assumptions can never be proved by direct means. Their merit is their suitability to express phenomena. They are Representative Fictions.¹⁷

“All assertions as to the ultimate structure of the particles of matter,” continues Bain, “are and ever must be hypothetical. . . .” “The kinetic theory of heat, he says, “serves an important intellectual function.” But we cannot hold it to be a true description of the world. It is a Representative Fiction.

Bain was surely right a century ago. Assumptions about the minute structure of matter could not be proved then. The only proof could be indirect, namely that hypotheses seemed to provide some explanation and helped make good predictions. Such inferences need never produce conviction in the philosopher inclined to instrumentalism or some other brand of idealism.

Indeed the situation is quite similar to seventeenth-century epistemology. At that time knowledge was thought of as correct representation. But then one could never get outside the representations to be sure that they corresponded to the world. Every test of a representation is just another representation. "Nothing is so much like an idea as an idea," as Bishop Berkeley had it. To attempt to argue for scientific realism at the level of theory, testing, explanation, predictive success, convergence of theories and so forth is to be locked into a world of representations. No wonder that scientific anti-realism is so permanently in the race. It is a variant on "The Spectator Theory of Knowledge."

Scientists, as opposed to philosophers, did in general become realists about atoms by 1910. Michael Gardner, in one of the finest studies of real-life scientific realism, details many of the factors that went into that change in

climate of opinion.¹⁸ Despite the changing climate, some variety of instrumentalism or fictionalism remained a strong philosophical alternative in 1910 and in 1930. That is what the history of philosophy teaches us. Its most recent lesson is Bas van Fraassen's *The Scientific Image*, whose "constructive empiricism" is another theory-oriented anti-realism. The lesson is: think about practice, not theory.

Anti-realism about atoms was very sensible when Bain wrote a century ago. Anti-realism about *any* sub-microscopic entities was a sound doctrine in those days. Things are different now. The "direct" proof of electrons and the like is our ability to manipulate them using well understood low-level causal properties. I do not of course claim that "reality" is constituted by human manipulability. We can, however, call something real, in the sense in which it matters to scientific realism, only when we understand quite well what its causal properties are. The best evidence for this kind of understanding is that we can set out, from scratch, to build machines that will work fairly reliably, taking advantage of this or that causal nexus. Hence, engineering, not theorizing, is the proof of scientific realism about entities.¹⁹

Notes

- 1 C. W. F. Everitt and Ian Hacking, "Which Comes First, Theory or Experiment?"
- 2 Ian Hacking, "Spekulation, Berechnung und die Erschaffung der Phänomene," in *Versuchungen: Aufsätze zur Philosophie Paul Feyerabend's*, (P. Duerr, ed.), Frankfurt, 1981, Bd 2, 126–58.
- 3 Nancy Cartwright makes a similar distinction in a sequence of papers, including "When Explanation Leads to Inference," in the present issue. She approaches realism from the top, distinguishing theoretical laws (which do not state the facts) from phenomenological laws (which do). She believes in some "theoretical" entities and rejects much theory on the basis of a subtle analysis of modeling in physics. I proceed in the opposite direction, from experimental practice. Both approaches share an interest in real-life physics as opposed to philosophical fantasy science. My own approach owes an enormous amount to Cartwright's parallel developments, which have often preceded my own. My use of the two kinds of realism is a case in point.
- 4 Hilary Putnam, "How Not To Talk About Meaning," "The meaning of 'Meaning,'" and other papers in the *Mind, Language and Reality, Philosophical Papers*, Vol. 2. Cambridge, 1975.
- 5 These terms occur in e.g., Hilary Putnam, *Meaning and the Moral Sciences*, London, 1978, 123–30.
- 6 Francis Bacon, *The Great Instauration*, in *The Philosophical Works of Francis Bacon* (J. M. Robertson, ed; Ellis and Spedding, Trans.), London, 1905, p. 252.
- 7 Ian Hacking, "Do We See Through a Microscope?" *Pacific Philosophical Quarterly*, winter 1981.
- 8 I thank Melissa Franklin, of the Stanford Linear Accelerator, for introducing me to PEGGY II and telling me how it works. She also arranged discussions with members of the PEGGY II group, some of which are mentioned below. The report of experiment E-122 described here is "Parity Non-conservation in Inelastic Electron Scattering," C. Y. Prescott et al., *Physics Letters*. I have relied heavily on the in-house journal, the *SLAC Beam Line*, Report No. 8, October, 1978, "Parity Violation in Polarized Electron Scattering." This was prepared by the in-house science writer Bill Kirk, who is the clearest, most readable popularizer of difficult new experimental physics that I have come across.
- 9 The odd-sounding bosons are named after the Indian physicist S. N. Bose (1894–1974), also remembered in the name "Bose-Einstein statistics" (which bosons satisfy).
- 10 But excluding Leibniz, who "knew" there had to be some real, natural difference between right- and left-handedness.

- 11 Iceland spar is an elegant example of how experimental phenomena persist even while theories about them undergo revolutions. Mariners brought calcite from Iceland to Scandinavia. Erasmus Batholinus experimented with it and wrote about it in 1609. When you look through these beautiful crystals you see double, thanks to the so-called ordinary and extraordinary rays. Calcite is a natural polarizer. It was our entry to polarized light which for 300 years was the chief route to improved theoretical and experimental understanding of light and then electromagnetism. The use of calcite in PEGGY II is a happy reminder of a great tradition.
- 12 It also turns GaAs, a $\frac{3}{4}$ - $\frac{1}{4}$ left/right hand polarizer, into a 50-50 polarizer.
- 13 I owe these examples to conversation with Roger Miller of SLAC.
- 14 The concept of a "convincing experiment" is fundamental. Peter Gallison has done important work on this idea, studying European and American experiments on weak neutral currents conducted during the 1970s.
- 15 I owe this information to Charles Sinclair of SLAC.
- 16 My attitude to "inference to the best explanation" is one of many learned from Cartwright. See, for example, her paper on this topic in this issue.
- 17 Alexander Bain, *Logic, Deductive and Inductive*, London and New York, 1870, p. 362.
- 18 Michael Gardner, "Realism and Instrumentalism in 19th-century Atomism," *Philosophy of Science* 46, (1979), 1-34.
- 19 (Added in proof, February, 1983). As indicated in the text, this is a paper of July, 1981, and hence is out of date. For example, neutral bosons are described as purely hypothetical. Their status has changed since CERN announced on Jan. 23, 1983, that a group there had found W, the weak intermediary boson, in proton-antiproton decay at 540 GeV. These experimental issues are further discussed in my forthcoming book, *Representing and Intervening* (Cambridge, 1983).

Hermeneutical Philosophy and Pragmatism: A Philosophy of Science

Patrick A. Heelan and Jay Schulkin

1 Introduction

The philosophy of science rooted in the works of Descartes, Hume, and Comte, took a great detour in the twentieth century (Babich 1994b). Beginning with a strong historical voice in P. Duhem, E. Mach, and G. Bachelard, often focussed on the theme of scientific creativity, this voice became muted at the mid-century following the rise and dominance of positivism and analysis. But with the close of the century, logical positivism is dead, and the historical voice has returned, joined now by those in the social studies of science, to confront the anti-historicism and reductionism of the prevailing tradition and its dismissal of interest in what N. R. Hanson (Hanson 1961) called patterns of discovery. One would expect then a revival of interest in the cultural processes that shepherd scientific inquiry in making theories and testing them within the socio-historical context in which they function to give meaning to the empirical world, and the modalities under which people, scientists and non-scientists, come to an understanding of the mission of science. These are areas crucial today for interdisciplinary cooperation and for public trust and understanding of one of our greatest institutions.

2 Elements of Consensus

Debate and criticism of the past few decades seem to have brought about widespread agreement on certain theses. Aware that the formulae do not mean quite the same for all, there is nevertheless strong support among diverse philosophers in opposition to residual positivism and to non-linguistic cognitive givens (knowledge is not built of such bricks). There is support for contextuality and semantic networks (whatever we know is relative to a particular background language and culture providing the relevant categories of human experience), and for an instrumentalistic orientation toward formalistic theories;¹ mathematical models, being abstract and divorced from the world of which they purport to speak, provide not *what* is known to be in the world but *means through which* the world becomes understandable to human knowers equipped to interact purposefully with it. With some uneasiness, there is a very general agreement that, in general, theories or semantic networks are properly used in social historical contexts to explore experiential horizons. In the experimental sciences theories are characteristically used with special instruments and technologies which provide research data that from the start are laden with scientific meanings – they are, it is said, “theory-laden”, but more about this below. There is

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a new focus on the diverse perspectives of different local scientific communities, embodied in their historical institutions and cultural artifacts. We focus on these themes in so far as they affect inquiry into scientific inquiry, but they also provide the context of inquiry into any form of inquiry.

In keeping with this transformed background, we can say with a certain presumption of broad agreement that perceptual experience is not to be taken as a curtain that cuts human inquirers off from a real world of generally imperceptible entities, but the milieu within which by interaction we come to understand the world of experience itself and the furniture it contains. There is general agreement that the entities of science are to be counted among the furniture of the world, but whether they are perceptual entities is still disputed. Also there is widespread agreement that experience is active, embodied, and engaged with public cultural realities, and that it is not passive, nor merely the private content of individual minds. Experience is ever more deeply penetrated by theoretical understanding from which people learn to adapt with growing success and flexibility to a changing environment. The experiential emphasis of all inquiry rests then on current and prospective shared knowledge of diverse perspectives through language, action, perception, and culture. This new background has changed the focus of philosophical interest in scientific inquiry away from the context of justification and prediction to the context of (let us call it) scientific culture.² This is the context of discovery, interpretation, laboratory practices, historical change, and the influence of science-based technologies on general culture.

So far, despite their different languages and origins, *pragmatism* and *hermeneutic philosophy* have each something to say that addresses these issues, each aiming in its own usage to speak “with truth” about the same contemporary lifeworld we all actively share.

3 Pragmatism

Pragmatism was a reaction on the one hand against the philosophical idealism of the Hegelians and Neokantians and on the other against the dogmatic authority of cultural, mostly religious, elites who claimed to possess privileged knowledge of the world stemming from a transcendent or supernatural source. It developed from a keen sense of and respect for the processes of human inquiry particularly those of the natural sciences and

adopted as its root metaphor science as the potent instrument of human evolutionary and cultural adaptability. However its fundamental principle was broader than just science: all processes of human inquiry occur within the domain of human experience as it struggles to cope with the world around it, and human language is designed to express this struggle. It is this dimension that makes it a philosophy.

Pragmatism proposed that all language was grounded in the adaptability of human experience to the social and worldly conditions of life. Thus, language purportedly about other-worldly agencies, immaterial forms, or religio-mythic figures was taken to be implicitly and metaphorically language about human life. The most potent tool to critique, correct, and enlarge language and to promote the goal of human adaptability by control of the environment was scientific inquiry. Science, however, was more than a method, but how much more was a matter of dispute among pragmatists. Did it confer “objectivity”³ on scientific entities or theories? Or show them to be “real” outside of the context of human history and culture? These themes will be taken up below.

Our principal concern in this paper is with the classical pragmatists: C. S. Peirce, W. James, G. H. Mead, C. I. Lewis, and J. Dewey. They reconfigured the rules and maxims of classical inquiry. In their judgment, these were aimed at providing on the one hand, as it were, permanent exhibits in a Science Museum of Knowledge, and on the other, topics of discourse for parlor intellectuals. These were not proper functions of serious inquiry. Inquiry was at the heart of everyday activity and it occurred at the level of ordinary people. Science only gave it precision.

For pragmatism, all human inquiry was tied exclusively to experience, and experience was active, never passive, and science was continually opening up new areas of experience for exploration. Philosophy of science then was centered on the activity of scientific research and science’s aim to enrich human experience with new goals worth pursuing.

Peirce pre-eminently among the classical pragmatists believed he understood the nature of scientific inquiry. Science was no disembodied study of the world, it needed environments for empirical work, such as the laboratory for interdisciplinary research in psychophysics which he set up at Johns Hopkins University which was one of the first of its kind in America. He also worked for the U.S. Coast and Geodetic Survey. This dedication to

empirical work tended to give him a laboratory frame of mind even in philosophy, replete with tests, methods and ideas.

However, he understood earlier than most of his colleagues the meaning of symbolic computational systems and their dependence in use on principles of interpretation. His familiarity with formal logic and its history grounded his logic of inquiry. The logic of inquiry comprises three modes or stages: *abduction* or the genesis of an idea, *induction* informed by specific instances, and *deduction* of logical consequences from general principles. Of these, abduction is the most interesting from the point of view of hermeneutics.

Peirce was a critical realist, contrary to Rorty's revisionistic views he did not emphasize the "glassy essence" and "the world well lost". Peirce understood that our theories are constrained by the things we encounter in the environments with which we are trying to cope, and that our ideas as a consequence are shaped by these environments, since adaptation requires us to forge a plan of action and implement strategies based on a coherent representation of these worldly environments.

With respect to perception, Peirce says that seeing is never (simply) seeing, it is always relative to a background, a "seeing as". To this, Dewey and Mead would add the sense of a rich social milieu, constituting what A. Schutz called "the lifeworld" (Schutz 1973). The pragmatists went to great lengths to distinguish their sense of experience from that of 17th and 18th century empiricism. The empiricism of Locke and Hume was passive and about the association of sensations. For James as for other pragmatists, experience was active, structured by ideas and tested by actions, and aimed functionally at broadening horizons by informing them with new ideas; experience was not just a passive reception of the world narrowly focussed, say, on sense data or other "givens".

Pragmatists took inquiry to stem from a breakdown of a form of life that had been replete with functional coherence. Frustrated with the doubt and insecurity that follows this breakdown, inquiry begins as the search to recover what was lost. For Peirce, abduction with its associated inductive and deductive activities was the generative process of new ideas that aimed to restore a secure and settled form of life and a stable pattern of action.

Inquiry has at its heart two components that are often in conflict with one another as history and practice show, these are *commitment* and *correction*. The spirit of

commitment tends narrowly to be satisfied with what has been accepted as "funded knowledge" or the permanent accomplishments of the disciplines. The spirit of correction prompts inquiry to look beyond the current state of "funded knowledge" and to cross borders among the disciplines. Both of these are also characteristics of hermeneutical inquiry.

Dewey shared the view that the origin of inquiry is in the precariousness of human existence and the countless searches to recapture life's lost equilibrium. In the pursuit of inquiry, theories were to guide actions, and feedback from actions was to correct theories. In Dewey's naturalistic evolutionary vision of life, the twin cardinal poles of human action were strife and resolution.

James' radical empiricism (James 1912/1996) is a kind of functionalism based on the search for adaptive behaviors through instrumental action, that is, on inquiry as the search to secure stability amidst ever changing circumstances (see Parrott and Schulkin 1993).

Although Dewey's categories of experience were often construed exclusively in terms of appetitive and consummatory experience as if human behavior was driven just to promote material satisfaction, esthetic experience as a way of balancing the books against too crass an interpretation of human life also constituted a serious focus of Dewey's interests (see Dewey 1958).

Besides the factors mentioned above as initiating inquiry, Peirce and other pragmatists also included *musement* or *wonder*. This is the kind of exploration of an issue essential to discerning what about it is to be understood as relevant. Musement has a certain resonance in Husserl's and Heidegger's turn towards the exploration of the "pre-predicative" state of human understanding prior to conventional categorization and predication.

A central message of classical pragmatism is that inquiry is a mode of action, of doing, in contrast with the cognitively sterile view that answers are to be researched in a museum of settled knowledge. Pursuing this metaphor, since science and philosophy are not museum pieces, they share, as it were, a common interactive space and can influence each other across disciplinary boundaries without one absorbing or being reduced to the other.

Pragmatism influenced the philosophy of science through the works of N. R. Hanson, E. Nagel, W. Sellars, W. V. O. Quine, H. Putnam, N. Goodman, I. Sheffler, among others. Hanson (1958) defended the thesis that scientific inquiry is theory-laden, replete with

theoretical meaning. Abduction for him was the process of creating a hypothesis from the fall-out of disputed hypotheses, within an investigatory form of life rooted in action guided by empirical consequences.

Sellars (1963) contributed a new and broad perspective which established the context dependence of all experience. All experience was understood as contextual either within the world's pragmatic "manifest image" which is the world as experienced perceptually (or in quasi-personal terms), or within the theoretical "scientific image", which is the world as explained in terms of "non-perceptual" – i.e., "theoretical" – scientific entities. Sellars departed from the pragmatic tradition by prioritizing the non-perceptual and mathematical-theoretical. In this respect he was more Kantian than pragmatist.

Another important contributor, Quine (1960), saw that, although the positivists' version of sense data had satisfied Mach and Carnap and the earlier generation of positivistically inclined philosophers, the positivists' view was incoherent and would not suffice for the confirmation of theory. He also came to see that science and metaphysics could not be separated as the positivists had envisioned. While the influence of pragmatism is seen in his support for historically changing scientific frameworks, Quine, like many other pragmatists, could not break the tie to a world of basic objective empirically given units of knowledge.

After Quine, some philosophers of science turned, like Quine himself, to philosophical behaviorism; others, like Chomsky and Fodor, turned to cognitivism, and the Churchlands, to eliminative materialism. Thereafter the perspective that the classical pragmatists gave to scientific inquiry became muted. It found limited expression in the discussion of (what T. S. Kuhn called) "paradigms" and in theories about the social constitution of knowledge. But the sense of rationality that mattered most to classical pragmatists, the grounding of a philosophy of human inquiry in human experience, seemed to flutter away.

One reason for this was ambiguity about the meaning and role of theory. Philosophers of science, seeing physics as the privileged exemplar of science, took theory to be a mathematical model tested against observations, while pragmatists, seeing experimental praxis as the privileged exemplar of science, took theory to be descriptive of scientific entities as these were perceived in laboratory praxis. The biological and social sciences today tend to use "theory" in the latter sense, while the

physical sciences continue to exploit the mathematical imagination in search of new theoretical models, or in their terms, simply theories. One of the problems that hermeneutical method and philosophy will address is the diversity in the meaning given to theories and the usage of the term.

4 Hermeneutical Philosophy

Although hermeneutical philosophy also comes from a scientific background, it does not come from the quantitative sciences, but rather from the side of (what the Germans call) the *Geisteswis-senschaften* and their characteristic method, hermeneutics. This is the tradition of humanistic scholarship in scriptural studies, history, art, philology and literature, and the humanistically oriented social sciences. Its characteristic method, hermeneutics, is oriented towards meaning not power, and towards the things – signs, symbols, actions – that can be construed as having meaning. These are, for example, the relics of past events, social institutions, religious myths and rituals, cosmological and natural phenomena, cultural artifacts not just in the domain of the arts, but most particularly, the spoken word and written texts. Biblical texts were among the earliest subject matter of modern hermeneutical science. All of the things just mentioned enter into public awareness endowed with some – though usually ambiguous – meaning. Many of these symbolic vehicles of meaning are clearly human artifacts, but others are natural or cosmological phenomena that seem at first sight to belong totally to a non-human realm. On deeper scrutiny, however, the meanings they carry also turn out to have a constitutive hermeneutic dimension capable of calling into question any hard and fast distinction between nature and culture.

Just as contemporary philosophy of science went through an early positivist phase that was overcome, so hermeneutical method had an early quasi-positive phase that too had to be overcome. In its early phase, hermeneutics assumed that each natural thing and event, each product of human making, each text and cultural object, had a specific original (though possibly hidden or disguised) meaning that was given to it by the cause (author, founder, ruler, creator, etc.) that brought it into being or gave it a charge. In its early phase the science of hermeneutics aimed precisely at uncovering these original meanings. Under the positivist influence, however, the meanings in question were taken to

be private mental entities, not verifiable empirical entities, and therefore not objects suitable for scientific research.

The process of hermeneutics in this early positivist phase was modelled on the metaphor of a “conduit” through which “messages” originating at a distant or currently non-existent source were passed on to a living receiver. The “conduit” could be inscriptions, architectural remains, or other artifacts, but most commonly it was a text inscribed on some durable material such as papyrus, paper, leather, or stone. As the “message” “travelled” in space and time from its sender/source to a distant human receiver/interpreter, there was a concern with the possible distortion of the “message” due to the difference between the linguistic and cultural environments of the receiver and sender. As long as the “message” to be communicated was thought to be the original meaning imposed on the inscription by the sender, the receiver/interpreter was enjoined to practice the art of re-living in imagination the cultural and historical world of the source and to re-construct the “message” out of empathy with the sender. This view of hermeneutics was to change dramatically due to the writings of W. Dilthey, E. Husserl, H-G. Gadamer, M. Heidegger, M. Merleau-Ponty, P. Ricoeur, and others.

For hermeneutical method to be recognized as a valid tool of modern scientific method universally applicable even to the natural sciences, a new understanding of the notion of meaning and hermeneutics had to take place. Some salient aspects of this new understanding are briefly summarized in the paragraphs below. We shall not defend them here since they have been defended elsewhere. But most of the extensive literature on such topics is found outside the philosophy of science corpus in what is called “continental philosophy”. Some of the positions laid out in these propositions have indeed entered analytic philosophy in its recent post-modern phase, but more as a kind of Feyerabendian *bricolage* than as a consequence of any basic revision of viewpoint.

5 Meaning

Meaning is not a private mental entity but a shared social entity embodied in language (understood always to include other language-like inscriptions, whether passive, like road signs, or active, like performances) and a cultural environment embodying community purposes.

Meanings are not fully complete unless incorporated in a linguistic utterance used to affirm or deny some content that finds itself *fulfilled in public experience*.

Perception relates to the perceptual field of the lifeworld. By “perceptual experience”, we do not mean simply sensory inputs, but the public recognition of the existence of objects in the space(s) and time(s) of the lifeworld that are understood and categorized through sensory and bodily interactions, and which are the referents of a public ostensive/descriptive language.

Fulfilled and perceptual meanings are not just private mental representations of something, a referent, but are in fact by intent identical with the referent that is presented in experience and give access to the *ontic* and *ontological*⁴ character of that referent under the aspect of what is in truth on this occasion given to understanding. They include *but are not exhausted by* whatever can be reached by a reflective and hermeneutical study of the constitution of fulfilled meanings. Husserl, for instance, typically focused on how “objects” (contents) of knowledge are “constituted” (presented to communal knowers) within “noetic” contexts of meaning (directed by a communal vector of inquiry). Heidegger referred to such objects as “ontic beings” disclosed perspectively to the “circumspective care of the human inquirer” as *Da-sein*,⁵ his term for the human being as coping with the lifeworld and immersed in the “ontological” history of Being. Merleau-Ponty studied them as the “flesh” (or embodiment) of things revealed by perception through the forms of embodied human life in the world (Merleau-Ponty 1962).

To the extent that language and other public expressive signs are the only means through which we articulate our public world and come to understand one another, the meanings that these signs convey are construals of human cultural communities and cannot be attributed to non-human sources except by metaphor. Taking meanings to be cultural does not mean that there is no truth, but that the truth possessed, even scientific truth, is always mediated by human language and culture which are a part of human history.

Knowledge is handed down by the medium of linguistic and expressive inscriptions and the cultural forms of life in which they find fulfillment. Phrases, however, that once meant one thing come to mean another with the passage of time, for language and culture change. As historians of science know, this is as true for natural science as it is for literature and politics. Of special interest then are the circumstances of

continuity and change in the historical transmission of scientific meanings via the media of language, mathematics, laboratory praxes, and the culture of the scientific community. Meanings originating at one (linguistic, historical, cultural, geographic) local site are received/interpreted/fulfilled at a distant local site as different meanings. These latter are adopted from traditions of interpretation, or constructed or re-constructed in keeping with the responsibilities, constraints, and presumptions of rational hermeneutical inquiry (see below, the *hermeneutical circle*) which require that each find fulfillment in local experience at the reception site. One of these constraints is the extent of the linguistic and cultural resources available to the distant reader. One of the presumptions is that there is no single meaning that is relevant to and fulfillable by all readers of such a text; there are many, and they depend on the linguistic and cultural resources as well as on the cultural ambience of the reader (Nickles 1995). Like a hammer or any piece of equipment, a text can be used successfully for several meaningful cultural purposes. As in the case of the hammer, for each useful purpose there are criteria as to how well it performs for this purpose in human life. The uses are not arbitrary, for nothing but nonsense would be gained by arbitrary use, but this does not imply that there is just a single correct meaningful use. Once again, as in the case of the hammer, there may be a priority of users set by a firm cultural tradition – hammers for construction workers, scientific results for scientific research communities – but no one use need go unchallenged either by logic or by experience nor should any one use become the sole property of just one interested group.

Rational hermeneutic inquiry acknowledges the existence of *traditions of interpretation* that give to today's readers and inquirers a culturally privileged version (shaped to the goals of the linguistic and cultural environment of the community with special "ownership" rights in the subject matter) of past sources. Within the sciences such traditions of interpretation are at the basis of what Kuhn called "paradigms".

In addition to meanings construed on the basis of a common tradition of interpretation (with its presumption of continuity), other meanings can be legitimate that are independent from any presumption of the existence of a continuity of meaning with the source through a common tradition of life, action, and interpretation. Such *discontinuities of meaning* within the sciences are exemplified by what Kuhn called "revolutions" in which

old "paradigms" are replaced by new ones. In the work of hermeneutics, however, a radically new meaning need not expel the old, because each, though different, may be a valid historical and cultural perspective. Indeed, despite some sense of discomfort, we often find in the sciences the old flourishing side by side with the radically new, quantum mechanics with Newtonian mechanics (though these are formally incompatible with one another), statistical thermodynamics with phenomenological thermodynamics, and so on. Each through its own empirical processes of testing and measurement is in dialogue with confirming or disconfirming data.

In summary and for the purposes of this paper, hermeneutic method is the strategy according to which a living inquirer goes about the task of finding or constructing a contemporary meaning for a non-present or, at least, non-understood source event, natural or artificial; if the source event is a human artifact, say, a text or an action, the hermeneutic process of the interpreter has to bridge the difference between the linguistic/cultural environments of the source and the interpretation. This strategy is the *hermeneutical circle*. It is also called a *method*, though results are not guaranteed; but it is an orderly process and to that extent *methodological*. Interpretative work of this kind is clearly historical, cultural, and anthropological, multidisciplinary in character and in need of a philosophical foundation which hermeneutical philosophy (to be taken up below) tries to provide. In this work lies the significance and power of hermeneutic method and hermeneutic philosophy for the history and philosophy of science. And not just for these, but also for understanding how quantitative empirical methods function in science to give meaning to empirical contents, in particular, how measurement equipment plays a double role creating both theoretical and cultural meanings, and how theory laden data depend on the successful public self presentation of the (so-called) "theoretical entity" as a public cultural entity. Such a self presentation is an essential part of laboratory measurement and is an ordinary part of the culture of scientific research. But a theoretical entity, say, a magnetic field, can also manifest its presence as a cultural object to a wider public through an essential role it happens to play in a public standard technology, say, a magnetic compass.

Hermeneutical philosophy and *pragmatism* have their root metaphors in different kinds of scholarship, the former in humanistic scholarship and the latter in the quantitative sciences. Such a difference prompts us to ask whether there is as a consequence a serious risk of systematic

misunderstanding or a significant obstacle to translation from one to the other.

As a prelude to our attempt to give an answer to this question we need to consider the nature of *philosophical inquiry*.

6 Philosophical Inquiry

Inquiry for Husserl and Heidegger – as incidentally also for Peirce and Dewey – begins when some real expectation based in experience fails and we are curious why, and look for an answer that will enable us to fulfill our failed expectation, or failing this, to go around the problem or alternatively to transform the context re-assessing if need be our goals. For Husserl, eidetic phenomenological analysis explores the invariant boundaries of an imagined experience that is subjected to imagined variations of approach. Both see inquiry as connected with a breakdown of intelligibility – for Heidegger when action fails in the world, for Husserl when the noetic structure of the imagination fails. Husserl's approach is more logical, conceptual, and abstract while Heidegger's is more existential, historical, and action oriented. It is then to Heidegger's philosophy that we will turn almost exclusively for an account of hermeneutical philosophy.

For the limited purpose of this inquiry into scientific inquiry, it is useful to enter Heidegger's philosophy through *Being and Time*, first drawing down from his analysis of equipment to lay out the methodology of the hermeneutical circle (Heidegger 1927/1996, 357–64). Here he illustrates the *genesis and process of any inquiry* by focusing on what happens when in the middle of a task, a tool, say, a hammer, breaks. A hammer, a tree, a text, an atom, all are recognized by their characteristic function in the lifeworld; each may fail on some occasion – perhaps even systematically – to fulfil its expected function, and such a failure would initiate a process of inquiry.

To start with the philosophical background: the breakdown of the task initiates inquiry by calling on the deep structure of pre-theoretical pre-categorical understanding⁶ of Being which is the life world (*Vorhabe*). The human inquirer is *Da-sein*, *Da-sein* is “existence”, the embodied understanding of Being, a “there-ness” (*Da*) in the domain of Being (*Sein*). Inquiry is awakened when *Da-sein* poses a directed question (*Vorsicht*) which, like all directed questions, already implicitly contains an outline of a search and discovery strategy that aims at finding

a solution to the problem or an answer to the query. The question so construed in this case is not yet articulated; only later will it achieve an adequate expression in apophantic discourse as (what philosophers of science call) an “explanation”. There follows an active dialogue between *Vorsicht* and *Vorhabe*, accompanied by actions seeking practical fulfillment in the awareness that the sought-for understanding (*die Sache selbst*) has presented itself and made itself manifest to the inquirer (*Vorgriff*). If on first trial the sought-for understanding is absent, something nevertheless has been learnt, and the search resumes, dipping again into the available resources of *Vorhabe*, *Vorsicht* and *Vorgriff*. This circle of inquiry, called the “hermeneutical circle” – sometimes called the “hermeneutical spiral” – is repeated until a solution presents itself within a new cultural praxis in the lifeworld. Only at that time is it in order to express the solution linguistically in statements, that is, in apophantic form.

Let us now apply the hermeneutical circle to the problem of the broken hammer. In order to finish the job on hand, we draw on our background understanding of the lifeworld (*Vorhabe*), and ask ourselves, perhaps for the first time in our lives, what kind of thing is a hammer, what specifications does it have. The question itself (*Vorsicht*) suggests strategies for searching and finding. A dialogue is initiated that has theoretical and practical dimensions. First we aim at defining the theoretical specifications of a hammer, then we look for or construct something that fulfills these specifications, and when we have it, we try it out (*Vorgriff*). Does it work? If it does the job – if our first attempt at defining the theoretical specifications is fulfilled in practical experience – we are aware of the presence of what we were looking for, something with which to finish this job. We may still need a new hammer, but for the moment the job can go on. If, however, the trial fails, a thought may intervene, “We may have to revise our goals!” But No! We revise the theoretical specifications in the light of the previous outcome (a revised *Vorsicht*) and try again, modifying the conditions of the experimental trial if necessary (a revised *Vorgriff*). This phase may be repeated several times until we have a theory and practice that works. If we experience nothing but failure, we re-assess our options (returning to the *Vorhabe* for other suggestions), e.g., getting the job done in a different way, hiring a carpenter, or turning to a different technology, or finally, we could just fold our tent for the time being.

This philosophico-methodological process of inquiry is *hermeneutical* because it is a search for a theoretical – in

fact, explanatory – meaning to be fulfilled in a new cultural praxis in the lifeworld. The process has a cyclic pattern which is repeated over and over, from the general background understanding of the lifeworld (*Vorhabe*) to proposed theory (*Vorsicht*) to trial experience (*Vorgriff*) or summarily, the circle of background, theory, and experience. This process is called the *hermeneutical circle*.⁷ The term “*hermeneutical spiral*” is sometimes used to indicate both the cycling and the progressive character of the process. Every rational inquiry then moves in a forward spiral aiming at fulfillment in a solution made present in experience as governed by a conscious if revisable goal.

7 Theoretical Understanding in a Hermeneutical Perspective

During his analysis, Heidegger (focusing his discussion initially on equipment and the like) makes a special and highly critical point about *theoretical understanding*. Since the characteristic goal of all scientific or scholarly inquiry is theoretical understanding, it is important to understand what theory does. Theory, as in the case of a hammer, a tree, a text, or an atom is always connected with something as fulfilling a social or cultural function. Theory-making arises then out of some public need and the desire to learn how to fulfill that need. He would remind us that, when presented with an individual piece of equipment, say, a hammer, we must realize on the one hand that the theory of a hammer does not assign to it an exclusive or “objective” essence, for that which can function as a hammer can function on occasion in other ways too, as a door stop, nutcracker, etc. On the other hand, old shoes and wooden mallets can also on occasion function for the hammering of nails. All individual tools or equipment are (as Heidegger says) no more than a *mere resource* unless they are in actual use or designated for use, when they are *dedicated (or designated) resources*. Equipment is a dedicated resource when it is pragmatically related to the fulfillment of its role within a cultural function-as-meant. The distinction is significant because only dedicated resources belong to the furniture of the lifeworld and so have ontic status.

These distinctions are reflected in the use of words. The sentence, “I want a hammer”, can be used in a theory-laden context where the sentence refers to the structure that makes hammering possible, or in a praxis-laden context where the sentence refers to something that is in actual use in construction or designated for

such use. Words and sentences about tools or equipment take on different meanings according to whether they are used in one or other of these contexts.

Returning to the cultural praxis-laden meaning of the hammer, what is it? It is what ties a thing – the hammer – to construction or building projects. This is different from its theory-laden meaning for this latter relates to its specifications as a tool and “explains” the thing *qua* hammer by specifying the conditions under which it can be the host of the cultural meaning of a hammer. There are then two meanings in dialogue, a *theory-laden meaning* and a *cultural praxis-laden meaning*. The *theory-laden meaning* makes sense only if the individual hammer is *praxis-laden* within the function of construction. If perchance one were to look for a theory to explain construction-praxes, one would look beyond (hammer-) theory, toward a theory at the level of architectural and engineering practices.

The same kind of analysis holds for the social sciences. There is, however, a difference in efficacy: in the natural sciences, theory or explanatory meaning generally confers predictive power and effective control over some physical aspect of the environment possessed of the cultural meaning which the theory explains; in the social sciences, theory is no less meaningful but it is less powerful since cultural aspects of the environment are less easy to manipulate.

Despite the fact then that (hammer-)theory “explains” (hammering) praxis, they belong to different perspectives and there is no one-to-one correlation between the two. The (hammer-)theory-ladenness of a thing is just a mere possibility of serving as a real hammer (it could alternatively serve as a nutcracker); the (hammering-)praxis-ladenness of the thing in the context of construction could be served by means other than the use of hammers. Let us call the theoretical principles of construction, “architecture/engineering theory”.

Then, (hammer-)theory is not an essential part of architecture/engineering theory, nor is (hammering-) praxis an essential part of construction praxis, although each may be a contingent part of the other. Theoretical inquiry into hammers and hammering, however, can inaugurate a dialogue with the higher cultural function (construction) and lead to the design of new science-based (designer) construction techniques that dispense with hammers using, say, ready-made clip-together plastic units.

When such new science-based technologies are added to the lifeworld, scientific terms can be introduced into everyday descriptive language with new

(non-theoretical) practical lifeworld meanings. A set of new lifeworld entities are thereby naturalized, the effect of which has the power to transform the old cultural environment. This happened, for example, in the *quattrocento* during the Italian Renaissance when perceptual space was subjected to universal measurement by mathematical perspective and in the process was transformed from a variable geometry space into a Euclidean space thus preparing the way for the Copernican revolution (see Heelan 1983/1988, Part I).

In any case, to be theory-laden means to “explain” – to prescribe the “infrastructural” conditions – why something *can* play a particular socio-cultural role, but it does not explain whether, or if so, why it is in fact playing that role or has been designated to play that role. “To be theory-laden” then always implies an unexpressed cultural or lifeworld hypothetical. Otherwise “to be theory-laden” implies no more than “to be a mere resource” disjoint from the lifeworld – and this no more entitles a thing to be included in the furniture of the world than every old shoe under the category of hammers.

What kind of entity then is a hammer as a dedicated resource? It is a public cultural reality, a physical reality constituted by a socio-cultural meaning (in this case, the open cultural perspective of construction and its practical underpinnings in architecture and engineering) to which the individual hammer has been dedicated by a social choice. It has a specific theory-laden meaning that conceals (renders tacit/implicit) but does not replace (say, by a reductive move) its higher socio-cultural meaning as described above. On such empirical entities (where the “natural” and the “artificial” are not distinguished) a new kind of “empiricism” can be built. Some might see in pragmatism a fulfillment of this goal – but more about this below.

Now, to the extent that nothing (or almost nothing) in our experience – a hammer, a tree, a text, or an atom – is without a cultural purpose, everything in our experience bears some resemblance, however distant, to a tool or instrument. This deep structure of pre-theoretical pre-categorical understanding belongs to the human inquirer’s (*Dasein*’s) background understanding of the lifeworld (*Vorhabe*) as described above. Everything then while actually praxis-laden in a cultural sense, is also involved in the possibility of becoming theory-laden in an explanatory sense *even prior to actual scientific inquiry, because such is the deep structure (Vorhabe) of the human inquirer.*

These conclusions have important consequences for understanding the role of *measurement equipment in the*

quantitative sciences. The data – or better, the “raw data” or “proto-data” – that are produced belong *hypothetically* to the perspective of measurement but *affirmatively* to the perspective of some public cultural reality within which the data display “in truth” not just themselves but the public cultural entity of which they are profiles. By saying that the raw or proto-data belong “hypothetically” to the measurement context, we mean that they do so only if they are recognized as meaningful in a cultural forum. This forum could be, for example, scientific research strategy and the research “narratives” that Rouse (1996, 27 and in chap. 9) speaks about. But it could also extend to technological applications, media, entertainment, or other aspects of general culture. Only in such fora are the data real – given “in truth” as *die Sache selbst*. There they can witness to the presence of individual scientific entities, say, electrons or atoms, as public cultural realities, dedicated resources, part of the furniture of the world, and incidentally perceptual objects (see Heelan 1983/1988 and 1989). As such the data and the scientific entities they exhibit are only implicitly theory-laden. They emulate the relationship between individual hammers and construction projects. If they are not recognized as dedicated resources within an appropriate cultural context, they are not data at all, but functionally meaningless marks (non-entities, junk, etc.) with all the indeterminacy of (positivism’s) *sense data*.

Heidegger embodied this conclusion in his choice of the Greek term, *aletheia* (literally “uncovering”) for truth (see Heidegger 1927/1996, 213f). It signalled a change in the notion of truth from the classical model of full transparency to the human mind, towards one of only partial, practical, or contextual transparency. Polanyi says the same in different terms: the *explicit meaning* conceals a *tacit meaning* (see Polanyi 1964, x-xi). Let us reflect on what this means historically.

People everywhere and always have lived in a socially linguistically represented action-oriented world in which what a thing is must be derived from what it comes to mean within human life. This is what Husserl, Heidegger, and Schutz called “the lifeworld” (see Husserl 1954/1970, Heidegger 1927/1996, Schutz 1973), and for which W. Sellars coined the term “manifest image of the world” (Sellars 1963, 6). Within this perspective, many things are first grasped as having fixed essences dedicated (as it were) “by nature” to a single function. Such was the opinion of Plato and Aristotle, Aquinas and Descartes, Bacon and Newton, and it is a view still held by many philosophers and scientists today. However,

with the advent of modernity, the world changed adopting as its defining characteristic an *inquiring theorizing scientific spirit*. Open season for scientific inquiry was declared on whatever is given in human experience, not just hammers, trees, texts, or atoms, but also political society, perception, food, athletics, emotions, religion, love itself, all present themselves as possible subjects for scientific studies. From each of these studies there is a latent theory to be derived that explains something in its individual socio-cultural meaning *all things being equal* by a set of explanatory theoretical parameters. As in the case of the hammer, these explanatory parameters address just one aspect of the thing in question, the *explanandum* or cultural meaning to be explained, forgetful of the other aspects the thing may have. But in so doing the theorizing process reveals the extent to which the *explanandum* can be taken over and assumed by other things or artifacts than the exemplars studied. Theory shows that what makes this or any individual hammer to be a hammer – or what makes this or any individual thing in human experience to be what it is perceived to be – is *not a defining essence but a movable contextual set of properties that can be found or engineered in many different ways in many different physical hosts*. To the extent then that explanatory theorizing scientific inquiry is successful, it turns the objects of its inquiry whether natural or cultural – into mere replaceable resources to serve a variety of cultural lifeworld functions.

Everything that has been said about theory stands whether theory is interpreted 1. as a mathematical model connected technically with laboratory practice (the way most physicists look on theory) or 2. as a defining set of normative scientific concepts exemplified culturally in experimental practice (the way biologists and sociologists use theory). Heidegger also intended his critique of theory to apply 3. to the predication of all abstract, universal, quantitative and non-quantitative concepts to the perceptual domain, therefore also (among others) to the domains of natural and social sciences; they too constitute a theory about what is perceived, for they simplify experience by focusing just on one “as-such” aspect; they are then also subject to the conclusions stated above.

Whether then one interprets *theory* according to 1. or 2. above, one is faced with a duality of (explanatory) theory-laden and (cultural) praxis-laden contexts at the heart of all scientific culture. Moreover, this is also true for 3. Theory-laden and praxis-laden contexts are relatively independent of one another. They generate

two loosely coordinated perspectival languages that are not isomorphic to one another but have only many-to-one and one-to-many correspondences; these are partially ordered by statement inclusion within a complemented non-distributive lattice (or *context logic*).

Human beings receive great benefits from scientific theories, not just in such tradition-bound domains as agriculture, health care, and the organization of work, but in every domain, for there is no domain that cannot be transformed by the products of science, from air travel to childbirth, from how we perceive to how we control our emotions. But there is a price to be paid for such changes. They affect the way cultural life teaches people to be human and communicates to them the sense of the wholeness, integrity, and goodness of the world, the self, and human communities. Changing the traditional vehicles by means of which these core meanings are maintained and handed on inevitably changes how people regard themselves, their neighbors, and the world around, with consequent risks of cultural instability in all three areas. Whether and with what consequences science is changing our culture is the domain of sociology, politics, and cultural anthropology (see Geertz 1973; and 1983). For such reasons hermeneutical philosophy must also become a salient feature of the philosophy of science, even of the natural sciences.

8 Hermeneutic Philosophy and Classical Pragmatism; Common Themes

How close is the hermeneutical philosophy of science outlined above to a pragmatism that draws its inspiration from the works of Peirce, Dewey, James, C. I. Lewis, and Mead? Pragmatism, like hermeneutic philosophy, turns to the lived world of inquiry but, unlike the latter with its root metaphor in the humanities, it derives its inspiration from the quantitative sciences. We have two idioms and two perspectives, a pragmatist one and a hermeneutic one. How much is *intertranslatable without residue*?⁸ We shall next try to express the common themes, and put down separately what resists translation without residue because peculiar to just one of the perspectives.

We listed at the start of this paper common ground elements which, though coming from diverse sources and often understood in different ways, have nevertheless acquired widespread support within the larger

philosophy of science community. One would expect to find then that pragmatism and hermeneutical philosophy have some measure of intertranslatability.

Pragmatists emphasize the process of inquiry and experience, as does the hermeneutical tradition. Both are rooted in a critique of scientific culture and the scientism of its current philosophy; the pragmatists focus on the quantitative and model-building sciences, the hermeneutical philosophers the cultural meaning-oriented sciences. Both are self-reflective. While one emphasizes meaning and the other action, these turn out to be in great part mirror reflections of each other. Both traditions acknowledge that inquiry is initiated by the breakdown of habits and beliefs that normally serve as guides to thinking, and is directed toward the search for new hypotheses that cross old disciplinary boundaries and the construction of ways to test these in human experience. Each emphasizes the expanded role of perception replete with cultural meaning which for Peirce and Dewey is a part of habitual knowledge. For Heidegger, there is the additional problem (to be taken up below), the inauthenticity of habitual knowledge.

In particular, all three see themselves as grounded in a lifeworld that is historical, concern-filled, social, and technological of which we have an embodied understanding. Both see the interpretation of experience as evolving through actions that are understandable and are themselves interpretations – hermeneutic philosophy calls them “existential interpretations” of experience; they have an affinity with artistic “performances”, a concern of pragmatism. Both see science as the creation not just of theoretical meanings but more significantly of cultural meanings. While agreeing about the instrumental character of scientific theory, both pragmatism and hermeneutic philosophy naturalize such objects in the lifeworld regarding them therefore as perceptual objects though they may offer different justifications for this move (see Bourgeois 1996). There is then much in common between pragmatism and hermeneutic philosophy that is roughly intertranslatable.

9 Themes Peculiar to Pragmatism

Classical pragmatists, rooted in a sense of nature, and very much taken by the power of evolutionary biology, construed human problem solving on a continuum with animal problem solving. All knowledge is greatly oriented to ways of adapting to dilemmas whether local or global, animals adapting almost exclusively to local

problems, and humans to a confluence of both local and global problems. The root metaphor of past evolutionary continuity of humans with animals is a powerful influence on pragmatists whatever they are discussing, whether it is the philosophy of science or esthetics. Classical pragmatists then place the roots of problem solving in animal life where the body is the medium in which the world is received and represented. This body is not passive but replete with perceptual and cognitive strategies, and the horizons of both human and animal understanding are expanded through bodily action in the world. Minds and bodies are not separated substances, and the continuum of problem solving abilities is not broken at the juncture between animals and humans.

Classical pragmatists adopted (what they took to be) the epistemology of the natural sciences; in this sense, they were naturalized epistemologists, but they were not overtly reductionistic as later variants of this position became. Their approach to the evolution of problem-solving was creative. After all, their philosophy of science was rooted in the capacities of human perception to affirm even what positivists called “theoretical entities” as things in the lifeworld.

They erred, in the case of James, in rendering truth cheap; in the case of Dewey in favoring technological domination; and for Peirce, in a representational theory which legislated that truth will be determined by whatever science says in the long run, an unhelpful and sometimes misleading view. However, the saving grace of classical pragmatism is its wide notion of inquiry, and the prominent role given to perception in knowledge acquisition.

10 Themes Peculiar to Hermeneutic Philosophy

Hermeneutic philosophy seeks a level of understanding beyond pragmatism which is rather the condition of possibility of the pragmatist’s world in which theory and practice merge in action. This is (what Heidegger called) the *ontological* dimension, an understanding at the level of the human inquirer’s pre-predicative and pre-categorized⁹ active involvement with the lifeworld. The human inquirer, *Da-sein*, unlike the pragmatist’s more commonsensical inquirer, is the human individual thrown into the world at a certain time and place, conscious of having a temporal destiny, and sharing the historicity of the human community’s involvement with

its most fundamental concern, Being; Da-sein's existence is understanding historical Being.

Although Heidegger sees theoretical or "calculative" thinking as necessary, he sees it as ever in danger of dissolving the dialectical distinction between cultural goals and their theoretical explanation, substituting the latter for the former. Such for him is the danger of inauthenticity with the reduction of (what he calls) "meditative" thinking to "calculative" thinking. The core stratum of meditative thinking, the deepest subject of human inquiry, Heidegger finds, neither in theory, nor indeed in practice, but in ontological Being. At this level, there are no articulated theories – neither quantitative, nor descriptive of scientific cultural entities, nor theories providing abstract categories of the perceptual world. But there, at their source in *Da-sein*, led by cultural as well as explanatory desires for the human good, is the upward movement toward the articulation of human understanding. This upward movement is met by a downward movement that seeks fulfilment in the self-manifestation of "*die Sache selbst*" thus closing the hermeneutical circle. Ontological Being then justifies the search for – as well as the subsequent discovery of – entities that (in the hermeneutical sense) are both theory – and praxis-laden. The art of such discovery is learned in daily life (say, from broken hammers), and it is brought to a fine art within the sciences where it can be learned only from apprenticeship to an expert community of research scientists. *Such a conclusion offers to provide an epistemic hermeneutical justification of pragmatism's – and science's – abductive methods.*

Hermeneutic philosophy's approach to scientific inquiry is also subtly different from pragmatism's in another respect, because its thinking is shaped predominantly by a different *strenge Wissenschaft*, one guided by literary, moral, social, political, historical, and religious interests. All *wissenschaftliche* inquiry takes place within the lifeworld and is characterized by a *theoretical* thrust that necessarily results in a distinction between the theory-laden mere resource of the explanatory or abstract dimension, and the praxis-laden dedicated resource of the public cultural domain. In humanistic scholarship explicit categories often introduce no more than play items making suggestions to the imagination without going so far as to cause them to be revealed in the present and actual lifeworld. Scientific research can benefit both from the imagination of the humanistic disciplines and the extraordinary potential for changing the lifeworld that the scientific disciplines possess. What may begin as a work of literary imagination – say, to discover black holes in our

back yard or intelligent creatures in the galaxy – can become a scientific program and, if successful, it could change forever, not just human imagination, but the human lifeworld into which future generations will be born.

Hermeneutical activity, then, in contrast with pragmatism's more earthy abductive methods, is fundamentally metaphorical, multi-valued, and flexible until definite orientations are chosen for assertive expression with a consequent specification of meaning. Where an inquiry seeks new categories for the subject matter at hand, metaphors are first borrowed from areas better understood, to serve the inquiring imagination (as *Vorsicht*) in the hermeneutical circle of discovery. The history of science is full of such examples, from billiard balls, elastic bands, ethers, mechanical devices, and molecular bench models, to computer simulations, harmonic oscillators, and ten-dimensional spaces. Nor is it possible to come to understand modern physics or biology without passing through stages of metaphor. In the context of discovery, an initial multiplicity of metaphorical meanings is sifted by a cyclical interplay among the trio of background, theory, and experience that is called the "hermeneutical circle". In this process a proto-theory (or bunch of proto-theories) are fashioned and refashioned into something usable as a potential finite-dimensional model that eventually comes to express a certain way of meaningfully grasping experience within the cultural context of the particular inquiry. The outcome then usually gets handed on as the literal meaning of the discovery.

Since it is the case that scientists value literal expression over the metaphorical and make the (disputed) claim that theoretical language is normatively literal, the question arises: how do metaphorical expressions become literal? They take on literal meanings when authoritative conventions are made by those who can effectively establish "ownership" of a domain of knowledge, "ownership" in this case normatively implying acknowledged expertise. Metaphor becomes literal expression then only when there exists an authoritative community of experts (see Dear 1995, 23).

There is, however, always a suspicion of inauthenticity in literal usage, since literal use is always defined by a community whose credentials for expertise and legitimacy can – and sometimes should – be scrutinized. Moreover, uniformity of meaning tends to go hand in hand with forgetfulness of the diversity of meaning resources implicit in their hermeneutical origin and pragmatic use. Again, theoretical models are precise while life-world situations are always imprecise, and so theories always function in a cultural milieu that,

being praxis-laden, does not need or support unlimited univocity or precision.

There is another aspect of hermeneutical thought of which pragmatists on the whole have little cognizance; this is the hermeneutic concern with “facticity”. This refers to the hermeneutical fact that each individual human inquirer enters into life at a definite place and time as a member of a definite network of communities and cultures and pursues thereafter a unique life trajectory until death. It is within this limiting framework that the individual human inquirer, whether philosopher or scientist, comes to experience the circumspensive (concern-filled) onticity of the temporal life-world.¹⁰ The temporality of human existence puts limits to among others the achievement of authenticity. While scientists and philosophers were very much aware of the insecurity of habitual human knowledge seeking stability amid insecurity, Heidegger saw a danger in the search for security as indicative of a desire for a kind of existence that is contradicted by every individual’s life-towards-death. If the human inquirer, for instance, has a tendency to objectify whatever is expressed by nouns in human language, such as ideas, theories, things, and functions, as if these existed independently of human culture, only rarely do human inquirers have the opportunity to delve deeply into the originary roots and metaphors in the imagination that feed the meanings of these words.

A similar temporal tendency towards inauthenticity affects community cultural paradigms and institutions leading to forgetfulness of their historical origins in a common metaphor-filled life. So old forms of life are fated to be dropped and ever to be replaced by new ones. This too is the story of science whether one organizes the story according to “paradigms” and their overthrow by “revolutions” or in some other way. “Scientific revolutions”, whether Kuhnian or not, share this revolutionary character with all institutionalized forms of knowledge. Within the hermeneutical context, this means that there is no guarantee of historical convergence toward a final scientific account or any other account.

11 Implications for the Philosophy of Science

Pragmatism and hermeneutic philosophy both treat science (or in general, all scholarship) as a *form of human culture* which approaches the world in the spirit of active

inquiry in which background, theory, and praxis work together in orderly succession. Pragmatism tends to see them as working together seamlessly in solving problems and helping humans to adapt to changing ontic environments. Hermeneutic philosophy pries them apart to study the contribution each makes to the generation of meaning; among them the lifeworld has priority as ontological background, because *there* is to be found living human understanding, and from it springs the intellectual desires and frustrations that stimulate inquiry and serve human life. Established cultural praxes have a certain priority because theoretical inquiry is instigated in order to improve, re-establish, or adapt these practices to human needs; they thus furnish *explananda*. The search for the *explanans* is then the search for the relevant model or theoretical infrastructure of an existing cultural praxis and it proceeds by the process of the hermeneutical circle (ontological background, to theory, to trial, and back). When a solution is found, a new cultural context is inaugurated in which, all things being equal, the *explanandum* becomes subject to manipulation through its model-theoretical infrastructure. The historical character of the relationship between *explanandum* and *explanans* gives point to Hume’s concern that the occult powers that cause the observed regularity in nature may not be reliable in the long run (see Dear 1995, 18).

In science, the *explanans* is apt to contain new entities, “theoretical entities”. These are revealed in experimental practice as parts of the explanatory infrastructure, the *explanans*, of the *explanandum*. Exploration of the *explanans* constitutes a new scientific research program to which these entities belong essentially. Turning to the laboratory, the reference of the *explanans* is in the first place to the measurement setup, its design and engineering; it is to this environment that the new “theoretical entities” primarily and essentially belong: they belong only contingently, if at all, to the constitution of the *explanandum* (see above).

Both pragmatism and hermeneutic philosophy have a stake in answering the question: What is theory and what is its role in culture? But the tension to clarify the role of theory is strong in hermeneutical philosophy and weak in pragmatism. The hermeneutical answer to this question should dispel the view widespread even among some pragmatists that the old cultural account is capable of being replaced by a single new scientific-cultural account, this last as we have shown is beset by logical problems which will be mentioned all too briefly below.

Since all scientific and scholarly inquiry embarks on a project whose goal is to construct an explanatory theory

about a starting point that is anchored in the cultural life of people, the discovery process is always constrained by the condition that a meaningful coordinated relationship to public culture of common as well as scientific experience be maintained throughout the inquiry. Common sense then always retains a certain authority. For this reason, the social study of science and its cultural anthropology are of keen interest both to pragmatism and to a hermeneutical philosophy of science. From the perspective of hermeneutical philosophy, these studies need to be guided – as indeed all inquiry should be guided – by the hermeneutical circle of ontological background, theory, and practice discussed in this paper. The pragmatist circle in which cultural background, theory, and praxis are seamlessly joined fails to address some deeper interpretative issues.

Since hermeneutic philosophy sees the effects of technologies on the historicity of scientific culture and the lifeworld, an important task of hermeneutic philosophy is to inquire into the coherence implicit within the multiplicity of cultural and theoretical perspectives that arise in sociohistorical and technological contexts. Has it a logical structure? Is it, say, the logical structure of context-logic?

While we do not ask of a philosophy that it contribute to the successful practice of science, science continually throws up metaphysical questions that divide the scientific community and constrain or limit its energies in a world of temporal inquirers, historical institutions, and finite resources. Increased clarity about the mission and process of scientific inquiry can be helpful without intruding on the actual practice of science.

For example, the philosophical principles laid out in this paper could conceivably throw new light on some special issues that arguably need the dialectical character of theory and cultural praxis for a solution. Among them, for instance, are conceptions of the universalizing theoretical role of individual experiments (see Dear 1995, 21–25), and of *measurement* as the locus of the interface between scientific theory making and its practical cultural object. Other deeply philosophical problems in natural science relate to Wigner’s problem of the “unreasonable effectiveness” of mathematics, the Bohr-Heisenberg problem of the distinction between large and small, the praxis-laden meaning of theoretical non-commutability in quantum physics, a theory/praxis approach to the quantum paradoxes of space and time and to the possibility of a unified quantum relativity, and the praxis-laden stratification of natural science under broken theoretical symmetries. In the social, psychological, and neural sciences, confusion between the theoretical and the cultural abounds, in great part because

these sciences have not yet a way of coping with the contextual dependency that empirical data in these fields have on conscious or unconscious cultural influences.

Hermeneutical philosophy and pragmatism both support the principle that scientific entities, even those not perceptible to the unaided senses, function (with the help of science-based technologies) as naturalized citizens of the lifeworld. In both philosophies, such entities arguably become public cultural entities by their ability to carry and fulfill perceptual meanings within the lifeworld. In this case scientific entities become a common possession of society integrating science with the life-world, a highly desirable situation for a democratic society.

Within a political society such as ours that is so deeply aware of the enormous needs for and benefits from theoretical knowledge, but that nevertheless has its own independent set of practical goals, it is highly desirable for scientific institutions to be able to give a better account of their public role as the principal producer of theoretical knowledge. It may be a mistake to suppose that the current questioning of the agenda of scientific culture by public agencies and media indicates a “flight from rationality” or a lapse of public confidence in scientific knowledge, rather than a general failure of public institutions including scientific ones to present a believable culturally attuned and historical account of science.

Returning to where we began in this paper. The import of historical, social, and political studies of the practice of science first got serious public attention through the work of the late Thomas S. Kuhn, who gave *paradigms* and *scientific revolutions* their names. He failed, however, as most others have failed too, to give a good philosophical account of historical theory change and the cultural construction of scientific entities (see Hoyningen-Huene 1993, Dear 1995, Shapin 1996). Hermeneutical philosophy and a hermeneutically sensitive pragmatism could fare better. What is needed in addition is a philosophy of scientific discovery and change to help bring the history and philosophy of science together with the social and cultural studies of science. Such an accomplishment would provide elements for a better scholarly and public appreciation of what is certainly one of the greatest institutions of our society.

A final word and conclusion: the principles laid out above stress the fact that so-called “theoretical entities” are naturalizable in the lifeworld through science-based technologies and thereby become public cultural and perceptual entities. These principles which span both pragmatism and hermeneutical philosophy can found a *new empiricism* and restore kinship with the scientific revolution that began, not with Descartes or Boyle, but with the empiricism of Galileo.

Notes

- 1 For the purposes of this paper unless otherwise indicated by the context, we take “theories” and “categories” to be reflectively defined abstract objects such as scholarship and science provide; they may be mathematically defined objects or kinds of perceptual objects.
- 2 In this essay, we follow Pickering (1995) in taking *scientific culture* to cover not just a field of knowledge – “scientific facts and theories” – but in addition “to denote the ‘made things’ of science, in which [we] include skills and social relations, machines and instruments ...” (p. 3). We interpret this to include the external relations of the active scientific community to other communities, for instance, in terms of technological use and cultural transformations.
- 3 By “objective” knowledge – the quotes are just to draw attention to the need for clarification – we mean, knowledge that purports to represent reality according to a correspondence theory of truth, that is, as it is independently of and undeformed by cultural biases.
- 4 The terms “ontic” and “ontological” are used in Heidegger’s sense; “ontic” applying to things distinctly categorized in the lifeworld, “ontological” signifying the background of Being in which *Da-sein* lives antecedently to all descriptive categories.
- 5 By *Da-sein* is meant the human inquirer, individual, historical, thrown into the world at a certain time and place, and yet *Da-sein* shares in the destiny of the human community’s involvement with Being. Heidegger speaks of *Da-sein* as to-understand-Being, to-be-there-amid-Being, to-have-been-thrown-into-Being, etc.
- 6 Readers may find some difficulty with the meaning of this language. It attempts to direct thinking to the conditions of possibility of every articulation of human experience in the lived understanding of the lifeworld, antecedent (in principle) to the formation of perceptual kinds (of things, events, etc.) and their representations in language or language-like signs. I have translated *Vorhabe* as *lifeworld background*, *Vorsicht* as *proposed theory*, and *Vorgriff* as *looked for fulfillment in experience or experiment*. To anticipate what comes later in this essay: the pre-theoretical pre-predicative understanding of the world is taken as the condition of possibility of what in Dewey’s thought is understood as the intelligent habits presupposed by our everyday behavior; this is the pragmatist’s world.
- 7 Some readers are confused by the word “circle” taking it to mean “return to the same starting point”, but that is not what is meant here. The “circle” of hermeneutics indicates the repetition of a methodological cycle, not a return to the same contents but to progressively transformed contents.
- 8 By “[inter]translatable without residue” is meant: there is nothing lost or gained in the translation and as a consequence there is a minimum risk of misinterpretation when a translation is made.
- 9 By “pre-categorized” is meant: when language is used ostensibly, that is, before descriptive terms are reflexively given abstract definitions. By “pre-predicative” is meant: before such terms are used to make assertions (by predicating them of presentations in human experience). The degree of specificity of categorial definitions will vary with subject matter, but in each case it will be an abstract content and theory-like.
- 10 *Facticity* is partially reflected in pragmatism’s concern for the unresolved conflicts of the human condition, but this is not a fundamental theme that deeply colors the characteristic optimism of classical pragmatism.

References

- Babich, B. E.: 1994b, “Philosophies of Science: Mach, Duhem, Bachelard”, in Richard Kearney (ed.), *Twentieth Century Continental Philosophy*, Routledge Encyclopedia of Twentieth Century Philosophy, Volume VIII, Routledge, New York, pp. 175–221.
- Bourgeois, P.: 1996, “Merleau-Ponty, Scientific Method, and Pragmatism”, *Journal of Speculative Philosophy* 10, 120–127.
- Dear, P.: 1995, *Discipline and Experience: The Mathematical Way in the Scientific Revolution*, University of Chicago Press, Chicago.
- Dewey, J.: 1958, *Art as Experience*, Putnam, New York.
- Geertz, C.: 1973, *The Interpretation of Culture*, Basic Books, New York.
- Geertz, C.: 1983, *Local Knowledge*, Basic Books, New York.
- Hanson, N. R.: 1958, *Patterns of Discovery*, Cambridge University Press, Cambridge.
- Heelan, P. A.: 1989, “After Experiment: Research and Reality”, *Amer. Phil Qrtly* 26, 297–308.
- Heelan, P. A.: 1983/1988, *Space-Perception and the Philosophy of Science*, University of California Press, Berkeley and Los Angeles.
- Heidegger, M.: 1927/1996, *Being and Time*, trans., by Joan Stambaugh, Albany NY, SUNY Press. Page references in the text and notes are to the German 1927 edition and are given in the margins of this and the Macquarrie/Robinson translation.
- Hoyningen-Huene, P.: 1993, *Reconstructing Scientific Revolutions: Thomas S. Kuhn’s Philosophy of Science*, University of Chicago Press, Chicago.
- Husserl, E.: 1954/1970, *Crisis of European Sciences and Transcendental Phenomenology*, Northwestern University Press, Evanston.

- James, W.: 1912/1996, *Essays in Radical Empiricism*, University of Nebraska Press, Lincoln and London.
- Merleau-Ponty, M.: 1962, *The Phenomenology of Perception*, trans. by Colin Smith, Routledge and Kegan Paul, London.
- Nickles, T.: 1995, "Philosophy of Science and History of Science", *Osiris* **10**, 139–163.
- Parrott, W. J. and Schulkin, J.: 1993, "Neuropsychology and the Cognitive Nature of the Emotions", *Cognition and Emotion* **7**, 43–59.
- Pickering, A.: 1995, *The Mangle of Practice: Time, Agency and Science*, Chicago University Press, Chicago.
- Polanyi, M.: 1964, *Personal Knowledge*, Harper and Row, New York.
- Quine, W.: 1960, *Word and Object*. MIT Press, Cambridge MA.
- Rouse, J.: 1996, *Engaging Science*, Cornell University Press, Ithaca and London.
- Schutz, A.: 1973, *The Problem of Social Reality*, Vol. 1 of *Collected Papers*, Martinus Nijhoff, The Hague.
- Sellars, W.: 1963, *Science, Perception, and Reality*, Routledge, London.
- Shapin, S.: 1996, *The Scientific Revolution*, University of Chicago Press, Chicago.

What are Cultural Studies of Science?

Joseph Rouse

The social constructivist tradition has dramatically transformed interdisciplinary studies of the sciences over the past two decades. The postpositivist interdisciplinary formulation of “history and philosophy of science” has been fundamentally challenged by the sociological perspectives offered by the Edinburgh Strong Programme, the Bath constructivist-relativist approach, applications of discourse analysis to science, and ethnographic laboratory studies. Many features of scientific work which have been highlighted by these sociological traditions have become indispensable considerations for subsequent interpretations of scientific work. Social constructivist studies have brought renewed attention to the epistemic importance of laboratory practices and equipment, to the omnipresence of conflict and negotiation in shaping the outcome of scientific work, to the formation and dissolution of disciplinary boundaries, and to the permeability in practice of any demarcation of what is “internal” to scientific work. Constructivist studies have also effectively highlighted the sheer difficulty of scientific work: getting equipment and experiments to work reliably, replicating their results, and achieving recognition of their success and significance.

Despite the significance of social constructivism, however, much subsequent work in science studies does not easily fit within the legitimation project that encompasses the disagreements between social constructivists and the proponents of internalist history and philosophy of science. Among the central issues between social

constructivists and internalists were the relative importance of social and rational (or external and internal) “factors” in explaining the content of scientific knowledge, the relations between empirical descriptions and epistemic evaluations of the methods and achievements of scientific research, and the coherence of either realist or relativist/constructivist accounts of how scientific knowledge is related to the world. Work in a variety of science studies disciplines has increasingly challenged the very terms of these debates. Concerns have been raised about the goal of explaining scientific knowledge, the presumed explanandum of the “content” of knowledge, the supposed opposition between descriptive and normative approaches, and the intelligibility of the question that realist or constructivist interpretations of knowledge are supposed to answer.

I shall articulate and illustrate some important issues that mark the movement beyond the terms of the disputes between internalists and social constructivists. I introduce the phrase “cultural studies of science” to refer to this quite heterogeneous body of scholarship in history, philosophy, sociology, anthropology, feminist theory, and literary criticism. In using such a phrase, we must keep in mind that it cuts across some very important theoretical, methodological, and political differences and that some significant scholarly work takes place across the very boundaries I articulate between cultural studies and the social constructivist tradition. My aim is not to reify cultural studies but to highlight some

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important issues that might reshape the terms of interdisciplinary science studies.

So what are *cultural studies of science*? I use the term broadly to include various investigations of the practices through which scientific understanding is articulated and maintained in specific cultural contexts and translated and extended into new contexts. ‘*Culture*’ is deliberately chosen both for its heterogeneity (it can include “material culture” as well as social practices, linguistic traditions, or the constitution of identities, communities, and solidarities) and for its connotations of structures or fields of meaning. Several historical vignettes may help situate the differences between cultural studies as I conceive them and the sociological and philosophical traditions to which they are responding. I should emphasize that these sketches constitute only some possibly revealing fragments of a history of cultural studies. In this context, I shall then discuss more systematically what I take to be the most important theoretical issues that demarcate cultural studies of science as a significant and distinctive field of inquiry.

My first historical note fittingly recognizes the indebtedness of cultural studies of science to the social constructivist tradition. Cultural studies follow the lead of the Strong Programme and its sociological successors in refusing to require distinctive methods or categories to understand scientific knowledge as opposed to other cultural formations. Karl Mannheim’s earlier sociology of knowledge notoriously exempted the natural sciences and mathematics from its purview.¹ Similarly, the Mertonian tradition, which still largely dominates American sociology of science, did address the natural sciences but insisted that its investigation of scientific institutions and norms largely took for granted the content of successful scientific work.² Mertonians have been concerned over how that work could be embodied institutionally and culturally and how deviations from its established norms and methods might be appropriately explained. Much of philosophy of science (and some historical work) have likewise been constituted by distinctions between (on one hand) the imagination, reasoning, and evidence “internal” to the establishment of scientific knowledge and (on the other hand) the biographical and social factors that at least ideally might be excluded from epistemological reflection. Cultural studies may nevertheless go further than some social constructivists in refusing to make knowledge, or the “content” of knowledge, an important *focus* of their inquiries: a deflationary approach to knowledge thereby

departs from any attempt to characterize knowledge more generally in terms of consensus, representation, or rule-governed forms of life.

By contrast, cultural studies of science take as their object of investigation the traffic between scientific inquiry and those cultural practices and formations that philosophers of science have often regarded as “external” to knowledge. The sciences are taken to be cultural formations that must be understood through a detailed examination of the resources on which their articulation draws, the situations to which they respond, and the ways they transform those situations and have an impact on others. As I shall argue, cultural studies do not try to replace internalist accounts of knowledge by relying on a privileged alternative explanatory framework (for example, social factors), but neither do they grant epistemic autonomy to what is currently accepted as scientific work.

A second, more historically specific vignette may help locate some interesting differences between social constructivism and cultural studies of science. The culture and politics of scientific knowledge became a focal point of state politics in the United States and Great Britain during and after the Second World War, as the state became more actively involved in the support and direction of scientific research. The issue broadly concerned how best to organize, support, and direct scientific inquiry in a democratic political culture. In Great Britain, crystallographer J. D. Bernal argued for the deliberate political management of science for socially beneficial ends.³ Bernal was a committed socialist who argued that a capitalist society was incapable of developing or utilizing scientific knowledge effectively or humanely. He emphasized that scientific inquiry was a social product of human labor, which required considerable resources, and that it promised great benefits but could also create new resources for oppression. What was needed was a social transformation in which a humane science could flourish, one that he also saw the aims of science itself call for implicitly: “Science implies a unified and coordinated and, above all, conscious control of the whole of social life.”⁴

“Bernalism” was prominently opposed by the physical chemist Michael Polanyi.⁵ Polanyi’s epistemology emphasized the importance of practical skills and non-verbal communication in what he called the “personal knowledge” that shapes scientific work. But his position had important and conservative political consequences. Science could not be deliberately directed to social ends

without undermining its epistemic success; furthermore, because the basis of scientific knowledge was inarticulable, no one could understand how best to advance science who was not a practicing scientist. Polanyi saw no alternative to unrestrained freedom of scientific inquiry, and administrative control of scientific resources by a scientific elite.

The social constructivist tradition has taken an ambivalent stance toward the Bernal/Polanyi debate. Constructivists have adopted a Bernalist interpretive stance toward scientific activity, emphasizing that research is a process of social production and certification which must be understood in terms of social categories. The descriptions of scientific activity which they have developed, however, are deeply indebted to Polanyi, Polanyi's account of scientific knowledge as locally situated, tacit know-how directly influenced both relativist and ethnographic studies of scientific laboratories (for example, those by Harry Collins, Trevor Pinch, Bruno Latour and Steve Woolgar, Karin Knorr-Cetina) which have been an important component of the constructivist tradition. Furthermore, despite their occasional rhetoric of antisocialism, the constructivist tradition has predominantly shared Polanyi's antinormative stance, which forecloses the possibility of criticizing scientific practices and beliefs.⁶ Constructivists initially seem to preclude criticism of scientific practices on different grounds than did Polanyi; they espouse a far-reaching epistemic relativism instead of an elitist defense of the unquestionable authority of scientific communities. Yet, in practice, these two positions converge in their defense of community authority. Thus, constructivists Collins and Steven Yearley offer this Polanyiesque objection to Michel Callon's account of the fate of a French research project on scallop cultivation: "There is only one way we know of measuring the complicity of scallops, and that is by appropriate scientific research. If we are really to enter scallop behavior into our explanatory equations, then Callon must demonstrate his scientific credentials."⁷

Where social constructivists therefore find themselves drawn to both sides of the Polanyi/Bernal debate, proponents of cultural studies will typically be attracted to neither. The poststructuralist theoretical influence on much of cultural studies of science is not congenial to the Marxist humanism that animated Bernal: Bernal's presumption of a common human interest and a shared project of liberation through the social appropriation of production is at odds with the sensitivity of

cultural studies to differences and contested meanings and identities. Yet Polanyi's vision of a self-managing scientific elite is still less attractive. Instead of sanctioning or relativizing scientific communities, cultural studies contest their boundaries and the authority established by marking and policing those boundaries.⁸ A very different politics of knowledge must follow from this stance, neither Polanyi's scientific oligarchy nor constructivists' pluralism of epistemic communities.

Such an epistemic politics cannot allow the scientific community to speak authoritatively in a unified voice; nor can it colonize science in the name of a privileged vocabulary imposed on science from a standpoint of epistemic sovereignty.⁹ My final historical vignette thus appropriately emphasizes the indebtedness of cultural studies of science to the last half-century of political criticism of science from within the scientific community. Contemporary cultural studies of science owe much to the political ambivalence among physicists which led to the *Bulletin of the Atomic Scientists* as well as to the more widespread scientific opposition to militarized scientific research (especially during the Vietnam War); the formation of groups such as Science for the People and the Radical Science Journal Collective; the rise of a scientific environmentalism that included opposition to corporate and government domination of research on pesticides, low-level radiation, and so forth; up through the controversies over recombinant DNA research and then the Human Genome Project. The first wave of research on issues of science and gender, which emphasized the criticism of ideological treatments of gender in biology and psychology, was also largely the work of scientists, and their work was probably a precondition for the more far-reaching discussion of science and gender in cultural studies.¹⁰ Cultural studies of science belong not only to the history of the academy and its disciplined historical, philosophical, and sociological interpretations of science but also to the historical studies of science, the culture of science itself, and political struggles over scientific knowledge.

In situating cultural studies of science in these ways, I have tried to emphasize their continuity with important aspects of the twentieth-century culture of science. But now the time has come to say something about their own distinctive contributions to understanding science. Of course, given that cultural studies of scientific knowledge are both diverse and contested, I find something artificial about attributing to them a common picture of scientific work. Yet there are significant common

themes, however diversely developed, that mark important contrasts to other ways of understanding the sciences. I shall mention six such themes: antiessentialism about science, a non-explanatory engagement with scientific practices, an emphasis on the locality and materiality of scientific practices and even more so on their cultural openness, subversion of rather than opposition to scientific realism or conceptions of science as “value-neutral,” and a commitment to epistemic and political criticism from within the culture of science.

Cultural studies of science reject the existence of an essence of science or a single essential aim to which all genuinely scientific work must aspire. In Richard Rorty’s succinct formulation, “Natural science [is not] a natural kind.”¹¹ The practices of scientific investigation, its products, and its norms are historically variant. They also vary considerably both across and within scientific disciplines. High-energy physics, low temperature physics, radio astronomy, synecology, molecular biology, taxonomy, paleontology, and meteorology are in many respects quite different epistemic practices, and this list does not encompass even more directly “applied” scientific fields. Scientific work is also culturally variant even within the same field; there are often, for example, important national differences in the style, direction, standards, and goals of scientific work.¹² This does not at all mean that different scientific cultures are self-enclosed or mutually uncomprehending or that individual scientists or groups cannot navigate their borders quite effectively. Nor does it mean that the epistemically interesting differences in scientific cultures neatly map onto national, linguistic, or other cultural boundaries.

For now I just want to emphasize that the variability within scientific practice involves many of its important features. It includes the scale, precision, technological sophistication, sensitivity, theoretical transparency, and theoretical independence of its instruments; the scale, location, mobility, and accessibility of its objects of inquiry; its social order (for example, the size of its effective research groups and their degree of heterogeneity in knowledge, skill, mutual understanding, status, and so on); its theoretical sophistication and the relations between theory and experimental or observational practice; its distance from specific “applications” of knowledge; the character and significance of its engagement with other cultural practices; the relative importance of description and explanation; and the institutional organization of its research and communication.

Insensitivity to the heterogeneity of the sciences is an important part of what cultural studies take to be wrong

with global legitimations of the rationality of science or of its referential success and what they take to be equally wrong with those epistemic relativisms that place scientific communities (and their accepted results) on a par with others and with one another. Whether one argues that scientific inquiry as such is superior to other epistemic practices, is “no better than” others, or is somehow less adequate, the mistaken assumption once again is that scientific knowledge belongs to a single kind similar or distinguishable *in kind* in any interesting way from other kinds. Similar problems are manifest in any attempt to distinguish natural science from social or human science.¹³

The antiessentialism of cultural studies extends to my second theme. One of their most important differences from the social constructivist tradition is their opposition to an explanatory stance toward scientific knowledge (or its “content”). Social constructivism typically presents itself as an explanatory social science that can (potentially) account fully for the epistemic outcomes of scientific practices. In this case, the vocabulary of social interaction (interests, negotiations, and so on) is supposed to hold the key to an adequate understanding of scientific work. But as Nancy Cartwright has noted about physical explanation, “the aim [of an explanatory science] is to cover a wide variety of different phenomena with a small number of principles. The explanatory power of [a] theory comes from its ability to deploy a small number of well-understood [expressions] to cover a wide variety of cases. But this explanatory power has its price [which is] to constrain our abilities to represent situations realistically.”¹⁴ The need to account for the phenomena in terms of a theory’s explanatory concepts suppresses differences among the phenomena being explained, whether those differences are susceptible to alternative explanatory frameworks or not. For example, a social explanation of the content of a scientific practice is not well situated to consider the variety of ways such a practice may be appropriated and used; cultural studies of science may well be concerned with the plasticity of what constructivist studies take as an unproblematic explanandum.

But two related difficulties with an explanatory stance are perhaps even more fundamental for cultural studies. First, cultural studies take exception to the ways in which an explanatory stance reifies the boundaries between the interpretation and what it interprets. This reification can take different forms. Latour and Woolgar, for example, adopt (at least rhetorically) the stance of the ethnographer as stranger,¹⁵ whereas Collins and Yearley present themselves as disciplinary antagonists to the natural sciences:

“We provide a prescription: stand on social things – be social realists – in order to explain natural things. The world is an agonistic field (to borrow a phrase from Latour); others will be standing on natural things to explain social things. . . . [SSK, then,] wants to use science to weaken natural science in its relation to social science.”¹⁶

Cultural studies have instead been influenced by that tradition in postcolonial anthropology which is suspicious of attempts to impose categories unilaterally on the Other,¹⁷ even when anthropology has been repatriated, science has been made into the Other, and the imperializing anthropologists present themselves as the “underdog” to the established cultural authority of the natural sciences.¹⁸

The second related problem with social explanations of scientific knowledge concerns the reification of the categories of the (social) explanans, which is self-consciously defended by Collins and Yearley in the passage I just quoted. Cultural studies focus on the articulation and significance of meanings and are reluctant to set the categories of social explanation outside of their purview. This reluctance increases wherever such explanations presume the unity of social identities or categories, which cultural studies must frequently deconstruct. Such an exception becomes more troubling given the widespread acknowledgment that the categories and practices of social explanation themselves belong to a scientific tradition.¹⁹

Such reifications of the categories of a social science have been critically discussed within the social constructivist tradition under the heading of “reflexivity.” This issue has been most prominently associated with the work of Woolgar and of Malcolm Ashmore.²⁰ Woolgar and Ashmore regard the aspiration to social explanation of scientific knowledge as rhetorically incoherent: sociological accounts aim to undermine the naïvete and apparent transparency of scientific representations, but they are no less naïve in their own representationalist rhetoric. [Elsewhere, I have] argued against the representationalist conception of language which frames Woolgar’s presentation of reflexivity and against the general philosophical skepticism that his account suggests. Cultural studies, however, respond to reflexive criticism of the aspiration to social explanation in ways that can be further differentiated from Woolgar’s and Ashmore’s approaches. For Woolgar and Ashmore, taking reflexivity seriously suggests giving up the instrumental concern to improve representations of science in favor of inventive and playful “interrogations” of representation itself: “Reflexivity,” Woolgar proclaims, “is the ethnographer of the text.”²¹ Cultural studies instead take reflexive

questions as an invitation to consider their own complex epistemic and political relations to the cultural practices and significations they study.²²

This distinction is not meant to exempt the rhetoric of science studies from reflexive criticism. Donna Haraway and Sharon Traweek, for example, also criticize common rhetorical strategies within science studies, but to different ends. Traweek notes that, like scientists, “almost all those writing the newer social studies of science and technology also account for everything and reject all other stories. Almost all these stories, whether about nature, scientists, or science, are narrative leviathans, producing and reproducing all-encompassing stories of cause and effect through the same rhetorical strategies.”²³ Such stories work by “relentless, recursive mimesis; the story told is told by the same story.”²⁴ In criticizing such rhetoric, Haraway and Traweek are not concerned to “interrogate” and defamiliarize representational practices generally. From their perspectives, Woolgar’s stories make up yet another narrative leviathan, one about how all representations (including his own) are projections of “the Self.” For Haraway and Traweek, by contrast, reflexivity discloses partiality and situatedness, not self-enclosure. It exposes the illusion that representation is autonomous and self-projecting; we can never encounter or understand ourselves except through our interactions with others in partially shared surroundings. If rhetoric is always situated, then reflexive concern for one’s own authorship cannot remain internal to the text. The textual self-presentation of the author is subject to reflexive criticism only as part of a larger concern for writing and speaking as forms of action. What do these writings and sayings do? To whom and about whom are they expressed? In what ways do they allow for and acknowledge, or foreclose and not hear, the responses of those to, about, or past whom they speak? Above all, to whom are they accountable? Critical reflection on knowledge claims is thus always as much moral and political as epistemological, and Haraway’s and Traweek’s calls for reflexivity aim to reconfigure the politics of science and science studies. Haraway notes that while “the natural sciences are legitimately subject to . . . Cultural and political evaluation ‘internally,’ not just ‘externally,’ the evaluation is also implicated, bound, full of interests and stakes, part of the field of practices that make meanings for real people accounting for situated lives.”²⁵ Reflexive attention to one’s own practices of speaking and writing is thus integral to a political engagement with science which would be appropriately modest and self-critical.²⁶

Haraway's and Traweek's emphasis on reflexively situated inquiry points toward a third distinctive feature of cultural studies, an insistence on the local, material, and discursive character of scientific practice.²⁷ Scientific knowledge is often discussed as if it were a body of free-floating ideas detachable from the material and instrumental practices through which they were established and connected to things. Cultural studies (along with other recent studies of experimental practice) instead emphasize the importance of specific complexes of instruments and specialized materials, as well as the skills and techniques needed to utilize them, in shaping the sense and significance of knowledge. They also emphasize the particularity of networks of scientific communication and exchange which shape both what needs to be said and what vocabulary and technical resources can be appropriately utilized. For example, cultural studies stress the ways in which disciplines can be created or transformed as much by new instruments and objects as by new concepts or theories (although we should beware of distinguishing these categories too sharply, as if instruments and objects were somehow prediscursive). The transformation of classical cytology into modern cell biology was focused more by uses of the ultracentrifuge and the electron microscope than by any particular theoretical innovations, but it thereby changed what counted as a scientifically interesting question about cells and an adequate answer to this question.²⁸ Peter Galison has argued as well that some basic concepts of particle physics were altered by the use of counters in the 1930s; in practice they transformed "electron," for example, from an aggregate to an enumerable concept (without instantiating distinct individuals).²⁹

Instruments belong ineliminably to local contexts within which there are the facilities, skills, and discursive practices that enable them to operate significantly. Philosophers in the 1960s and 1970s drought that the influence of instruments on scientific knowledge could be captured in terms of the theory-ladenness of observation, which presumed that the crucial aspects of the instrument's functioning were theoretically understood. Almost invariably this is not the case, as sources of error and noise are regularly circumvented by practical engineering that does not require full theoretical comprehension.³⁰ The locality of knowledge is also suggested by the importance of the exchange of actual materials to be used or investigated (particular cell cultures, plasmids, superconducting ceramics, and so on); they are not readily reproducible from a description. Some scientists and

philosophers may balk at this emphasis on the irreducible locality of scientific knowledge, but they should be clear about what they are thereby doing: they are excluding from scientific knowledge most of what experimentalists, instrumentalists, and even phenomenologists within the sciences distinctively know and do.

Cultural studies' emphasis on the locality and materiality of scientific practices must nevertheless be distinguished from the suggestion that such practices exhibit knowledge that is "tacit" (as Polanyi argued) or mute (as is perhaps implied by some studies of experimental practice, which may seem to suggest a materialist explanation of scientific knowledge as opposed to its cultural interpretation). In either case, material practice would be rendered *inarticulable* and hence inaccessible to the interpretive practices of cultural studies. The localization of scientific practices and capabilities should also not be taken to exclude the adaptation and standardization of practices to extend them into new local settings and to establish and maintain large-scale continuities across those settings.³¹ Latour's account of the extension and maintenance of networks and their connections to centers of calculation³² and my earlier discussion of the dissemination of knowledge and power through contested alignments are quite consistent with the locality of scientific practice. The claim that scientific practices and knowledges are local is opposed to conceptions of the effortless and immaterial universality of scientific reasoning and knowledge, not to the specificity and materiality of global interconnections (networks, alignments, relations) which might be extended anywhere (with sufficient social and material support) but which can never hold everywhere at once.³³

My fourth theme from cultural studies, what I have been calling the openness of scientific practices, conflicts with a widespread sense of scientific communities as relatively self-enclosed, homogeneous, and unengaged with other social groups or cultural practices. Even such an influential and informative precursor to cultural studies of science as Thomas Kuhn's *Structure of Scientific Revolutions* stresses the intellectual and normative autonomy and uniformity of scientific communities. The social constructivist tradition has often followed Kuhn in this respect, focusing on either the social interests or the social interactions that constitute the shared beliefs, values, and concerns of scientific communities.³⁴ But cultural studies of science display a constant traffic across the boundaries that allegedly divide scientific communities (and their language and norms) from the rest of the

culture. Latour has provocatively expressed this sense of the openness of scientific work in saying that scientific work itself effectively destabilizes any distinctions between what is inside and outside of science, or between what is scientific and what is social.³⁵

It is important to recognize that the traffic across the boundaries erected between science and society is always two-way. For now, I will talk about the ways in which scientific work continually draws on and is influenced by the culture “outside.” The traffic in this direction involves, among other things, scientists seeking and acquiring material and financial resources, recruits, meaningful or significant questions and problems to investigate, a vocabulary and the metaphors and analogies it incorporates, allies, and much more. I want to present multiple examples to illustrate my point, to make plausible the range and depth of the claim that cultural studies make and their justification for it.

My initial case is taken from Robert Marc Friedman.³⁶ Friedman has shown how important *theoretical* features of Vilhelm Bjerknes’s evolving studies of atmospheric geophysics were shaped by specific relationships cultivated with military and civil aviation, fisheries, and agriculture. Bjerknes’s group replaced the prevailing statistical/climatological approach to meteorology with a three-dimensional modeling of atmospheric dynamics. His models emphasized the formation and movement of atmospheric discontinuities (or “fronts”). But this very conception initially depended on both the needs of and the resources providable by aviation and shipping. Aviation needed much finer-grained and differently conceptualized atmospheric analyses than prevailing meteorological theory could discriminate. Yet airplanes and airships were necessary for acquiring data enabling a three-dimensional atmospheric geophysics that could reveal rapidly moving and sharply delineated discontinuities. These relationships were indispensable for the successful struggle to impose a common instrumentarium and metrology throughout Europe and North America, one marked in physically rather than phenomenologically significant units and temporally synchronized rather than timed for local convenience. Most previously practicing meteorologists did not even comprehend the new units of measurement; yet, without these changes, there could be no knowledge of relevant atmospheric features.

High-energy physics (HEP) may seem more remote from particular social interests or cultural practices than does meteorology. But cultural and political engagement can make considerable difference in what kind of

knowledge can be produced. As Traweek has pointed out, the principal determinant of an HEP group’s work is its detector.³⁷ All accelerator research groups take pulses of particles from the same beam, but what knowledge they produce depends on the detector they put in its path. In the United States, detectors are short-lived and continually tinkered to keep them at the very edge of the state of the art without encountering irreducible noise in one’s data or expense and time in one’s work. Experimental physicists build detectors themselves (and rework them), both to minimize noise and to achieve the precise data response desired. In Japan, this approach is not possible. Funding for HEP is tied to Japan’s corporations; physicists specify only general design criteria for a detector, which is then built by industrial firms and cannot be altered on site. As Traweek notes, such highly expensive machines with the most sophisticated components must then be used for a long time. Whereas in the United States a physicist will typically work with several generations of detectors, in Japan a detector will survive through several cohorts of physicists who spend their careers with one machine. These differences strongly affect the kinds of questions one can ask and the characteristics of good results.

My third example comes from historian Donna Haraway. She has documented a sharp transformation in the 1940s and 1950s in the metaphors that organized research and its interpretation in several fields of biology, notably evolutionary theory, genetics, developmental biology, and immunology. Haraway described the change as “a transformation from a discourse on physiological organisms, ordered by the hierarchical sexual division of labor and the principle of homeostasis, to a discourse on cybernetic technological systems, ordered by communications engineering principles.”³⁸ Haraway’s argument connects both the theoretical and economic resources for these transformations of core fields of biological science to war-related developments in operations research and labor management, and their intellectual plausibility in part to contemporary transformations in the economy and in cultural images of language and self. Such metaphorical structures in science are tremendously important epistemically, especially because of the ways they shape the development of subsequent research. They help frame the interesting questions and what would be intelligible as an answer to those questions.

The intertwining of scientific knowledge with cultural constructions of sex and gender should be specially emphasized, for it has been very influential in the

formation of cultural studies of science. Some engagements of science and gender should by now be unsurprising (although they have certainly not been uncontested). Could research into endocrinological influences on sex differences in behavior or ability or evolutionary explanations of gender difference be expected to escape the effects of cultural constructions of gender? Similarly, when one recognizes the epistemic importance and cultural complexity of researchers' credibility, it would be astonishing if gender were not significant there. I thus choose two more indirect examples to accentuate the theme of the openness of scientific work.

The first comes from Evelyn Fox Keller, whose historical inquiries have concerned the cultural formation of molecular biology in its peculiarly central place within the biological sciences today. From H. J. Muller's ecstatic analogies between his x-ray-induced genetic mutations and Rutherford's bombardment of atomic nuclei with alpha particles ("Mutation and transmutation – the two keystones of our rainbow bridges to power"³⁹) to molecular biologists' frequent identification of DNA molecules with "the secret of life" and "the displacement of flesh-and-blood reference that is [thereby] symbolically effected,"⁴⁰ Keller argues that the representation of the significance of molecular biology has been powerfully gendered. She interestingly connects the ways scientists have attempted to legitimate the biological centrality of this work to powerful cultural narratives of male birthing and second birthing. What is at issue here is not the specific role that DNA molecules play in heredity but the gendered significance of specific research programs in biology in relation to other elements of biological (and physical) science.

A very different sort of example is displayed in a recent discussion by Haraway of the content of *Science*.⁴¹ The contents of this official journal of the American Association for the Advancement of Science are usually understood to be its scientific articles and its letters, news, and commentary. But almost a quarter of the journal's actual pages by my count are typically devoted to advertisements. This fact alone suggests the economic significance of scientific practices and equipment. But what Haraway has done is to study the imagery developed and exploited in the advertisements to striking effect. From the rabbit at the computer keyboard staring at its graphically constructed image on the screen ("A few words about reproduction from an acknowledged leader in the field") to the male scientist bottle-feeding

a monkey in the lab at midnight and to DuPont's genetically engineered laboratory mouse with active oncogenes ("OncoMouse™"), the humor and imagery in the advertisements play subtle and not-so-subtle variations on cultural narratives of gender and birthing, origins and salvation, purity and pollution, nature and culture. These advertisements raise complicated issues about their intended audience and the significance of the imagery they embody. But they remind us that scientific understanding encompasses much more than what appears in the carefully dry prose of the canonical journal report.

This sense of the openness of scientific practices and the inappropriateness of any principled boundaries between what is internal or external to science brings us back to the close linkages between knowledge and power. [...] knowledge and power cannot be reduced to the same thing, because neither should be understood as a kind of thing at all. Talking about knowledge and about power are ways of understanding the interrelations among practices and the things disclosed within them. 'Power' and its associated concepts (coercion, domination, authority, empowerment, and so forth) provide a way to understand how some agents and instrumentalities act in concert within a particular setting to transform others' possibilities for acting. The use of 'knowledge' and related concepts enable interpretation and assessment of how agents and their surroundings function together to disclose or understand one another. 'Power' concerns how people and things can align effectively, whereas 'knowledge' concerns how they can align informatively. Some of the same elements and patterns may participate in both kinds of alignment, and an epistemic alignment may itself contribute to an alignment of power or vice versa. Knowledge and power frequently come together in scientific practices, which have not only changed how the world is understood but also influenced people's situations and life possibilities.⁴² As a consequence, the critical assessment of scientific claims to (or presumptions of) knowledge must often be closely intertwined with criticisms of power relations that the associated scientific practices help constitute or sustain. Feminist studies of science have often displayed the most sophisticated grasp of this point, for they have never given up the quest for more adequate and reliable knowledge of the world, while recognizing that claims to knowledge are inevitably entangled in relations of domination and empowerment.

The final two points I want to make about cultural studies are closely connected. Cultural studies take a subversive rather than an antagonistic stance toward some long-standing philosophical questions about science, such as realism and value neutrality; they challenge the formulation of the question rather than proposing an alternative to its traditional answers. This approach is in turn connected to the place of epistemological and political criticism within cultural studies of science. Cultural studies endorse neither the global legitimations of science often put forward by philosophers nor the attempt by many sociologists of science to describe science while bracketing or relativizing any critical assessment of it.

Realism is the view that science (often successfully) aims to provide theories that truthfully represent how the world is independent of human categories, capacities, and interventions. Social constructivists typically reject realism on two counts: the world that science describes is itself socially constituted, and its aims in describing that world are socially specifiable (satisfying interests, sustaining institutions and practices, and so on). Cultural studies of science are better understood as rejecting both realism and the various antirealisms, including social constructivism.⁴³ Both realists and antirealists propose to explain the content of scientific knowledge, either by its causal connections to real objects or by the social interactions that fix its content. The shared presumption here is that there is a fixed “content” to be explained. Both scientific realists and antirealists presume semantic realism, the thesis that there is an already determinate fact of the matter about what our theories, conceptual schemes, or forms of life “say” about the world. Interpretation must come to an end somewhere, they insist, if not in a world of independently real objects, then in a language, conceptual scheme, social context, or culture.

Cultural studies instead reject the dualism of scheme and content, or context and content, altogether. No determinate scheme or context can fix the content of utterances, and hence it is not possible to get outside of language. How a theory or practice interprets the world is itself inescapably open to further interpretation, with no authority beyond what gets said by whom, when.⁴⁴ This position has at least two important consequences in comparison with social constructivism. First, cultural studies can readily speak of statements as true, for ‘truth’ is a semantic concept that never takes us beyond language. To say that ‘*p*’ is true says no more (but also no less) than saying *p*. Second, it dissolves the boundaries between

cultural studies of science and the scientific practices they study. Cultural studies offer interpretations of scientific practices, including the texts and utterances that such practices frequently articulate. But scientific practices are themselves already engaged in such interpretations, in citing, reiterating, criticizing, or extending past practice. As Arthur Fine suggested:

If science is a performance, then it is one where the audience and crew play as well. Directions for interpretation are also part of the act. If there are questions and conjectures about the meaning of this or that, or its purpose, then there is room for those in the production too. The script, moreover, is never finished, and no past dialogue can fix future action. Such a performance is not susceptible to a reading or interpretation in any global sense, and it picks out its own interpretations, locally, as it goes along.⁴⁵

Cultural studies’ interpretive readings are thus part of the culture of science and not an explanation or interpretation of it from “outside.” The boundaries between its “inside” and “outside,” its centers and its margins, are always themselves at issue in interpretive practice and not something already fixed. The point is not to place all interpretations on a par, for some count as relevant, serious, and significant while others do not. Rather it is to say that which interpretations count in this way, when, and where are themselves part of what is at stake in Ongoing interpretation.

What I earlier called the “openness” of scientific practice is crucial here. Internalist history and philosophy of science as well as social constructivism are thus both mistaken when they try to fix what is relevant to the determination of truth, either to reasons and evidence narrowly construed or to “social factors.” One cannot separate the determination of the truth of a scientific claim from the heterogeneous considerations that shape it as a truth claim, one that is intelligible, significant, bearing a (variable) burden of proof, and relevant to various other practices and claims.

Cultural studies likewise try to subvert questions about whether science is (or should be) value-neutral. Traditional discussions of “the” question of value neutrality reify the notion of ‘value’ just as the realism debates attempt to reify ‘truth’.⁴⁶ Questions about truth inevitably devolve into multiple questions about significance, relevance, intelligibility, or burden of proof. Similarly, Robert Proctor has argued, the question of value neutrality is not one question but many.⁴⁷ Proctor’s work thereby opens a significant topic for cultural

studies of science, namely, to locate historically and culturally the very conception of scientific research and knowledge as value-free.

The prominence of the term 'value-free' undoubtedly stems from the influence of Max Weber. Ironically, Proctor has shown us, Weber's principal concern was not to keep values from influencing science but the reverse. His advocacy of *Wertfreiheit* was a critique of scientism. But other important concerns have been articulated under this same heading. Against the Nazis' advocacy of a racialized and nationalized science or the Soviet Communist Party's rejection of Mendelian genetics, the notion of value freedom has been timidly invoked to challenge the political censorship of scientific work (timid, for it suggests that if science were not fully and rigidly value-free, it might be appropriately subject to censorship). Similarly timidly, the notion of value freedom has been used to challenge exclusions of scientists on grounds of gender, race, nationality, or political or religious affiliation. A very different use of the conception of "value freedom" has been to draw problematic distinctions of pure from applied, or basic from "mission-oriented" research. Of course, those scientists and their employers whose work is applied or mission-oriented by any plausible criterion have not hesitated to appropriate the legitimating notion of value freedom.

Value freedom is also attributed to nature as well as to science. Here we encounter both the modern conception of the "disenchanted" universe, which rejects an ordered cosmos, and the criticisms of vitalism and teleology in biology. This conception of nature as value-free is in direct conflict with the frequent use of scientific work to legitimate or discredit values (for example, the controversies over sociobiology). But what is important for our purposes is that the various conceptions of nature as disenchanted and science as value-free are an important topic for cultural studies, with a rich and contradictory history, and not a framing of its investigations.

These discussions of the concepts of truth and value lead us to the final issue that I take to characterize cultural studies of science. Sociological constructivists frequently insist that they merely describe the ways in which scientific knowledge is socially produced, while bracketing any questions about its epistemic or political worth. In this respect, their work belongs to the tradition that posits value freedom as a scientific ideal. By contrast, cultural studies of science have a stronger reflexive sense of their own cultural and political engagement and typically do not eschew epistemic or political criticism. They

find normative issues inevitably at stake in both science and cultural studies of science but see them as arising both locally and reflexively. One cannot not be politically and epistemically engaged.

Two examples of how the burden of proof is determined in AIDS research will illustrate my point and reinforce the earlier claim that cultural studies of science are in the end continuous with the reflexive practice of science itself. Paula Treichler and Cindy Patton have both noted that retrovirologists confidently announced that a sequence of RNA which they had isolated was "the AIDS virus" or "the cause of AIDS" long before anything had been established about its detailed role in the clinical development of the disease or about the presence or absence of cofactors.⁴⁸ Within the present scientific climate, the burden of proof falls heavily on the opponents of what Keller has called "master molecule" explanations of biological phenomena; what kind and degree of evidence they and the proponents of such explanations need to provide for their claims differs accordingly among them.⁴⁹ Similarly, the widespread scientific discussion of the "African origin" of AIDS has, for historically and politically significant reasons, confronted looser standards of evidence than have other claims about its epidemiology. Treichler's and Patton's arguments in each case are neither uncritical descriptions of how the scientific burden of proof is assigned nor part of a global relativizing of scientific argument. Instead, they offer a detailed criticism of both how that burden falls and its consequences, via an interpretation of how it was historically constituted. Their argument is not that scientific claims should be rejected for extrascientific reasons but that the local patterns of scientific reasoning and relevance relations need to be reconstructed at specific points.

The critical standpoint afforded by such cultural studies is not that of epistemic sovereignty as inscribed in a "narrative leviathan,"⁵⁰ which would legislate for science and culture on the basis of its grasp of the right explanatory factors to account for scientific knowledge without residue. Rather, cultural studies are located within ongoing conflicts over knowledge, power, identity, and possibilities for action. Whatever critical insight and effectiveness they might have must result from their responsiveness to the resonances and tensions among what I have called the alignment and counter-alignments shaping an epistemic situation. [As described elsewhere] epistemic alignments are dynamic and heterogeneous arrays of practices, objects, and communities

or solidarities which reinforce, appropriate, or extend one another and thereby constitute knowledge. Cultural studies are reflexive attempts to strengthen, transform, or reconstitute existing alignments or counteralignments by resituating them historically and geographically.

The crucial differences between the normative standpoints of social constructivism and cultural studies of science are succinctly expressed by several of their most prominent practitioners. Pinch sees “the task for the sociologist [being] to try and recapture some of the ‘life world’ of the scientist – the taken-for-granted practices and interpretations which make available the natural world.”⁵¹ The goal of such a “recapture” is to rearrange the relations of authority among disciplines. As Collins and Yearley put it, “SSK wants to use science to weaken natural science in its relationship to social science We want all cultural endeavors to be seen as equal in their scientific potential.”⁵² It is instructive to contrast such accounts to Haraway’s articulation of a vision for cultural studies:

Feminists have to insist on a better account of the world; it is not enough to show radical historical contingency, and modes of construction for everything. . . . [So] ‘our’ problem is how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognizing our own ‘semiotic technologies’ for making meanings, *and* a no-nonsense commitment to faithful accounts of a ‘real’ world, one that can be partially shared and friendly to earth-wide projects of finite freedom, adequate material abundance, modest meaning in suffering and limited happiness.⁵³

To put the difference polemically, social constructivism is antagonistic to the cultural authority claimed by the natural sciences but uncritical of scientific practices. Cultural studies reverse this stance, aiming to participate in constructing reliable and authoritative knowledge of the world by critically engaging with the sciences’ practices of making meanings.

Notes

- 1 Mannheim 1952.
- 2 See, for example, Merton 1973.
- 3 Bernal 1967, 1954; for an informative discussion of Bernal’s views, see Werskey 1978.
- 4 Bernal 1967: 409.
- 5 Polanyi 1958.
- 6 For a useful discussion of the continuity between the social constructivist tradition and Polanyi’s antinormative account of scientific research, see Fuller 1992.
- 7 Collins and Yearley 1992a: 316.
- 8 For critical discussions of the epistemic significance of policing epistemic borders, see Traweek 1992 and Rouse 1991.
- 9 The concept of epistemic sovereignty was introduced to extend Foucault’s (1978, 1980) criticism of the ways in which the problematic of sovereignty frames political theory. The concept is articulated and critically applied to science studies in Rouse 1993, 1996.
- 10 For example, Hubbard 1990, Fausto-Sterling 1985, Bleier 1984 and Birke 1986.
- 11 Rorty 1991: 46–62
- 12 Recent studies of such differences include Traweek 1988 and Harwood 1993.
- 13 Rouse 1987: chap. 6.
- 14 Cartwright 1983: 139.
- 15 Latour and Woolgar 1986.
- 16 Collins and Yearley 1992b: 382–83.
- 17 For discussions of these issues, see Marcus and Fischer 1986, Clifford and Marcus 1986, and Rosaldo 1989.
- 18 Collins and Yearley (1992b) explicitly portray their own explanatory antagonism toward the cultural hegemony of the natural sciences as like “the underdog so familiar from romantic portrayals of science” (382).
- 19 For many social constructivists, sociology offers an alternative route to a fully naturalized scientific study of science itself. Whereas Quinean naturalists, for example, take epistemology or philosophy of science to be the scientific study of how scientific knowledge is constructed from sensory stimulations, the Edinburgh school finds the crucial issue for a scientific study of science in how diverse beliefs are generated from similar environmental surroundings. In both cases, however, the aim is to close the domain of science by bringing its own activities within its purview, and in both cases, the resulting knowledge stands or falls with the claims of scientific knowledge more generally. The critical resources of such naturalized epistemologies are limited to identifying and removing inconsistencies within the totality of science. Cultural studies take these critical resources to be inadequate. A naturalized science of science is also thereby committed to a conception of science as essentially aimed toward producing a consistent system of representational knowledge, a conception that cultural studies reject.
- 20 See esp. Woolgar 1988a, b and Ashmore 1989.
- 21 Woolgar 1988a.
- 22 Haraway 1989 and Traweek 1992 both illustrate how reflexive attention to the construction of one’s own text can engage the political significance of doing cultural

- studies of science and not just undertake the futile rhetorical task of representing the supposed “ideology of representation” (Woolgar 1988b: chap. 7).
- 23 Traweek 1992: 430.
- 24 Haraway 1997.
- 25 Haraway 1989: 13.
- 26 Haraway’s discussion of the scientific career of primatologist Alison Jolley (1981: chap. 10) provides an illuminating example of how such reflexive modesty might be realized in one very particular setting. Jolley’s career and its scientific and cultural setting are unusual in ways that would strongly discourage taking her work as a model for politically engaged scientific practice, but it nevertheless illustrates Haraway’s conception of a reflexive rhetoric and politics.
- 27 For a detailed discussion of the locality and materiality of scientific knowledge, see Rouse 1987: chap. 4, and Rouse 1991.
- 28 For detailed discussions, see Rheinberger 1992, 1994, and Bechtel 1993. The differences between these discussions are themselves salutary for the concerns of the present argument, for Rheinberger’s account exemplifies the kind of interpretation of the articulation of meaning which I attribute to cultural studies, whereas Bechtel attempts a mediation between social constructivism and more-traditional history and philosophy of science.
- 29 Galison 1987: chaps. 2–3.
- 30 Hacking 1983; Traweek 1988: chap. 2.
- 31 Rouse 1987: chaps. 4 and 7.
- 32 Latour 1987: chap. 6; for the purposes of cultural studies, Latour’s account of networks, centers, and the metrologies and other policing practices that sustain them may be more attractive than his semiotic interpretation of those practices and his rhetorical construction of technoscience and science studies alike as militarized trials of strength. For critical discussion of these latter aspects of Latour’s work, see Haraway 1994, 1997, and Lenoir 1994.
- 33 Fraser and Nicholson (1988) usefully discuss the political significance of rejecting universality without abandoning the analysis of particular large-scale historical and geographical constructions.
- 34 Kuhn 1970; prominent examples of social constructivists who emphasize the role of relatively enclosed scientific communities or forms of life include Collins 1992 (especially his notion of a “core set”) and Bloor 1983. Knorr-Cetina 1981, with its emphasis on “trans-scientific fields,” was remarkable for its early divergence from the focus on scientific communities.
- 35 Latour 1983, 1987.
- 36 Friedman 1989.
- 37 My discussion of this example is drawn from Traweek 1988.
- 38 Haraway 1981–82: 245.
- 39 Quoted in Keller 1990:397.
- 40 Keller 1992: 52.
- 41 Haraway 1992.
- 42 For a more extended and detailed discussion of the intertwining of knowledge and power in scientific practices, see Rouse 1987: chap. 7.
- 43 Rouse (1987: chap. 5) offers an extended argument rejecting both realism and empiricist or constructivist antirealisms, based on a minimalist or “deflationary” conception of truth.
- 44 For further discussion of this account of meaning and truth, see Wheeler 1986, 1991; and Rouse 1987: chap. 5.
- 45 Fine 1986a: 148.
- 46 Stich (1990) displays a stunning blindness to this parallel. Having powerfully argued that any attempt to fix the intension of ‘truth’ potentially drives a wedge between “‘p’ is true” and the reasons for believing “p,” Stich settles on a cultural pluralism about reason by appealing to the values that fix the objects of an individual’s or culture’s desires, without recognizing that an exactly parallel argument could be developed to fragment the concept of ‘value’.
- 47 Proctor 1991.
- 48 Treichler 1989, 1992; and Patton 1990.
- 49 Keller 1985: chap. 8.
- 50 I take this phrase from Traweek 1992.
- 51 Pinch 1986: 19.
- 52 Collins and Yearley 1992b: 383.
- 53 Haraway 1990: 187.

References

- Ashmore, Malcolm. 1989. *The Reflexive Thesis: Wrighting Sociology of Scientific Knowledge*. Chicago: University of Chicago Press.
- Bechtel, William. 1993. Integrating Sciences by Creating New Disciplines: The Case of Cell Biology. *Biology and Philosophy* 8: 277–99.
- Bernal, J. D. 1954. *Science in History*. Cambridge: MIT Press.
- Bernal, J. D. 1967. *The Social Function of Science*. Cambridge: MIT Press.
- Birke, Lynda. 1986. *Women, Feminism, and Biology*. Brighton: Wheatsheaf.
- Bleier, Ruth. 1984. *Science and Gender: A Critique of Biology and Its Theories on Women*. New York: Pergamon.
- Bloor, David. 1983. *Wittgenstein: A Social Theory of Knowledge*. New York: Columbia University Press.
- Bloor, David. 1991. *Knowledge and Social Imagery*. 2d ed. Chicago: University of Chicago Press.

- Cartwright, Nancy. 1983. *How the Laws of Physics Lie*. Oxford: Clarendon.
- Clifford, James, and George Marcus, ed. 1986. *Writing Culture: The Poetics and Politics of Ethnography*. Berkeley: University of California Press.
- Collins, Harry. 1992. *Changing Order: Replication and Induction in Scientific Practice*. 2d ed. Chicago: University of Chicago Press.
- Collins, Harry, and Steven Yearley. 1992a. Epistemological Chicken. In Pickering 1992: 301–26.
- Collins, Harry, and Steven Yearley. 1992b. Journey into Space. In Pickering 1992: 369–89.
- Fausto-Sterling, Anne. 1985. *Myths of Gender*. New York: Basic.
- Feyerabend, Paul. 1987. *Farewell to Reason*. London: Verso.
- Fine, Arthur. 1986a. And Not Anti-Realism Either. In Fine 1986c: 136–50.
- Fine, Arthur. 1986b. *The Shaky Game: Einstein, Realism, and the Quantum Theory*. Chicago: University of Chicago Press.
- Foucault, Michel. 1977. *Discipline and Punish*. Trans. Alan Sheridan. New York: Random House.
- Foucault, Michel. 1978. *The History of Sexuality*, vol. 1. Trans. Robert Hurley. New York: Random House.
- Foucault, Michel. 1980. *Power/Knowledge*. New York: Random House.
- Fraser, Nancy, and Linda Nicholson. 1988. Social Criticism without Philosophy: An Encounter between Feminism and Postmodernism. In *Universal Abandon? The Politics of Postmodernism*, ed. Andrew Ross, 83–104. Minneapolis: University of Minnesota Press.
- Friedman, Robert Marc. 1989. *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology*. Ithaca: Cornell University Press.
- Fuller, Steve. 1988. *Social Epistemology*. Bloomington: Indiana University Press.
- Fuller, Steve. 1992. Social Epistemology and the Research Agenda of Science Studies. In Pickering 1992: 390–428.
- Galison, Peter. 1987. *How Experiments End*. Chicago: University of Chicago Press.
- Galison, Peter, and David Stump. 1996. *The Disunity of Science: Boundaries, Contexts, and Power*. Stanford: Stanford University Press.
- Gooding, David, Trevor Pinch, and Simon Schaffer. 1989. *The Uses of Experiment*. Cambridge: Cambridge University Press.
- Grossberg, Lawrence, Cary Nelson, and Paula Treichler. 1992. *Cultural Studies*. New York: Routledge.
- Hacking, Ian. 1983. *Representing and Intervening*. Cambridge: Cambridge University Press.
- Haraway, Donna. 1981–82. The High Cost of Information in Post-World War II Evolutionary Biology: Ergonomics, Semiotics, and the Sociobiology of Communication Systems. *Philosophical Forum* 13: 244–78.
- Haraway, Donna. 1989. *Primate Visions: Gender, Race, and Nature in the World of Modern Science*. New York: Routledge.
- Haraway, Donna. 1990. *Simians, Cyborgs, and Women*. New York: Routledge.
- Haraway, Donna. 1992. The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others. In Grossberg, Nelson, and Treichler 1992: 295–337.
- Haraway, Donna. 1994. A Game of Cat's Cradle: Science Studies, Feminist Theory, Cultural Studies. *Configurations* 2: 59–71.
- Haraway, Donna. 1997. *Modest Witness @ Second Millennium: FemaleMan-c Meets OncoMouse.™* New York: Routledge.
- Harwood, Jonathan. 1993. *Styles of Scientific Thought: The German Genetics Community, 1900–1933*. Chicago: University of Chicago Press.
- Hubbard, Ruth. 1990. *The Politics of Women's Biology*. New Brunswick: Rutgers University Press.
- Keller, Evelyn Fox. 1985. *Reflections on Gender and Science*. New Haven: Yale University Press.
- Keller, Evelyn Fox. 1990. Physics and the Emergence of Molecular Biology. *Journal of the History of Biology* 23: 389–409.
- Keller, Evelyn Fox. 1992. *Secrets of Life, Secrets of Death: Essays on Language, Gender, and Science*. New York: Routledge.
- Knorr-Cetina, Karin. 1981. *The Manufacture of Knowledge: An Essay on the Constructive and Contextual Nature of Science*. Oxford: Pergamon.
- Knorr Cetina, Karin, and Michael Mulkey. 1983. *Science Observed: Perspectives on the Social Study of Science*. London: Sage.
- Kuhn, Thomas. 1970. *The Structure of Scientific Revolutions*. 2d ed. Chicago: University of Chicago Press.
- Latour, Bruno. 1983. Give Me a Laboratory and I Will Raise the World. In Knorr-Cetina and Mulkey 1983: 141–70.
- Latour, Bruno. 1987. *Science in Action*. Cambridge: Harvard University Press.
- Latour, Bruno, and Steve Woolgar. 1986. *Laboratory Life: The Construction of Scientific Facts*, 2d ed. Princeton: Princeton University Press.
- Lenoir, Timothy. 1994. Was the Last Turn the Right Turn? The Semiotic Turn and A. J. Greimas. *Configurations* 2: 119–36.
- Mannheim, Karl. 1952. *Essays on the Sociology of Knowledge*. London: Routledge & Kegan Paul.
- Marcus, George, and Michael Fischer. 1986. *Anthropology as Cultural Critique*. Chicago: University of Chicago Press.
- Merton, Robert. 1973. *The Sociology of Science: Theoretical and Empirical Investigations*. Chicago: University of Chicago Press.
- Patton, Cindy. 1990. *Inventing AIDS*. New York: Routledge.
- Pickering, Andrew. 1989. Living in the Material World. In Gooding et al. 1989: 275–97.
- Pickering, Andrew. 1992. *Science as Practice and Culture*. Chicago: University of Chicago Press.
- Pickering, Andrew. 1995. *The Mangle of Practice*. Chicago: University of Chicago Press.
- Pinch, Trevor. 1986. *Confronting Nature*. Dordrecht: D. Reidel.
- Polanyi, Michael. 1958. *Personal Knowledge*. Chicago: University of Chicago Press.
- Proctor, Robert. 1991. *Value-Free Science? Purity and Power in Modern Knowledge*. Cambridge: Harvard University Press.

- Rheinberger, Hans-Jörg. 1992. *Experiment, Differenz, Schrift*. Marburg: Basilikenpresse.
- Rheinberger, Hans-Jörg. 1994. Experimental Systems: Historicity, Narration and Deconstruction. In *Science in Context* 7: 65–81.
- Rorty, Richard. 1991. *Objectivity, Relativism, and Truth: Philosophical Papers*, vol. 1. Cambridge: Cambridge University Press.
- Rosaldo, Renato. 1989. *Culture and Truth*. Boston: Beacon.
- Rouse, Joseph. 1987. *Knowledge and Power: Toward a Political Philosophy of Science*. Ithaca: Cornell University Press.
- Rouse, Joseph. 1991. Policing Knowledge: Disembodied Policy for Embodied Knowledge. *Inquiry* 34: 353–64.
- Rouse, Joseph. 1993. Foucault and the Natural Sciences. In *Foucault and the Critique of Institutions*, ed. John Caputo and Mark Yount, 137–62. State College: Pennsylvania State University Press.
- Rouse, Joseph. 1996. Beyond Epistemic Sovereignty. In Galison and Stump, 1996: 398–416.
- Stich, Stephen. 1990. *The Fragmentation of Reason*. Cambridge: MIT Press.
- Traweek, Sharon. 1988. *Beamtimes and Lifetimes*. Cambridge: Harvard University Press.
- Traweek, Sharon. 1992. Border Crossings: Narrative Strategies in Science Studies and among Physicists in Tsukuba Science City, Japan. In Pickering 1992: 429–65.
- Treichler, Paula. 1988. AIDS, Homophobia, and Biomedical Discourse: An Epidemic of Signification. In *AIDS: Cultural Analysis/Cultural Activism*, ed. Douglas Crimp, 31–70. Cambridge: MIT Press.
- Treichler, Paula. 1989. AIDS and HIV Infection in the Third World: First World Chronicles. In *Remaking History*, ed. Barbara Kruger and Phil Mariani, 31–86. New York: Dia Art Foundation.
- Treichler, Paula. 1992. AIDS, HIV, and the Cultural Construction of Reality. In *The Time of AIDS*, ed. Gilbert Herdt and Shirley Lindenbaum, 65–98. Beverly Hills: Sage.
- Werskey, Gary. 1978. *The Visible College*. New York: Holt, Rinehart, and Winston.
- Wheeler, Samuel C. III. 1986. Indeterminacy of French Interpretation: Derrida and Davidson. In *Truth and Interpretation: Perspectives on the Philosophy of Donald Davidson*, ed. Ernest LePore, 477–94. Oxford: Blackwell.
- Wheeler, Samuel C. III. 1991. True Figures: Metaphor, Social Relations, and the Sorites. In *The Interpretive Turn*, ed. David Hiley, James Bohman, and Richard Shusterman, 197–217. Ithaca: Cornell University Press.
- Woolgar, Steve. 1988a. Reflexivity Is the Ethnographer of the Text. In Steve Woolgar, *Knowledge and Reflexivity: New Frontiers in the Sociology of Knowledge*, 15–34. Beverly Hills: Sage.
- Woolgar, Steve. 1988b. *Science: The Very Idea*. London: Tavistock.

Revaluing Science: Starting from the Practices of Women

Nancy Tuana

Introduction

Work in the social studies of science in the last twenty years has undermined the belief common to positivist models of science that value-neutrality is both a hallmark and goal of scientific knowledge. The ideal of a value-free science was linked to the tenet that neither the individual beliefs or desires of a scientist nor the social values of a scientific community are relevant to the production of knowledge, and models of scientific method were constructed with the goal of factoring out such contaminating influences. The rapid militarization of science in the United States since the 1970s and the current rise of influence of venture capital in charting the direction of scientific research have made it increasingly difficult to draw any clear lines between a “pure,” disinterested science, and a goal-oriented, transformative “applied” science. Questions in the philosophy of science have shifted from the “pure” epistemological question “How do we know?” to questions that reflect the locations of science within society and the relationships between power and knowledge: “Why do we know what we know?” “Why don’t we know what we don’t know?” “Who benefits or is disadvantaged from knowing what we know?” “Who benefits or is disadvantaged from what we don’t know?”

“Why is science practiced in the way that it is and who is advantaged or disadvantaged by this approach?” “How might the practice of science be different?”

Feminist theorists of science have been active participants in this research program. Our work has added an important dimension to discourses concerning the value-neutrality of science by focusing attention onto the dynamics of gender and oppression in the theories and methods of science.¹ One of the central insights of feminist science studies has been the increased awareness of the ways in which social locations, locations that include political and ethical dimensions, are gendered. Through this attention to gender we have contributed to the transformation of the traditional question “How do we know?” in numerous ways, including investigating whether traditional models of rationality and of the scientific method have been gender biased, that is, have privileged traits viewed as masculine and denigrated those perceived to be feminine; documenting the ways in which scientific theories have reinforced sexist and/or racist biases: delineating the ways in which men in dominant groups have benefited (and been hindered) by the questions asked and avoided in science; and analyzing the impact of the exclusion, as well as the inclusion, of women in science.

An important resource for feminist investigations of science has been the practices of women scientists. Many feminist theorists, particularly those who embrace a feminist standpoint epistemology, have argued that the distinctive experiences of women in a gender-stratified society provide an important resource, a resource

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typically overlooked by nonfeminist theorists, that, in the words of Sandra Harding, enables “feminism to produce empirically more accurate descriptions and theoretically richer explanations than does conventional research” (Harding, 1991, p. 119). One of my goals in this essay is to illustrate the ways in which the experiences of women, particularly women scientists, provide a resource for feminist critiques of the ideal of value-neutrality in science.

Women’s differences, both their differences from men and their differences from one another, can highlight overlooked or minimized aspects of the knowledge process in science. I will here limit my analysis to three of these, each of which is relevant to transformations of the traditional epistemological question “How do we know?” and the rejection of the ideal of value-neutrality in science:

- (1) replacing the traditional model of the knower as a detached, disinterested individual with the dynamic model of engaged, committed individuals in communities;
- (2) recognition of the epistemic value of affective processes;
- (3) examination of the role of embodiment in the knowledge process.

Individuals in Communities

Descartes envisioned himself alone in this study, attempting to put aside all he had learned from authority and all the beliefs he had unquestioningly inherited from his culture, as well as endeavoring to suppress the needs of his body. Descartes believed that only after he had removed all such influences from his rational processes would he be capable of pursuing his method for gaining true knowledge, alone and unencumbered by others.

Although Descartes was hardly an empiricist, it is the Cartesian subject that is designed to hold the subject position in S-knows-that-p models of knowledge. This is a model of knowledge that aims ideally at removing all individual traces of the knowing subject. Both perception and cognition are assumed to be invariant from knower to knower – at least in the ideal case. All other factors such as personal beliefs, desires, and bodily configurations are deemed irrelevant at best, contaminating at worst. Based on this picture of rationality, much of modern epistemology has been

focused on the ways in which variations between knowers could be filtered out.

This model of the knowing subject is in tension with the feminist acknowledgement of the fact that as humans we are always in relations of interdependence and that these relationships are crucial not simply for personal satisfaction, but also for moral, political, and scientific deliberation. In the words of Seyla Benhabib, “the self only becomes an I in a community of other selves who are also I’s. Every act of self-reference expresses simultaneously the uniqueness and difference of the self as well as the commonality among selves” (Benhabib, 1987, p. 94).

A careful study of the actual practice of science also discloses a different model of the knowing subject, one that necessitates a rejection of the model of the isolated knower and replaces it with a dynamic model of individuals in communities. An examination of the complexity of the communities relevant to the production of knowledge in science also reveals that the production of good science does not require disinterested, dispassionate scientists. As Sandra Harding has convincingly argued, objectivity does not require neutrality.² A scientist’s social locations can be epistemically significant to her or his practice of science. The ideal of a pure science, a science uninfluenced by values, and the scientist as a neutral recorder of facts are myths, ones that can be rejected without abandoning objectivity.

Changing the subject of evolution

The development of “woman, the gatherer” theories of human evolution has been the subject of much discussion in feminist science literature because this example is an excellent illustration of not only the inescapable fact of value within the construction of scientific theories, but also the potential epistemic significance of the various communities, including political communities, in which the knower participates.³

Feminist discussions of the epistemological significance of being part of the feminist community have found the science of primatology to be particularly relevant due to the fact that its stories of human evolution arise out of origin myths, that is, accounts of the origins of the family, of the sexes and their roles, as well as of the divisions between human and nonhuman animals. In other words, accounts of human evolution wear the metaphysics of their authors “on their sleeves” and thus provide clear accounts of the ways participation in alternative communities can be epistemologically significant.

To understand the androcentrism of traditional “man, the hunter” accounts of evolution, we need only attend to the respective roles of women and men. “Man, the hunter” theories of human evolution attribute the evolution of *Homo sapiens* to those activities and behaviors engaged in and exhibited by male ancestors. Males, the explanation goes, having the important and dangerous task of hunting big animals to provide the central food source, invented not only tools but also a social organization, including the development of language, that enabled them to do so most successfully. Hunting behavior is posited as the rudimentary beginnings of social and political organization. “In a very real sense our intellect, interests, emotions, and basic social life – all are evolutionary products of the success of the hunting adaptation. . . . The biology, psychology, and customs that separate us from apes – all these we owe to the hunters of time past” (Washburn and Lancaster, 1976, pp. 293, 303).

Such accounts do not omit women, but place them firmly “at home.” While men are out hunting, women are taking care of hearth and children, dependent upon the men for sustenance and protection. Note the assumptions embedded in this account. Only male activities are depicted as skilled or socially oriented. Women’s actions are represented as biologically oriented and based on “nature.” This definition of woman’s functions as natural curtails any analysis of them, such as their relation to the physical and social environments or the role they might play in determining other social arrangements. Men are depicted as actively transforming their nature, while women are portrayed as constrained by it.

The alternative origin stories told by feminist primatologists transform women from a passive, sexual resource for males to active agents and creators. The work of Linda Marie Fedigan, Sarah Blaffer Hardy, Lila Leibowitz, Sally Linton Slocum, Barbara Smuts, Shirley Strum, Nancy Tanner, and Adrienne Zihlman, among others, began in the 1970s to transform the complexion of accounts of the nature of woman and man. One key to understanding the explosion of alternative images of women’s nature lies in the woman’s movement of the 1960s that contested the definitions of woman as the second sex, definitions that simultaneously relegated her role to the private realm of family while designating the public realm of culture and politics as that which makes one fully human.

Feminist attention to perceptions of women’s roles and the linkage of woman and nature provided the basis for a rethinking of evolution for a number of scientists.

The anthropologist Sally Linton Slocum, for example, in her 1970 essay “Woman the Gatherer: Male Bias in Anthropology” [Slocum, 1971] identified ways in which females were being obscured within evolutionary theories by the association of their actions with nature and began to question the assumption that women’s actions were unimportant because they were derived from instinct and thus not relevant to the evolutionary process. Slocum’s position was in turn developed by the paleoanthropological research of Adrienne Zihlman and Nancy Tanner. This shift of attention was the result not of any biological difference between women and men scientists, but because women scientists were more likely to be affected by and participate in the feminist community – a community that had been actively exposing the history and the impact of the androcentric bias of associating women with nature and men with culture, as well as working to revalue the socially defined work of women, including childcare and housework.⁴ This political awareness arising from the influences of the feminist community changed the focus of attention for researchers like Slocum, Tanner, and Zihlman and contributed to the construction of alternative questions.

But it would be inaccurate to see the accounts of these scientists as influenced only by their participation in communities that were redefining woman’s nature. These women were also influenced by their membership in scientific communities and the then current theories of evolution. The point is that accounts by women primatologists, particularly feminist primatologists, while marked both by their gender and their politics as they attempt to carve a role for women out of the standard narrative of evolution, nevertheless evolve out of and are influenced by the accepted narratives and standards of evidence of their scientific communities.

Nor should alternative evolutionary accounts such as “woman, the gatherer” be seen simply as feminist “correctives,” that is, as an ideological image imposed onto the data. I will argue that this alternative model of evolution arose in response to changes within the scientific community, provided more accurate accounts of the evidence, and was therefore the result of better science. But this is not incompatible with saying that the model emerged from the practice of feminist scientists who, because of the impact of their communities, attended differently to the data. To say that the practice of science is marked by gender and by politics is not the same as claiming that it arises out of wishful thinking or ideological concerns. A scientific theory can provide

consistent methods for obtaining reliable knowledge, yet be influenced by certain values or interests. Objectivity and neutrality are not the same thing. [...]

Zihlman's creation of an alternative to the androcentric "man, the hunter" theory was made possible by the knowledge she gained from the communities of which she was a member, in this case both scientific and nonscientific. However, it is not a coincidence that the "woman, the gatherer" hypothesis was initiated by the work of Sally Linton Slocum, and developed by Nancy Tanner and Adrienne Zihlman. Being a feminist scientist can affect one's practice of science. In the words of Lynn Hankinson Nelson, "it makes a difference to one's observations, appraisals of theories, and one's own theorizing, if one *recognizes* androcentric and sexist assumptions, categories, or questions and if one questions the inevitability of male dominance and/or the universality of hierarchical dominance relationships. In short, it makes a difference if one is working from a feminist perspective" (Nelson, 1990, p. 224). But Zihlman's participation within particular scientific communities was also a crucial factor in the development of her research. The point is that a scientist is simultaneously a member of a number of different epistemic communities and subcommunities. The values and beliefs of these various communities often interact in complex ways over the course of the knowledge process. Fully understanding the development of knowledge then requires an appreciation of the interactive effects of all relevant communities and an understanding of the underlying presuppositions, metaphysical as well as aesthetic and moral values, of each community's system of beliefs.

Engaged Knowers

Acknowledging that social values enter into the practice of science problematizes the traditional model of the knower as detached, disinterested, and autonomous. Both the individualism as well as the goal of neutrality posited by traditional accounts of knowledge must be questioned. Many feminist theorists of science contend that women's relative absence from the practice of science is not due simply to institutional barriers such as limited access to advanced science training, but is also an aspect of a model of the scientist that privileges traits that have historically been associated with masculinity (autonomous, detached, disinterested) and

suppress those traditionally associated with femininity (dependent, connected, engaged).⁵ In other words, despite its professed neutrality, the positivist model of knowledge, like all models, arises out of a tradition and is imprinted with the values of that tradition. Neither science nor our models of science correspond to the neutrality ideal.

Feminist studies of science thus reveal the myopia of traditional individualist accounts of the knowing subject. On the traditional S-knows-that-p model of knowledge, we need have no knowledge of S. Knowers, while envisioned as distinct individuals, are not seen as *distinctive*. Neither the body nor any "subjective" aspect of an individual's mental activity is seen as affecting the proper pursuit of knowledge. This model of knowledge is linked to the belief in a universal faculty of reason common to all potential knowers. Whether it be Descartes' ability to apprehend clear and distinct ideas or the positivist vision of a deductive logic, knowing capacities are invariant (though not all equally developed). S-knows-that-p models thus embrace the vision of the generic "man" – a sameness that removes the threat of allegedly biased or partial perspectives.

Feminist investigations of science are resulting in what Helen Longino labels the strategy of "changing the subject" of knowledge. We are finding that S-knows-that-p models of knowledge are inadequate to the actual practice of science. The conception of the subject of knowledge as "generic" and hence not itself a subject of study does not fit the epistemic importance of differences between subjects. Such a model, for example, does not account for the epistemic role of the complex relationships between agents of knowledge as evidenced in examples like that of "woman, the gatherer" theories of human evolution. Equally problematic, this model overlooks the epistemic significance of subjective aspects of the relationship between scientists and the subject of inquiry, such as the scientist's commitments, desires, and interests. It also ignores the fact and nature of a scientist's embodiment. In this section I examine the role of what has traditionally been labeled "the passions" in the knowledge process in science, reserving the question of the role of the body for the final section of the essay.

A feeling for the organism

Evelyn Fox Keller offers a portrait of the geneticist Barbara McClintock that provides a very different image of the scientist than that of the disinterested,

detached observer. McClintock describes herself as having developed a close relationship with the objects of her investigation. “I start with the seedling [of maize], I don’t want to leave it. I don’t feel I really know the story if I don’t watch the plant all the way along. So I know every plant in the field. I know them intimately, and I find it a great pleasure to know them” (Keller, 1983, p. 198). McClintock viewed the complexity of nature as being beyond full human comprehension. “Organisms can do all types of things; they do fantastic things. They do everything that we do, and they do it better, more efficiently, more marvelously Trying to make everything fit into set dogma won’t work There’s no such thing as a central dogma into which everything will fit” (Keller, 1983, p. 179). In holding to this belief – a metaphysical value – McClintock deviated from the positivist assumption – yet another metaphysical value – that there were underlying regularities of nature, the laws of nature, that were discrete and individually knowable by humans. This difference in basic values contributed to McClintock’s commitment of developing a close relationship with the material she was studying, for only by listening carefully can one “let the material tell you.” “I feel that much of the work [in science] is done because one wants to impose an answer on it. They have the answer ready, and they [know what they] want the material to tell them. [Anything else it tells them] they don’t really recognize as there, or they think it’s a mistake and throw it out *If you’d only just let the material tell you*” (Keller, 1983, p. 179).

Knowing other people

Feminist studies of science, particularly the detailed studies of the practices of women scientists, have served as an important resource for feminist epistemologists. Influenced by examples like that of McClintock, many feminists are developing epistemologies that include the tenet that subjectivity is an important and indispensable component of the process of gaining knowledge.⁶ But successfully doing so requires offering alternative models of knowledge. Lorraine Code has offered such an alternative, the model of “knowing other people.” While S-knows-that-p models of knowledge are based on what Code calls ordinary knowledge of medium-sized objects in the immediate environment – the red book, the open door – Code’s model is based on the centrality of our relationships with others. “Developmentally, recognizing other people, learning what can be expected of them, is both one of the first and one of the most essential kinds

of knowledge a child acquires” (Code, 1991, p. 37). Code presents this model as an *addition* to the S-knows-that-p epistemologies that perhaps work for simple objects in simple settings. She argues that the latter model is not sufficient for more complex instances in which knowledge requires constant learning, is open to interpretation at various levels, admits of degree, and is not primarily propositional. For such cases, a standard of knowledge modeled after our knowledge, of other people would be more accurate.

Code, influenced by examples like that of McClintock, argues for a remapping of the epistemic terrain. A model that posits knowing other people as a paradigmatic kind of knowing challenges the desirability or even possibility of the disinterested and dislocated view from nowhere. Code’s model of knowing other people is a dynamic, interactive model. It is a vision of a process of coming to know, “knowing other people in relationships requires constant learning: how to be with them, respond to them, and act toward them” (Code, 1993, p. 33). It is a model of knowledge that admits of degree, that is not fixed or complete, that is not primarily propositional, and is acquired interactively.

Code’s model embraces the subjective components of the knowledge process illustrated in McClintock’s method, McClintock’s desire to develop an intimate relationship with the subject of her study, to take the time to listen, to get right down there, to develop a feeling for the organism, are all aspects of the knowing process accounted for by Code’s model. “Rocks, cells, and scientists are located in multiple relations to one another, all of which are open to analysis and critique. Singling out and privileging the asymmetrical observer-observed relation is but one possibility” (Code, 1991, p. 164). Code’s alternative model, unlike S-knows-that-p models, embraces McClintock’s metaphysical belief that nature, like other people, is far too complex to allow for complete and universal knowledge. For McClintock, our knowledge of nature will always be partial, always changing, always in process – just as is our knowledge of people. This is not a critique or belittlement of our knowledge capacities, but rather a recognition and appreciation of the extraordinary complexity and continual evolution of both nature and of people. Such recognition leads to a model of knowledge that embraces the importance of empathy and imagination as a resource for “letting the material tell you.” It is a model that, while acknowledging the importance of categories and theories, does not privilege them over and above the

importance of listening attentively and responsibly to the stories told to us – accounting for the differences rather than imposing a model upon the world.

Code's point and one that is shared by many feminist epistemologists is that the traditional image of the dispassionate scientist removed from her or his object of study has blinded us to the complexity of the possible relationships between subjects and objects. Code argues that McClintock gained her knowledge *because* of her engaged relationship with the object of her study. That is, McClintock's fascination with the maize is epistemically significant. She is drawn to it not just to predict the genetic patterns, but because she desires a full understanding of the organism in all its stages. When she refers to her study of maize, she does so with affection – "these were my friends."

Code posits nothing like an essential femininity that entails that all and only women will embrace an engaged style of knowledge production. She argues rather that McClintock's femaleness is one aspect of the complex conjunction of subjective factors at play in her practice of science. Code's goal and the goal of other feminists is to open epistemology and science education and practice to the importance of such subjective features and to argue that S-knows-that-p models of scientific knowledge are inadequate to the full complexity of knowing. Code's intention is to reclaim subjective components of the knowledge process, components often defined as "feminine" and suppressed from traditional accounts. The aim is not to create a "feminine" science, but "to make a space in scientific research for suppressed practices and values that, coincidentally or otherwise, are commonly associated with 'the feminine'" (Code, 1991, p. 152).

Embodied Knowers

The feminist rejection of the supposedly "generic" knower thus requires that attention be paid to the characteristics and situation of the knower as an important part of the knowledge process. As illustrated in my example of Zihlman's practice of science, the various communities of which one is a part, including one's political beliefs, can be epistemically significant to the knowledge process. As we see with McClintock, a knower's emotive capacities and her or his openness to their relevance to the knowing process, can also be epistemically significant. This is the content of Code's claim that a person's gender can

be epistemically significant. In contemporary Western culture, one who is female is more likely than one who is male to be socialized in such a way as to make her more proficient in and accepting of the usefulness of emotions such as empathy and imagination. Just as a feminist is more likely to question the categorization of female activities as "natural" and male activities as "cultural," a woman in contemporary Western culture is more likely to be accepting of and skilled in the employment of emotions in the knowledge process.

But an additional aspect of the knowing subject that is epistemically significant is the fact of and nature of their embodiment. The model of the generic knower has traditionally rejected the relevance of our bodily differences. Attention to the body calls attention to the specificities and partiality of human knowledge, as well as reminding us of the importance of acknowledging the body, and its variations, in the knowledge process. Once we admit the body into our theories of knowledge, we must also recognize its variations; we must, for example, examine the ways in which bodies are "sexed."⁷

Vision

Traditional models of knowledge privilege vision over the other senses. The association of knowledge and vision provides a model of knowledge as disembodied. Vision, perceived as the most detached of the senses, is employed in such a way as to conceal the action of the body. The world appears to my gaze without any apparent movement or action on my part. The action of the body disappears into the background and with it as a model of knowledge, the philosopher places the world at a distance from the observer, thereby dematerializing knowledge. The perceived scene, as well as the perceiver, is to be physically unaffected by the gaze.

There have been many studies that have examined the ways in which this conception of vision has shaped traditional Western conceptions of knowledge.⁸ The construction of an image of reason based on metaphors of vision has led to the notion of a "mind's eye" and a conception of knowledge in which the world is separated from the observer who sees it and thereby gains knowledge of it, without in any way contaminating it or being affected by it.

But these disembodied images of vision are possible only by "forgetting" the fact of our embodiment. What we are capable of seeing and what we attend to are part of our location within the world. Let me begin by using

a very different case study than those I've so far employed. Let us think about frogs and dogs.⁹

There are many ways to remember the significance of the situatedness of vision and thereby inhibit the tendency to use visual metaphors to construct allegedly generic images of reason. One of these is to reflect upon the significance of the specificities of human vision. A frog's visual cortex is different from ours. Neural response is linked to small objects in rapid, erratic motion. Objects at rest elicit little neural response and large objects evoke a qualitatively different response than small ones. Although this makes sense for frogs, let us imagine, along with Katherine Hayles, that a frog is presented with Newton's law of motion:

The first law, you recall, says that an object at rest remains so unless acted upon by a force. Encoded into the formulation is the assumption that the object stays the same; the new element is the force. This presupposition, so obvious from a human point of view, would be almost unthinkable from a frog's perspective, since for the frog moving objects are processed in an entirely different way than stationary ones. Newton's first law further states, as a corollary, that an object moving in a straight line continues to move so unless compelled to change by forces acting upon it. The proposition would certainly not follow as a corollary for the frog, for variation of motion rather than continuation counts in his perceptual scheme. Moreover, it ignores the *size* of the object, which from a frog's point of view is crucial to how information about movement is processed (Hayles, 1993, p. 28).

The point is that bodily differences in perceptual organs and neural patterns organize perception in highly specific, in this case species specific, ways. Far from being the neutral receptor or static mirroring of the visual metaphors informing traditional accounts of knowledge, observation is a dynamic process of organization in which our bodily being plays a central role.

The image of disembodied vision is similarly discounted by imagining a walk with one's dog. Haraway reminds us of the lessons that can be learned from such a walk. "I learned in part walking with my dog and wondering how the world looks without a fovea and very few retinal cells for colour vision, but with a huge neural processing and sensory area for smells. . . . [that] all eyes, including our own organic ones, are active perceptual systems, building in translations and specific *ways* of seeing, that is ways of life" (Haraway, 1991, p. 190).

Although the walk with your dog may remind you of human emphasis on color and shape over a canine

attention to smell, it may also remind you, depending on your focus of attention, of the essential and intimate connection of vision with our kinaesthetic sense and our sense of touch. As you walk through a meadow you may meditate upon the way in which your two eyes integrate to produce a unified vision of your dog, and as you reach out to pet her be reminded of the ways in which vision is woven together with motility and touch. Such a walk can impress upon us the realization that the image of vision as disembodied is a circumscribed perspective, and that its emphasis has been the result of complex factors. That is, it is an example of a partial, situated knowledge.

When we consider the human specificities of vision, those mandated by our bodies as well as by the social contexts which shape our experiences of it, we are reminded that the privileging of an image of vision which views it as passive, detached, and disinterested is itself a partial and biased perspective. As any loving parent who looks into the eyes of her or his six month old child or any lover who gazes into the eyes of the person she or he loves know, vision can also be a way in which we actively connect and interact with other people. It can be a way in which we express feelings and negotiate our relationships. Such vision is active, engaged, and reciprocal. An emphasis on vision as passive, detached, and disinterested is a situated vision, one that arises out of particular social situations and values. We are reminded again that vision, as well as objectivity, is not about neutrality, but is embedded in particular and specific embodiments.

A recognition of the epistemic importance of our embodiment requires a conception of knowledge as embodied, in which the emphasis on vision as the primary source of knowledge is replaced by an appreciation of the multiplicity of senses involved in the process of knowledge and an understanding of the ways in which faculties such as empathy, intuition, and reason enter into and interact in this process. [...]

Conclusion

As a final example I would like to quickly mention the ways in which this study, and others like it, serve as case studies of the very model of knowledge I am here professing. Much of feminist scholarship and practice over the last two decades has been devoted to revaluing the importance of interpersonal relationships. Many feminist political

theorists have argued that we must revalue the so-called “private realm” of relationships. Psychoanalytic feminists have called attention to the centrality of interpersonal relationships in the development of our personalities, our genders, and our desires. Feminist ethicists have offered and examined an ethics of care in which moral action is intimately linked to our relationships with others. Add to this the fact that women’s prescribed social role of primary caretakers of children, of the elderly, and of the ill, contributes to a heightened sensitivity to the fact and importance of our essential relationality and our embodiment, and it should be no surprise that it is feminist philosophers of science and epistemologists who are vociferously rejecting the Cartesian model of the isolated knowing subject and replacing it with models that emphasize the centrality of our relationships with others to the process of knowing.¹⁰

I and many other feminists came to positions like these *because* of our participation in feminist communities. This obviously was not the only epistemically significant community; we are also philosophers, historians, sociologists, and scientists. Nor does it mean that *only* feminists will hold such views. There are many theorists of science who do not participate in feminist communities who argue for versions of the above tenets. But a difference of feminist analyses is the persistent attention to gender as a variable of analysis. This is how our feminism is epistemologically significant.

What feminist epistemologists have realized is that it is a mistake to ask for a value-free science. As illustrated in the example of McClintock’s “feeling for the organism,” the development of knowledge, including scientific knowledge, is affectively influenced. And as the example of primatology illustrates, we cannot treat politics as *inherently* distorting the practice of science. Scientific research, as well as all cognitive endeavors, begins with metaphysical and methodological commitments. It arises out of and is conditioned by our participation in various epistemic communities. Each of us, in being part of a community and a number of subcommunities, participates in an evolving conceptual scheme that makes intersubjective experience possible, influence our interests and desires, and also sets the standards of what constitutes evidence.

The acceptance of the essentially relational nature of knowledge and the inseparability of subjective and objective components of knowledge does not result in relativism, though it does require an abandonment of the traditional “view-from-nowhere” conception of objectivity. This alternative notion of objectivity has been the research program of many feminist philosophers of science ... (see, e.g.,

Harding, Longino, Nelson). Although I will refer you to their work for the details of feminist accounts of objectivity, let me call attention to yet another way the development of feminist epistemologies are compatible with the model offered. Although there are significant differences between feminist epistemologies, one common tenet is the emphasis on diversity within the scientific community to ensure objectivity. To cite just one of many possible examples, consider Helen Longino’s claim that

...because background assumptions can be and most frequently are invisible to the members of the scientific community for which they are background and because unreflective acceptance of such assumptions can come to define what it is to be a member of such a community (thus making criticism impossible), effective criticism of background assumptions requires the presence and expression of alternative points of view. This sort of account allows us to see how social values and interests can become enshrined in otherwise acceptable research programs (i.e., research programs that strive for empirical adequacy and engage in criticism). As long as representatives of alternative points of view are not included in the community, shared values will not be identified as shaping observation or reasoning (Longino, 1993, pp. 111–12).

Once again we see the impact of the politics of feminism upon the development of feminist epistemology, for a central emphasis of feminism has been the importance of inclusion of previously excluded groups and viewpoints. Earlier feminist accounts focused on the impact of including women and attention to gender upon society, scholarly methods, politics, and so on. The last decade has intensified this commitment as feminists have become aware of the differences between women and have acknowledged the ways in which attention to such factors as class, race, and sexuality, as well as gender, reveals previously hidden assumptions and opens up new research programs.

Feminist philosophers of science have thus actively developed research programs consistent with the values and commitments we express in the rest of our lives. In this sense we are creating “feminist sciences,” the doing of science from the politics of feminism. We also acknowledge the need for science to be open to diverse groups of individuals and to have these groups engage in what Longino calls “an interactive dialogic community” (Longino, 1993, p. 113). This is not a simple pluralism, but one in which critical interchange between communities is highly valued. This, of course, does not mean that “anything goes.” Although scientific standards are not seen as unchanging or unresponsive to such critical

interaction, they do provide standards for acceptability. The “woman, the gatherer” model in human evolution studies arises out of a feminist political agenda yet meets the standards set by the field in which it is proposed. And this is important. Only if these alternative models receive a hearing within the scientific community will they ever secure serious attention.

A value implicit in this vision of science is that the best form of science will be that which is the product of the most inclusive scientific community. This suggests that the problem of developing a new science is the problem of creating a new social and political reality.

Notes

- 1 A relatively recent correction of contemporary feminist theory in general and feminist philosophy of science in particular is that theories that do not attend to the interactions of various forms of oppression, including class, race, and sexuality, distort the nature of gender oppressions. For an important contribution to this discourse in relation to science studies see Harding, 1993.
- 2 Harding, 1992. See also Proctor, 1991.
- 3 Accounts of “woman, the gatherer” theories can be found in Haraway, 1989; Longino, 1990; and Nelson, 1990. My analysis here is thoroughly influenced by Haraway’s *Primate Visions*.
- 4 For a more detailed argument in support of this position see Haraway, 1989.
- 5 See Keller, 1984 and 1992.
- 6 See Code, 1991 and 1993; Jaggar, 1989; Keller, 1984; Longino, 1990; Nelson, 1990; and Rose, 1983 and 1994.
- 7 Although I do not have the time to develop this point, I feel it is too important not to mention and to urge readers to explore the work done on this topic in the writings of feminists such as Rosi Braidotti, Elizabeth Grosz, and Luce Irigaray.
- 8 See Code, 1991; Keller and Grontkowski, 1983; Jonas, 1966; Leder, 1990; Merleau-Ponty, 1962; and Rorty, 1979.
- 9 My account here is influenced by Haraway, 1989 and Hayles, 1993, dogs and frogs respectively.
- 10 I am *not* claiming that feminists are the only theorists developing such a model, but that there is an epistemic link between this model of the subject of knowledge and the politics of feminism.

References

- Benhabib, Seyla: 1987, “The Generalized and the Concrete Other: The Kohlberg-Gilligan Controversy and Feminist Theory,” in Seyla Benhabib and Drucilla Cornell (eds), *Feminism us Critique: On the Politics of Gender*. University of Minnesota Press, Minneapolis.
- Code, Lorraine: 1991, *What Can She Know? Feminist Theory and the Construction of Knowledge*. Cornell University Press, Ithaca.
- Code, Lorraine: 1993, “Taking Subjectivity into Account,” in Linda Alcoff and Elizabeth Potter (eds), *Feminist Epistemologies*. Routledge, New York, pp. 15–48.
- Haraway, Donna: 1989, *Primate Visions: Gender, Race and Nature in the World of Modern Science*. Routledge, New York.
- Haraway, Donna: 1991, “Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective,” in *Simians, Cyborgs, and Women: The Reinvention of Nature*. Routledge, New York.
- Harding, Sandra: 1991, *Whose Science? Whose Knowledge?* Cornell University Press, Ithaca.
- Harding, Sandra: 1992, “After the Neutrality Ideal: Science, Politics, and ‘Strong Objectivity,’” *Social Research*, 59, 567–87.
- Harding, Sandra: 1993, *The “Racial” Economy of Science: Toward a Democratic Future*. Indiana University Press, Bloomington.
- Hayles, N. Katherine: 1993, “Constrained Constructivism: Locating Scientific Inquiry in the Theater of Representation,” in George Levine (ed.), *Realism and Representation*. University of Wisconsin Press, Madison.
- Jaggar, Alison: 1989, “Love and Knowledge: Emotion in Feminist Epistemology,” in Susan Bordo and Alison Jaggar (eds), *Gender/Body/Knowledge*. Rutgers University Press, New Brunswick.
- Jonas, Hans: 1966, *The Phenomenon of Life*. Chicago University Press, Chicago.
- Keefer, Chester: 1994, “Skillful Listening,” *Cortland Forum*, June, 74.
- Keller, Evelyn Fox: 1983, *A Feeling for the Organism*. W. H. Freeman and Company, New York.
- Keller, Evelyn Fox: 1984, *Reflections on Gender and Science*. Yale University Press, New Haven.
- Keller, Evelyn Fox: 1992, *Secrets of Life, Secrets of Death: Essays on Language, Gender and Science*. Routledge, New York.
- Keller, Evelyn Fox and Christine R. Grontkowski: 1983, “The Mind’s Eye,” in Sandra Harding and Merrill B. Hindkka (eds), *Discovering Reality*. D. Reidel, Dordrecht, pp. 207–224.
- Leder, Drew: 1990, *The Absent Body*. University of Chicago Press, Chicago.

- Longino, Helen: 1990, *Science as Social Knowledge*. Princeton University Press, Princeton.
- Longino, Helen: 1993, "Subjects, Power, and Knowledge: Description and Prescription in Feminist Philosophies of Science," in Linda Alcoff and Elizabeth Potter (eds), *Feminist Epistemologies*. Routledge, New York, pp. 101–120.
- Merleau-Ponty, Maurice: 1962, *Phenomenology of Perception*, trans. Colin Smith. Routledge and Kegan Paul, London.
- Nelson, Lynn Hankinson: 1990, *Who Knows: From Quine to a Feminist Empiricism*. Temple University Press, Philadelphia.
- Proctor, Robert N: 1991, *Value-Free Science? Purity and Power in Modern Knowledge*. Harvard University Press, Cambridge.
- Rose, Hilary: 1983, "Hand, Brain and Heart: A Feminist Epistemology for the Natural Sciences," *Signs*, 9, 73–90.
- Rose, Hilary: 1994, *Love, Power, and Knowledge: Towards a Feminist Transformation of the Sciences*. Indiana University Press, Bloomington.
- Rorty, Richard: 1979, *Philosophy and the Mirror of Nature*. Princeton University Press, Princeton.
- Slocum, Sally Linton: 1971, "Woman the Gatherer: Male Bias in Anthropology," in Sue-Ellen Jacobs (ed.), *Women in Perspective: A Guide for Cross Cultural Studies*. University of Illinois Press, Urbana.
- Washburn, Sherwood L. and C. S. Lancaster: 1976, "Evolution of Hunting," in R. B. Lee and I. De Vore (eds), *Kalahari Hunter – Gatherers*. Harvard University Press, Cambridge.

Is Science Multicultural?

Sandra Harding

Challenges and Resources

Are the natural sciences multicultural? Could they and should they be? Such questions initially may seem ignorant, or at least odd, since it is exactly the lack of cultural fingerprints that conventionally is held responsible for the great successes of the sciences. The sciences “work,” they are universally valid, it is said, because they transcend culture. They can tell us how nature really functions rather than merely how the British, Native Americans, or Chinese fear or want it to work.

There are good reasons to wonder whether one should regard this “universal science” claim as ending the matter, however. Multicultural perspectives are providing more-comprehensive and less-distorted understandings of history, literature, the arts, and the social sciences. They are beginning to reshape public consciousness as they are disseminated through television specials, new elementary and high-school history and literature textbooks, and, indeed, daily news reports of perspectives on the West (or should one say the “North”?) that conflict with the conventional beliefs that many Westerners now understand to be Eurocentric. Do the challenges raised by multicultural perspectives in other fields have no consequences for the natural sciences?

We can identify three central questions for anyone who wishes to explore this issue. First, to what extent does modern science have origins in non-European

cultures? Second, have there been and could there be other sciences, culturally distinctive ones, that also “work” and thus are universal in this sense? Third, in what ways is modern science culturally European or European-American? Fortunately, pursuit of these questions has been made easier by the appearance in English recently of a small but rich set of writings on such topics. These “postcolonial science studies,” as I shall refer to them, are authored by scientists and engineers, a few anthropologists, and historians of science, who are of both European and Third World descent (the latter live in the Third *and* First Worlds).

The proceedings of two recent conferences give a sense of the increasing international interest in these topics. *Science and Empires: Historical Studies about Scientific Development and European Expansion* contains about one-third of the 120 papers presented at a UNESCO-sponsored conference in Paris in 1986. The conference was organized by the French government’s National Center for Scientific Research, and these proceedings are published by one of the most prestigious and largest science studies publishers in the world. *The Revenge of Athena: Science, Exploitation and the Third World* contains twenty of the thirty-five or so papers presented at a 1986 conference in Penang, Malaysia, where Asian scientists, engineers, and science policy analysts were joined by several historians of science of European descent. The final version of the conference’s policy statement, the

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Third World Network's *Modern Science in Crisis: A Third World Response*, has been published separately.¹

Now is none too soon to note that the terms of this discussion are and must be controversial, for whoever gets to name natural and social realities gets to control how they will be organized. Moreover, it is not just language that is at issue, but also a "discourse" – a conceptual framework with its logic linking my words in ways already familiar to readers – that is adequate to the project of this essay.² For example, for conventional science theorists it is controversial to use the term "science" to refer to the sciences' social institutions, technologies and applications, metaphors, language, and social meanings: they insist on restricting the term's reference to sciences' abstract cognitive core – the laws of nature – and/or the legendary scientific method, thereby excluding the other parts of sciences' practices and culture, which many contemporary science theorists insist are also fundamental constituents of the sciences.³

Moreover, the terms of multicultural discourse are and must be controversial. Do my references to "Western" replicate the dualistic, orientalist thinking that has been so widely criticized? Is it not precisely from the borderlands between "Western" and "non-Western" that this paper and the thought of its cited authors arise?⁴ How "Western" is Western science anyway (a topic to be pursued below)? And which of the diverse peoples currently living in Europe and North America get to count as Western? Is Japan "non-Western" and "Third World"? Additionally, Third World cultures are immensely diverse, and they are internally heterogeneous by class, gender, ethnicity, religion, politics, and other features. Does ignoring or marginalizing these differences not disseminate characteristic Eurocentric tendencies to homogenize, and to refuse to think carefully about, peoples that Westerners have constructed as their Others? Furthermore, does "neocolonial" not designate better than "postcolonial" the present relations between the West and its former colonies? And are African and Indigenous Americans appropriately thought of as "colonized"? What are the politics of continuing to refer to the First and Third Worlds, when this contrast is the product of the Eurocentric Cold War? Finally, should the knowledge traditions of non-Western cultures be referred to as "sciences" rather than only as "ethnoscience" (a topic I take up below)?

We cannot easily settle such questions. In some cases, it is the familiar languages that are at issue in the questions raised in this essay. In other cases, less-controversial

terms have not yet been found or have not yet reached general circulation. Moreover, changing language sometimes advances the growth of knowledge – but in other cases it simply substitutes an acceptable veneer under which ignorance and exploitative politics can continue to flourish. Discourses, conceptual schemes, paradigms, and epistemes are at issue, not just words. I hope readers can penetrate beyond these inadequate languages to the issues that can help us develop less-problematic thinking, speech, and actions. I shall primarily use the terms that the postcolonial authors use, though their own usages are diverse and sometimes conflicting.

One term worth clarifying, however, is "Eurocentrism." Here I refer to a cluster of assumptions, central among which are that peoples of European descent, their institutions, practices, and conceptual schemes, express the unique heights of human development, and that Europeans and their civilization are fundamentally self-generated, owing little or nothing to the institutions, practices, conceptual schemes, or peoples of other parts of the world.⁵ If Western sciences and science studies turn out to be Eurocentric, we are likely to discover possibilities of multiculturalism in the natural sciences that have been hidden from view.

One last issue: Who is the "we" of this paper? In relation to its topics, I am positioned as a woman of European descent, and economically privileged. But the "we" I invoke is meant to include all people – regardless of their ethnicity, "race," nationality, class, gender, or other significant features of their location in local and global social relations – who are concerned to rethink critically those social relations past and present and the role of the sciences in them, and who wish to bring about more effective links between scientific projects and those of advancing democratic social relations.

The universal science view – that modern sciences are uniquely successful exactly because they have eliminated cultural fingerprints from their results of research – incorporates some assumptions that are probably false, or that at least have not been supported by evidence. For example, it assumes that no other sciences could generate the laws of gravity, or antibiotics; that modern science does not also "work" for producing human and natural disasters; that what has worked best to advance the West will and should work best to advance other societies; that modern sciences are the best ones for discovering all of the laws of nature; and that the kinds of projects for which modern sciences have worked best in the past are the ones at which any possible sciences – past, present,

and future – should want to succeed.⁶ Yet in spite of these problematic assumptions, the conventional view contains important insights. Such insights are more reasonably explained, however, in ways that give up these problematic assumptions and locate modern sciences on the more accurate historical and geographical maps produced by the postcolonial accounts.⁷

Let us turn to the three questions that will help to determine the degree to which science may be multicultural.

Question 1: Does Modern Science Have non-Western Origins?

The least controversial response is to acknowledge that modern sciences have borrowed from other cultures. Most people are aware of at least a couple of such examples. However, the borrowings have been far more extensive and important than the conventional histories reveal. Modern sciences have been enriched by contributions not only from the so-called complex cultures of China, India, and other east Asian and Islamic societies, but also from the so-called simpler ones of Africa, the pre-Columbian Americas, and others that interacted with the expansion of European cultures.

To list just a few examples: Egyptian mystical philosophies and premodern European alchemical traditions were far more useful to the development of sciences in Europe than is suggested by the conventional view that these are only irrational and marginally valuable elements of immature Western sciences.⁸ The Greek legacy of scientific and mathematical thought was not only fortuitously preserved but also developed in Islamic culture, to be claimed by the sciences of the European Renaissance.⁹ Furthermore, the identification of Greek culture as European is questionable on several counts. For one thing, the idea of Europe and the social relations that such an idea made possible only came into existence centuries later: some would date the emergence of “Europe” to Charlemagne’s achievements; others, to fifteenth-century events. Another point here is that through the spread of Islam, diverse cultures of Africa and Asia can also claim Greek culture as their legacy.¹⁰

Some knowledge traditions that were appropriated and fully integrated into modern sciences are not acknowledged at all. Thus the principles of pre-Columbian agriculture, which provided potatoes for almost every European ecological niche and thereby

had a powerful effect on the nutrition and subsequent history of Europe, were subsumed into European science.¹¹ Mathematical achievements from India and Arabic cultures provide other examples. The magnetic needle, the rudder, gunpowder, and many other technologies useful to Europeans and the advance of their sciences (were these not part of scientific instrumentation?) were borrowed from China. Knowledge of local geographies, geologies, animals, plants, classification schemes, medicines, pharmacologies, agriculture, navigational techniques, and local cultures that formed significant parts of European sciences’ picture of nature were provided in part by the knowledge traditions of non-Europeans. (“We took on board a native of the region, and dropped him off six weeks further up the coast,” reputedly report voyagers’ accounts.) Summarizing the consequences for modern sciences of British imperialism in India, one recent account points out that in effect “India was added as a laboratory to the edifice of modern science.”¹² We could say the same for all of the lands to which the “voyages of discovery” and later colonization projects took the Europeans.¹³

Thus modern science already is multicultural, at least in the sense that elements of the knowledge traditions of many different non-European cultures have been incorporated into it. There is nothing unusual about such scientific borrowing: it is evident in the ordinary, everyday borrowing that occurs when scientists revive models, metaphors, procedures, technologies, or other ideas from older European scientific traditions, or when they borrow such elements from the culture outside their laboratories and field stations, or from other contemporary sciences.¹⁴ After all, a major point of professional conferences and international exchange programs, not to mention “keeping up with the literature,” is to permit everyone to borrow everyone else’s achievements. As we shall shortly see, without such possibilities, sciences wither and lose their creativity. What is at issue here is only the Eurocentric failure to acknowledge the origins and importance to “real science” of these borrowings from non-European cultures, thereby trivializing the achievements of other scientific traditions.

To give up this piece of Eurocentrism does not challenge the obvious accomplishments of modern sciences. Every thinking person should be able to accept the claim that modern science is multicultural in this sense. Of course, it is one thing to accept a claim that conflicts with one’s own, and quite another to use it to

transform one's own thinking. To do the latter would require historians of science and the rest of us to locate our accounts on a global civilizational map, rather than only on the Eurocentric map of Europe that we all learned.

There are implications here also for philosophies and social studies of science. For example, the standard contrast of the objectivity, rationality, and progressiveness of modern scientific thought vs. the only-locally-valid, irrational, and backward or primitive thought of other cultures begins to seem less explanatorily useful and, indeed, less accurate after the postcolonial accounts. Whether overtly stated or only discreetly assumed, such contrasts damage our ability not only to appreciate the strengths of other scientific traditions, but also to grasp what are the real strengths and limitations of modern sciences.

These accounts of multicultural origins do not directly challenge the conventional belief that modern sciences uniquely deserve to be designated sciences, however, or that they are universally valid because their cognitive/technical core transcends culture. Other arguments in the postcolonial accounts do.

Question 2: Have There Been or Could There Be Other, Culturally Distinctive Sciences That “Work”?

Do any other knowledge traditions deserve to be called sciences? The conventional view is that only modern sciences are entitled to this designation. In such an account, science is treated as a cultural emergent in early modern Europe. While a shift in social conditions may have made it possible in the first place, what emerged was a form of knowledge-seeking that is fundamentally self-generating; its “internal logic” is responsible for its great successes. This “logic of scientific research” has been characterized in various ways – as inductivism, crucial experiments, the hypothetico-deductive method, or a cycle of normal science–revolution–normal science. Whatever the logic attributed to scientific research, it is conceptualized as “inside” science, and not “outside” it “in society.” Though Chinese or African astronomers may have made discoveries before Europeans, this is not sufficient to indicate that the former were really doing what is reasonably regarded as “science.”¹⁵ Thus while science is said to need a supportive social climate in order to flourish, the particular form of that climate is

claimed to leave no distinctive cultural fingerprints on science's results of research.

Is this a reasonable position? Is the content of the successes of modern sciences due entirely to the sciences' “internal” features? For one thing, not all of the successes attributed to Western science are unique to it. In many cases, “what has been ascribed to the European tradition has been shown on closer examination to have been done elsewhere by others earlier. (Thus Harvey was not the first to discover the circulation of blood, but an Arabic scientist was; Paracelsus did not introduce the fourth element ‘salt’ and start the march towards modern chemistry, but a twelfth-century alchemist from Kerala did so teaching in Saudi Arabia.)”¹⁶ Many other cultures made sophisticated astronomical observations repeated only centuries later in Europe. For example, many of the observations that Galileo's telescope made possible were known to the Dogon peoples of West Africa more than 1500 years earlier: either they had invented some sort of telescope, or they had extraordinary eyesight.¹⁷ Many mathematical achievements of Indians and other Asian peoples were adopted or invented in Europe much later. Indeed, it is as revealing to examine the ideas that European sciences *did not* borrow from the knowledge traditions they encountered as it is to examine what they did borrow. Among the notions “unborrowed” are the ability to deal with very large numbers (such as 1053), the zero as a separate number with its own arithmetical logic, and irrational and negative numbers.¹⁸

Joseph Needham points out that “between the first century B.C. and fifteenth century A.D. Chinese civilization was much more efficient than the occidental in applying human natural knowledge to practical human needs.... in many ways this was much more congruent with modern science than was the world outlook of Christendom.”¹⁹ Thus other knowledge traditions “worked” at projects that Western sciences could accomplish only much later. If the achievements of modern science should be attributed to its “internal logic,” then evidently this logic is not unique to it.

This brings us to a second point: Nobody has discovered an eleventh commandment handed down from the heavens specifying what may and may not be counted as a science. Obviously the project of drawing a line between science and nonscience is undertaken because it emphasizes a contrast thought to be important. Belief in the reality of this demarcation, as in the reality of the science vs. pseudo-science duality, is necessary in order to preserve the mystique of the uniqueness and purity of

the West's knowledge-seeking. Thus the sciences, as well as the philosophies that are focused on describing and explaining the kind of rationality so highly valued in the modern West, have been partners with anthropology in maintaining a whole series of Eurocentric contrasts – whether or not individual scientists, philosophers, or anthropologists so intended. The self-image of the West depends on contrasts, not only between the rational and irrational, but also between civilization and the savage or primitive, the advanced or progressive and the backward, dynamic and static societies, developed and undeveloped, the historical and the natural, the rational and the irrational. Through these and other contrasts the European Self has constructed its Other, and has thereby justified its exploitative treatment of various peoples.²⁰ My point here is that even though there clearly are obvious and large differences between modern sciences and the traditions of seeking systematic knowledge of the natural world to be found in other cultures, it is useful to think of them all as sciences in order to gain a more objective understanding of the causes of Western successes, the achievements of other sciences, and possible directions for future local and global sciences.²¹

One cannot avoid noticing, moreover, that European scholars disagree on exactly which distinctive features are responsible for the success of European sciences. It is instructive to look at four accounts of Western scientific uniqueness made by distinguished and otherwise progressive Western analysts – ones whose work has in important ways challenged conventional Eurocentric assumptions. Anthropologist Robin Horton, who has shown how African traditional thought is surprisingly similar to Western scientific thought, attributes the residual crucial differences to the fact that modern scientific thought takes a critical stance toward tradition and is aided in this project by its rejection of magical relations between language and the world; it holds that we can manipulate language without thereby changing the world.²² However, as philosopher J. E. Wiredu points out, Horton undervalues the extent to which noncritical and dogmatic assumptions prevail in modern Western scientific thought. After all, “classical” British empiricism is “traditional thought” for Western scientific communities and those who value scientific rationality: the once-radical claims of Locke and Hume have become uncontroversial assumptions for us – and yet an anthropologist from another culture might refer to them as our “folk beliefs.” So how accurate is it to claim that a critical approach to tradition is responsible for the successes of

modern sciences? Moreover, if science is modern in its rejection of magical relations between language and the world, scientists surely are not, Wiredu continues, since many also hold religious beliefs that invest in just such magical relations.²³ Many commentators have noted the sacred – dare one say “magical” – faith in the accuracy and progressiveness of modern science that is characteristic of many scientists and of the “educated classes” more generally.

Historian Thomas Kuhn would agree with Wiredu's assessment that Western sciences are in significant respects uncritical of conventional assumptions; indeed, he argues that they are dogmatic in rejecting a thoroughgoing critical attitude. However, he has explained that this scientific dogmatism is not an obstacle to scientific progress but, instead, a crucial element in its success. A field becomes a science only when it no longer questions a founding set of assumptions within which it can then get on with the business of designing research projects to resolve the puzzles that such assumptions have brought into focus. He attributes the unique successes of modern sciences to the distinctive (progressive?) organization of Western scientific communities: “only the civilizations that descended from Hellenic Greece have possessed more than the most rudimentary science. The bulk of scientific knowledge is a product of Europe in the last four centuries. No other place and time has supported the very special communities from which scientific productivity comes.”²⁴ Though one might think that a social community is not “internal” to the logic of science, Kuhn insists that in an important sense it is; the “very special” scientific communities are ones trained to follow modern science's success-producing internal logic of paradigm creation, puzzle solving with anomaly tolerance, paradigm breakdown, and then, eventually, another paradigm shift. Kuhn directed attention to the importance of the distinctive social organization of modern scientific communities. However, one can also see that his problematic here, his concern to identify a different, distinctive cause of modern science's successes, is inseparable in his thought from the widespread Eurocentric assumptions he articulates about the origins and virtues of European civilization.

Historian Joseph Needham – who does refer to Chinese knowledge traditions as sciences when comparing them to those of the modern West, and who would contest Kuhn's characterization of non-European sciences as primitive and the West's as uniquely descended from the Greek – proposes yet another kind of cause of the success of modern European sciences:

When we say that modern science developed only in Western Europe at the time of Galileo in the late Renaissance, we mean surely that there and then alone there developed the fundamental bases of the structure of the natural sciences as we have them today, namely the application of mathematical hypotheses to Nature, the full understanding and use of the experimental method, the distinction between primary and secondary qualities, the geometrisation of space, and the acceptance of the mechanical model of reality. Hypotheses of primitive or medieval type distinguish themselves quite clearly from those of modern type.²⁵

For Needham, success came, not from the attitudes on which Horton focuses, nor from the organization of scientific communities that appears so important to Kuhn, but from a specific set of assumptions about the nature of reality and appropriate methods of research.

Finally, sociologist Edgar Zilsel, asking why modern science developed only in Renaissance Europe rather than in China or some other “high culture,” claims it was the emergence of a new social class that, in contrast to the classes of aristocratic or slave societies, was permitted to combine a trained intellect with willingness to do manual labor, that allowed the invention of experimental method. Only in early modern Europe, where there was an absence of slavery and where aristocracy was being challenged, was there a progressive culture, he implies, that gave individuals reasons to want to obtain both intellectual and manual training.²⁶

No doubt one could find additional features of the cultures and practices of modern sciences to which other historians would attribute their successes. These different purported causes are probably not entirely independent of each other, and each would win its supporters. However, my point is only that there is no general agreement, even among the most distinguished and progressive Western science theorists, about the distinctive causes of modern science, and that the search for such an explanation and the kinds of accounts on which such scholars settle usually remain tied to Eurocentric dualisms.

A third source of skepticism about conventional claims for the unique efficacy of Western sciences arises from an often-repeated argument in the postcolonial accounts: European sciences advanced because they focused on describing and explaining those aspects of nature’s regularities that permitted the upper classes of Europeans to multiply and thrive, especially through the prospering of their military, imperial, and otherwise expansionist projects. Interestingly, evidence for this

claim can now easily be gathered from many of the museum exhibits and scholarly publications associated with the 1992 quincentennial of the Columbian encounter, which drew attention, intentionally or not, to the numerous ways European expansion in the Americas advanced European sciences. A detailed account of how British colonialism in India advanced European sciences is provided by R. K. Kochhar. The British needed better navigation, so they built observatories, funded astronomers, and kept systematic records of their voyages. The first European sciences to be established in India were, not surprisingly, geography and botany.²⁷ Nor is the intimate relation between scientific advance in the West and expansionist efforts a matter only of the distant past (or only of expansion into foreign lands, as noted earlier): by the end of World War II, the development of U.S. physics had been virtually entirely handed over to the direction of U.S. militarism and nationalism, as historian Paul Forman has shown in detail.²⁸

Thus European expansionism has changed the “topography” of global scientific knowledge, causing the advance of European sciences and the decline or underdevelopment of scientific traditions of other cultures:

“The topography of the world of knowledge before the last few centuries could be delineated as several hills of knowledge roughly corresponding to the regional civilizations of, say, West Asia, South Asia, East Asia and Europe. The last few centuries have seen the levelling of the other hills and from their debris the erection of a single one with its base in Europe.”²⁹

These arguments begin to challenge the idea that the causes of modern science’s achievements are to be located entirely in their purported inherently transcultural character. It turns out that what makes them “work” (and appear uniquely to do so) is at least partly their focus on kinds of projects that European expansion could both advance and benefit from while simultaneously clearing the field of potentially rival scientific traditions. This is not to deny that Western sciences can claim many great and, so far, unique scientific achievements. Instead, it is to argue, contrary to conventional views, that scientific “truths,” no less than false beliefs, are caused by social relations as well as by nature’s regularities and the operations of reason.³⁰

But could there be other, culturally distinctive sciences that also “work”? The postcolonial accounts have shown how rich and sophisticated were the scientific traditions of Asia, Islam, and “simpler” societies of the past. But what about the future? We return to this issue shortly.

Question 3: Is Modern Science Culturally “Western”?³¹

The very accounts that have been describing the histories of other scientific traditions also show the distinctive cultural features of modern sciences. These features are, for better and worse, precisely those that are responsible for their successes, as the discussions above began to reveal. That is, the distinctive social/political history of the development of modern sciences is not external to their content: it appears in the image of nature’s regularities and the underlying causal tendencies that they produce, in the very “laws of nature” that form their cognitive/technical core. Here I can identify only five of the distinctively “Western” features persistently noted in the postcolonial literature.

First, as indicated above, the particular aspects of nature that modern sciences describe and explain, and the ways in which they are described and explained, have been selected in part by the conscious purposes and unconscious interests of European expansion. Of course these are not the only factors shaping these sciences – androcentric, religious, local bourgeois, and other purposes and interests have also had powerful effects, as many recent accounts have shown – but they are significant. The “problems” that have gotten to count as scientific are those for which expansionist Europe needed solutions; the aspects of nature about which the beneficiaries of expansionism have not needed or wanted to know have remained uncharted. Thus culturally distinctive patterns of both systematic knowledge and systematic ignorance in modern sciences’ picture of nature’s regularities and their underlying causal tendencies can be detected from the perspective of cultures with different preoccupations. For example, modern sciences answered questions about how to improve European land and sea travel, to mine ores, to identify the economically useful minerals, plants, and animals of other parts of the world, to manufacture and farm for the benefit of Europeans living in Europe, the Americas, Africa, and India, to improve their health (and occasionally that of the workers who produced profit for them), to protect settlers in the colonies from settlers of other nationalities, to gain access to the labor of the indigenous residents, and to do all this to benefit only local European citizens – the Spanish vs. the Portuguese, French, or British. These sciences have not been concerned to explain how the consequences of interventions in nature for the benefit of Europeans of the advantaged gender,

classes, and ethnicities would change the natural resources available to the majority of the world’s peoples, or what the economic, social, political, and ecological costs to less-advantaged groups in and outside Europe would be of the interventions in nature and social relations that science’s experimental methods “foresaw” and to which it directed policy-makers. Sciences with other purposes – explaining how to shift from unrenewable to renewable natural resources, to maintain a healthy but less environmentally destructive standard of living in the overdeveloped societies, to clean up toxic wastes, to benefit women in every culture, and so on – could generate other, perhaps sometimes conflicting, descriptions and explanations of nature’s regularities and underlying causal tendencies.

Second, early modern sciences’ conception of nature is distinctively Western, or at least alien to many other cultures. For the resident of medieval Europe, nature was enchanted; the “disenchantment of nature” was a crucial element in the shift from the medieval to the modern mentality, from feudalism to capitalism, from Ptolemaic to Galilean astronomy, and from Aristotelian to Newtonian physics.³² Modern science related to a worldly power in nature, not to power that lay outside the material universe. To gain power over nature would, for modern man, violate no moral or religious principles.

Moreover, the Western conception of laws of nature drew on both Judeo-Christian religious beliefs and the increasing familiarity in early modern Europe with centralized royal authority, with royal absolutism. Needham points out that this Western idea that the universe was a “great empire, ruled by a divine Logos”³³ was never comprehensible at any time in the long history of Chinese science because a common thread in the diverse Chinese traditions was that nature was self-governed, a web of relationships without a weaver, with which humans interfered at their own peril: “Universal harmony comes about not by the celestial fiat of some King of Kings, but by the spontaneous co-operation of all beings in the universe brought about by their following the internal necessities of their own natures. ... [A]ll entities at all levels behave in accordance with their position in the greater patterns (organisms) of which they are parts.”³⁴ Compared to Renaissance science, the Chinese conception of nature was problematic, blocking their interest in discovering “precisely formulated abstract laws ordained from the beginning by a celestial lawgiver for non-human nature”: “There was no confidence that the code of Nature’s laws could be unveiled and read, because there was no assurance that a divine being, even

more rational than ourselves, had ever formulated such a code capable of being read.”³⁵

Of course, such notions of “command and duty in the ‘Laws’ of Nature” have disappeared from modern science, replaced by the notion of statistical regularities that describe rather than prescribe nature’s order – in a sense, a return, Needham comments, to the Taoist perspective. And yet other residues of the earlier conception remain. Evelyn Fox Keller has pointed to the positive political implications of conceptualizing nature simply as ordered rather than as law-governed.³⁶ My point here is only that Western conceptions of nature have been intimately linked to historically shifting Western religious and political ideals.

Third, the European, Christian conception of the laws of nature was just one kind of regional resource used to develop European sciences – elements of medieval scientific and classical Greek thought, and other religious, national, class, and gender metaphors, models, and assumptions also were available. The adoption of these cultural resources is familiar from the writings of conventional historians of Western sciences. In the context of the post-colonial literatures, these now appear as distinctively European cultural elements, ones that make modern sciences foreign to peoples in many other cultures.

Another kind of regional resource available only “in Europe” was created through the intermingling and integration of non-European elements with each other and with resources already available in Europe to make more useful elements for modern science. That is, the non-European elements indicated above were not only borrowed, but also frequently transformed through processes possible only for a culture at the center of global exchanges. Thus the map and route of European expansion could be traced in the expansion of the content of European sciences. Prior to European expansion, African, Asian, and indigenous American cultures had long traded scientific and technological ideas among themselves as they exchanged other products, but this possibility was reduced or eliminated for them and transferred to Europe during the “voyages of discovery.”³⁷

Fourth, the way peoples of European descent both distribute and account for the consequences of modern sciences appears distinctively Western: the benefits are distributed disproportionately to already-overadvantaged groups in Europe and elsewhere, and the costs disproportionately to everyone else. Whether one looks at sciences intended to improve the military, or agriculture, or manufacturing, or health, or even the environment, the expanded opportunities that they make possible have been

distributed predominantly to small minorities of already privileged people primarily (but not entirely) of European descent, and the costs to the already poorest, racial and ethnic minorities and women located at the periphery of local and global economic and political networks.³⁸

The causes of this distribution are not mysterious or unforeseen. For one thing, it is not “man” whom sciences enable to make better use of nature’s resources, but only those already positioned in social hierarchies. As Khor Kok Peng puts the point, the latter already own and control both nature, in the form of land with its forests, water, plants, animals, and minerals, and the tools to extract and process such resources. These people are the ones who are in a position to decide “what to produce, how to produce it, what resources to use up to produce, and what technology to use”:

We thus have this spectacle, on the one hand, of the powerful development of technological capacity, so that the basic and human needs of every human being could be met if there were an appropriate arrangement of social and production systems; and, on the other hand, of more than half the world’s population (and something like two-thirds the Third World’s people) living in conditions where their basic and human needs are not met.³⁹

Not only are the benefits and costs of modern science distributed in ways that disproportionately benefit elites in the West and elsewhere, but science’s accounting practices are distorted to make this distribution invisible to those who gain the benefits. All consequences of sciences and technologies that are not planned or intended are externalized as “not science.”⁴⁰ The critics argue that such an “internalization of profits and externalization of costs is the normal consequence when nature is treated as if its individual components were isolated and unrelated.”⁴¹

Fifth, and finally, even if modern sciences bore none of the above cultural fingerprints, their value-neutrality would itself mark them as culturally distinctive. Of course, this is a contradiction (“If it’s value-free, then it’s not value-free”), or at least highly paradoxical. The point is that maximizing cultural neutrality, not to mention claiming it, is itself a culturally specific value; both the reality and the claim are at issue here. Most cultures do not value neutrality, so one that does is easily identifiable. Moreover, the claim to neutrality is itself characteristic of the administrators of modern, Western cultures organized by principles of scientific rationality.⁴² Surprisingly, it turns out that abstractness and formality express distinctive cultural features, not the

absence of any culture at all. Thus when modern science is introduced into many other societies, it is experienced as a rude and brutal cultural intrusion precisely because of this feature, too. Modern sciences' "neutrality" devalues not only local scientific traditions, but also the culturally defining values and interests that make a tradition Confucian rather than Protestant or Islamic. Claims for modern sciences' universality and objectivity are "a politics of disvaluing local concerns and knowledge and legitimating 'outside experts.'"⁴³

Interesting issues emerge from the discovery of the cultural specificity of modern sciences. For example, the conventional understanding of the universality of modern science is contested in two ways. First, these accounts argue that universality is established as an empirical consequence of European expansion, not as an epistemological cause of valid claims, to be located "inside science" – for example, in its method. As one author puts it,

The epistemological claim of the "universality of science" ... covers what is an empirical fact, the material and intellectual construction of this "universal science" and its "international character." The "universality of science" does not appear to be the cause but the effect of a process that we cannot explain or understand merely by concentrating our attention on epistemological claims.⁴⁴

Second, a wedge has been driven between the universality of a science and its cultural neutrality. While the laws of nature "discovered" by modern sciences that explain, for instance, how gravity and antibiotics work, will have their effects on us regardless of our cultural location, they are not the only possible such universal laws of nature; there could be many universally valid but culturally distinctive sciences.

[I]f we were to picture physical reality as a large blackboard, and the branches and shoots of the knowledge tree as markings in white chalk on this blackboard, it becomes clear that the yet unmarked and unexplored parts occupy a considerably greater space than that covered by the chalk tracks. The socially structured knowledge tree has thus explored only certain partial aspects of physical reality, explorations that correspond to the particular historical unfoldings of the civilization within which the knowledge tree emerged.

Thus entirely different knowledge systems corresponding to different historical unfoldings in different civilizational settings become possible. This raises the possibility that in different historical situations and contexts sciences very different from the European tradition could emerge.

Thus an entirely new set of "universal" but socially determined natural science laws are possible.⁴⁵

These accounts thus provide additional evidence for the claim that fully modern sciences could be constructed within other cultures – the argument I left incomplete in the last section. Significant cultural features of modern sciences have not blocked their development as fully modern, according to the postcolonial accounts; indeed, they are responsible for just these successes.⁴⁶ Moreover, one can now ask, which of the original cultural purposes of modern science that continue today to shape its conceptual framework are still desirable? Should we want to continue to develop sciences that, intentionally or not, succeed by extinguishing or obscuring all other scientific traditions, directing limitless consumption of scarce and unrenewable resources, distributing their benefits internally and their costs externally, and so forth? Furthermore, these arguments show that if culture shapes science, then changes in local and global cultures can shape different sciences "here" as well as "there."

Future Sciences: Opportunities and Uncertainties

We live in one world, and the scientific choices made by each culture have effects on others. Class, gender, ethnicity, religion, and other social forces produce different and conflicting approaches to science and technology issues in the metropolitan centers, as they do in the cultures at the local and global peripheries. It would be a mistake to suggest that all of the difficulties faced by Third World cultures at this moment in history are the doing of the West or its sciences; that is not the message of the postcolonial accounts, or of this essay. These cultures, too, have historical and philosophic legacies of indigenous forms of inequality and exploitation, have followed policies that turned out not to be wise, and have suffered from natural and social processes that they could not escape. The point, instead, is that the balance sheet for both modern sciences and those of other knowledge traditions looks different from the perspective of the lives of the majority of the world's peoples than it does from that of the lives of advantaged groups in the West and elsewhere, and there are good reasons to think that in some respects the perspective of the elites is not less objective.⁴⁷ We should also recollect that sciences of European or other civilizational histories have different effects on the lives of women and men, and of peoples in different classes and ethnicities.⁴⁸

Notes

- 1 Patrick Petitjean et al., *Science and Empires: Historical Studies about Scientific Development and European Expansion* (Dordrecht: Kluwer, 1992); Z. Sardar, ed., *The Revenge of Athena: Science, Exploitation and the Third World* (London: Mansell, 1988); Third World Network, *Modern Science in Crisis: A Third World Response* (Penang, Malaysia: Third World Network, 1988). Many of the works cited below are useful far beyond the particular claim I cite. Additional writings that I have also found especially useful in thinking about the possible multiculturalism of science include Michael Adas, *Machines as the Measure of Man* (Ithaca, N.Y.: Cornell University Press, 1989); Donna Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (New York: Routledge, 1989); Charles Moraze, ed., *Science and the Factors of Inequality* (Paris: UNESCO, 1979); Vandana Shiva, *Staying Alive: Women, Ecology and Development* (London: Zed Press, 1989); Sharon Traweek, *Beamtimes and Lifetimes* (Cambridge, Mass.: Harvard University Press, 1988). See also Sandra Harding, *The Science Question in Feminism* (Ithaca, N.Y.: Cornell University Press, 1986) and “After Eurocentrism: Challenges for the Philosophy of Science,” in *Philosophy of Science Association 1992 Proceedings*, vol. 2., ed. David Hull, Micky Forbes, and Kathleen Okruhlik (East Lansing: Philosophy of Science Association, 1993), in addition to other works cited below.
- 2 Laurel Graham pointed this out.
- 3 For examples of the latter, see Andrew Pickering, ed., *Science as Practice and Culture* (Chicago: University of Chicago Press, 1992).
- 4 The term “borderlands” is from Gloria Anzaldúa’s *Borderlands/La Frontera: The New Mestiza* (San Francisco: Spinsters/Aunt Lute Book Company, 1987). The notion appears in the writing of many other “borderlands” thinkers.
- 5 See, e.g., Samir Amin, *Eurocentrism* (New York: Monthly Review Press, 1989).
- 6 Scientists usually claim that all they mean by the statement that “science works” is that it makes accurate predictions. However, in the next breath they usually defend the extraordinarily high U.S. investment in scientific establishments on what I take to be the only grounds that anyone could find reasonable in a society professing a commitment to democratic social relations – namely, that the results of science improve social life. Thus “science works” in this enlarged sense, which is conflated with the more technical sense of the phrase. As we shall see below, the success of sciences’ empirical predictions depends in part on social relations; there are good historical reasons for the conflation.
- 7 I am tempted to keep inserting “Western” into “modern science” – modern *Western* science – to avoid the standard Eurocentric assumption that non-Western traditions, including their scientific practices and cultures, are static; that only Western sciences are dynamic and thus only they have developed since the fifteenth century. However, that locution has other problems: it emphasizes the dualistic “West vs. the rest” framework, it ignores the non-Western components of modern science, etc.
- 8 See Frances Yates, *Giordano Bruno and the Hermetic Tradition* (New York: Vintage, 1969).
- 9 Donald F. Lach, *Asia in the Making of Europe*, vol. 2 (Chicago: University of Chicago Press, 1977); Seyyed Hossein Nasr, “Islamic Science, Western Science: Common Heritage, Diverse Destinies”, in Sardar, *Revenge of Athena* (above, n. 1), pp. 239–248.
- 10 See Martin Bernal, *Black Athena: The Afroasiatic Roots of Classical Civilization*, vol. 1 (New Brunswick, N.J.: Rutgers University Press, 1987); Cheikh Anta Diop, *The African Origin of Civilization: Myth or Reality?*, trans. M. Cook (Westport, Conn.: L. Hill, 1974); Lacinay Keita, “African Philosophical Systems: A Rational Reconstruction,” *Philosophical Forum* 9:2–3 (1977–78): 169–189; Lach, *Asia* (above, n. 9); I.A. Sabra, “The Scientific Enterprise,” in *The World of Islam*, ed. B. Lewis (London: Thames and Hudson, 1976); E. Frances White, “Civilization Denied: Questions on *Black Athena*,” *Radical America* 21:5 (1987): 38–40.
- 11 Jack Weatherford, *Indian Givers: What the Native Americans Gave to the World* (New York: Crown, 1988).
- 12 R. K. Kochhar, “Science in British India,” parts I and II, *Current Science* (India) 63:11 (1992): 694. Cf. also *ibid.* 64:1 (1993): pp. 55–62.
- 13 And, as V. Y. Mudimbe pointed out to me, of Europe itself, for European sciences also constituted European lands, cities, and peoples as their laboratories. Consider, for example, the way women, the poor, children, the sick, the mad, rural and urban populations, and workers have been continuously studied by natural and social sciences.
- 14 Susantha Goonatilake makes this point in “The Voyages of Discovery and the Loss and Re-Discovery of ‘Other’s’ Knowledge,” *Impact of Science on Society* 167 (1993): 241–264.
- 15 For one thing, Westerners note that Chinese or African astronomy is done within culturally local projects of a sort devalued by scientific rationality, such as (in some cases) astrology, or culturally local meanings of the heavens or other natural phenomena. So, whatever their accuracy, such astronomical discoveries could not be admitted as “real science” without permitting the possibility of assigning such a status also to astrology or Confucian religious beliefs. Alternatively, one could say that only those discoveries of other cultures that are duplicated by Western sciences count as scientific; this has the paradoxical

- consequence that as Western sciences develop, other cultures also (retroactively!) get more scientific. Nancy Brickhouse's questions helped me to clarify this point.
- 16 Susantha Goonatilake, "A Project for Our Times," in Sardar, *Revenge of Athena* (above, n. 1), p. 226.
 - 17 See the section on astronomy in Ivan Van Sertima, *Blacks in Science* (New Brunswick, N.J.: Transaction Press, 1986).
 - 18 Goonatilake, "Voyages of Discovery" (above n. 14), p. 256.
 - 19 Joseph Needham, *The Grand Titration: Science and Society in East and West* (Toronto: University of Toronto Press, 1969), pp. 55–56.
 - 20 See, e.g., Susan Bordo, *The Flight to Objectivity* (Albany: State University of New York Press, 1987); Genevieve Lloyd, *The Man of Reason* (Minneapolis: University of Minnesota Press, 1984); Tzvetan Todorov, *The Conquest of America: The Question of the Other*, trans. Richard Howard (New York: Harper and Row, 1984).
 - 21 See Needham's discussion of seven conceptual errors in standard Western thought about "universal science" that lead to erroneous devaluations of the scientific achievements of non-European sciences, in *Grand Titration* (above, n. 19).
 - 22 Robin Horton, "African Traditional Thought and Western Science," parts I and 2, *Africa* 37 (1967): 50–71; 155–187.
 - 23 J. E. Wiredu, "How Not to Compare African Thought with Western Thought," in *African Philosophy*, ed. Richard Wright, 3rd ed. (Lanham, Md.: University Press of America, 1984), pp. 149–162.
 - 24 Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago: University of Chicago Press, 1970), p. 167.
 - 25 Needham, *Grand Titration*, (above, n. 19), pp. 14–15.
 - 26 Edgar Zilsel, "The Sociological Roots of Science," *American Journal of Sociology* 47 (1941–42): 544–562.
 - 27 Kochhar, "Science in British India" (above, n. 12); Alfred Crosby, *Ecological Imperialism: The Biological Expansion of Europe* (Cambridge: Cambridge University Press, 1987); V. V. Krishna, "The Colonial 'Model' and the Emergence of National Science in India: 1876–1920," in Petitjean et al. (above, n. 1), pp. 57–72; Deepak Kumar, "Problems in Science Administration: A Study of the Scientific Surveys in British India 1757–1900," *ibid.*, pp. 269–280.
 - 28 Paul Forman, "Behind Quantum Electronics: National Security as Basis for Physical Research in the U.S., 1940–1960," *Historical Studies in Physical and Biological Sciences* 18 (1987): pp. 149–229.
 - 29 Susantha Goonatilake, "A Project for Our Times," in Sardar, *Revenge of Athena* (above, n. 1), pp. 235–236. (Should not African and indigenous American civilizations also count as regional ones containing scientific traditions?)
 - 30 The "Strong Programme" in the sociology of knowledge has developed this analysis. See, e.g., David Bloor, *Knowledge and Social Imagery* (London: Routledge and Kegan Paul, 1977).
 - 31 This section reviews the arguments of Sandra Harding, "is Modern Science Ethnoscience? Rethinking Epistemological Assumptions," in *Postcolonial African Philosophy: A Critical Reader*, ed-Emmanuel Chuckwudi Eze (Malden, MA and London: Wiley-Blackwell, 1997), pp. 46–70.
 - 32 See, e.g., Morris Berman, *The Reenchantment of the World* (Ithaca, N.Y.: Cornell University Press, 1981); Bordo, *Flight to Objectivity* (above, n. 20); Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper and Row, 1980); Nasr, "Islamic Science" (above, n. 9).
 - 33 Needham, *Grand Titration* (above, n. 19), p. 302.
 - 34 *Ibid.*, p. 323.
 - 35 *Ibid.*, p. 327.
 - 36 "[L]aws of nature, like laws of the state, are historically imposed from above and obeyed from below"; in contrast, "the concept of order, wider than law and free from its coercive, hierarchical, and centralizing implications has the potential to expand our conception of science. Order is a category comprising patterns of organization that can be spontaneous, self-generated, or externally imposed" (Evelyn Fox Keller, *Reflections on Gender and Science* [New Haven: Yale University Press, 1984], pp. 131, 132). See also the interesting discussion of Needham's argument in Jatinder K. Bajaj, "Francis Bacon, the First Philosopher of Modern Science: A Non-Western View," in *Science, Hegemony and Violence: A Requiem for Modernity*, ed. Ashis Nandy (Delhi: Oxford, 1990).
 - 37 See Bruno Latour's discussion of the importance to science of "centres of calculation," in chap. 6 of his *Science in Action* (Cambridge, Mass.: Harvard University Press, 1987).
 - 38 The complexity of these sentences arises from the fact that elites in Third World cultures also enjoy luxurious access to the benefits of modern sciences, and the majority of citizens in most First World cultures – that is, the poor and other disadvantaged groups – do not.
 - 39 Khor Kok Peng, "Science and Development: Underdeveloping the Third World," in Sardar, *Revenge of Athena* (above, n. 1), pp. 207–208.
 - 40 Claude Alvares, "Science, Colonialism and Violence: A Luddite View," in Nandy, *Science, Hegemony and Violence* (above, n. 36), p. 108.
 - 41 J. Bandyopadhyay and V. Shiva, "Science and Control: Natural Resources and Their Exploitation," in Sardar, *Revenge of Athena* (above, n. 1), p. 63.
 - 42 Dorothy Smith is especially eloquent on this point: see *The Conceptual Practices of Power* (Boston: Northeastern University Press, 1990) and *The Everyday World as Problematic: A Feminist Sociology* (Boston: Northeastern University Press, 1987). However, abstractness is not unique to such cultures. As Paola Bachetta pointed out (by letter), certain forms of ancient Hinduism are based on philosophical abstractions.

- 43 Bandyopadhyay and Shiva, "Science and Control" (above, n. 41), p. 60.
- 44 Xavier Polanco, "World-Science: How Is the History of World-Science to Be Written?" in Petitjean et al., *Science and Empires* (above, n. 1), p. 225.
- 45 Susantha Goonatilake, *Aborted Discovery: Science and Creativity in the Third World* (London: Zed Press, 1984), pp. 229–230.
- 46 This kind of critique enables one to see that sleeping in the feminist science analyses lies a direct challenge to conventional assumptions about the necessity of value-neutrality to the universality of science. A form of this challenge has been to question the necessity of value-neutrality to the maximal objectivity of science; see Sandra Harding, "After the Neutrality Ideal: Science, Politics and 'Strong Objectivity,'" *Social Research* 59:3 (1992): pp. 568–587, reprinted in *The Politics of Western Science, 1640–1990*, ed. Margaret Jacob (Atlantic Highlands, NJ: Humanities Press, 1994), pp. 81–102.
- 47 Some readers may be troubled by my retention of notions that seem so central to modern science and its mentality, such as "objectivity," "less distorted," "valid," and the like.

I cannot take the space here to discuss the reasons why I, like many other science critics, find these to be important terms to appropriate, "reoccupy," and strengthen as we try to relink sciences to projects of advancing democratic social relations. Let me just say, first, that not all imagined ways of working toward greater democracy are equally compatible with nature's constraints upon human activity (as the postcolonial critics themselves point out, after all). Second, as I discuss below, these notions (objectivity, etc.) are central in many other Western institutions besides the natural sciences – for example, the social sciences, the law, and public policy. We cannot "just say no" to such notions without abandoning a central moral and social value of many Westerners – not just a scientific or epistemological one. See the discussion of "strong objectivity" in Sandra Harding, *Whose Science? Whose Knowledge? Thinking from Women's Lives* (Ithaca, N.Y.: Cornell University Press, 1991), and "After the Neutrality Ideal" (above, n. 46).

- 48 One particularly good discussion of this is in Bina Agarwal, "The Gender and Environment Debate: Lessons from India," *Feminist Studies* 18:1 (1992): pp. 119–158.

On Knowledge and the Diversity of Cultures: Comment on Harding

Shigehisa Kuriyama

The central theme of Sandra Harding's essay can be expressed in more than one way. Harding's own formulation highlights the notion of multiculturalism. Her title asks, Is science multicultural? and the essay answers, unequivocally: Yes. But it is possible – and I think preferable – to recast her concerns in slightly different terms. Instead of lingering on the opposition of the universal and the multicultural, we might reinterpret her argument as one focused above all on the assertion of comparability.

One advantage of this alternative is that it is more precise. The term “multicultural” is notoriously vague: it sweeps under its blanket generality a tangle of confusions and uncertainties about how cultures can or should relate to each other, and how their worldviews relate to the world. “Comparability” identifies more exactly the crux of Harding's argument.

At issue is the relationship between modern Western science and traditions of knowledge found elsewhere. In one view, an unbridgeable chasm separates the two. There can, in this view, be no comparative studies of science, because only Western science is the real thing. Outside the West, one may find superstitions, folk wisdom, belief systems, even great religions, but not (indigenously) the hard, objective, systematic grasp of how the world really is. Not true science.

Harding's three arguments against this view form the core of her essay. She urges, first, that what is called

Western science incorporates significant elements from non-Western cultures; second, that there are knowledge traditions outside the West that have legitimate claims to be considered sciences; and third, that Western science, no less than knowledge elsewhere, is enmeshed in a dense network of broader cultural values and assumptions. The heart of her critique, in other words, is a critique of the assumption of radical difference. It is an argument for comparability.

At stake, of course, are not just perceptions of similarity and otherness, but judgments of superiority and inferiority, struggles for dignity and power – and these judgments and struggles rank, quite properly, among Harding's foremost concerns. But here again, “comparability” captures the gist of the matter: it evokes in its very etymology the primacy of parity, the quest for a way of imagining cultures that asserts equality while recognizing difference. As I read her, this is the cornerstone of Harding's conception of the multicultural. Hers is a pluralistic vision of knowledge in which modern Western science represents, not the absolute, universal standard, but just one way – among many possible ways – of engaging the world.

Is Harding right? Should we speak of multiple scientific traditions? Or is modern Western science incomparably unique? A second advantage to casting the debate in terms of comparability is that it makes clear how this choice really is not a choice at all. The question

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of whether or not two things can be compared has no fixed answer: it depends on the grounds of comparison. We cannot compare cakes and cars in terms of taste or the smoothness of the ride, but we *can* compare their color, their weight, the time required to make them. In some contexts, taste may be what matters most; in others, time may be of the essence.

This brings me to what I see as the chief weakness in Harding's stance: she asserts comparability without actually comparing – without trying, even, to specify the grounds of comparison. Her vision of multiculturalism is abstract, theoretical, and general. She casts doubts on received assumptions of difference, and she confidently urges the possibility of sciences other than modern Western science; but she offers no details about how we might recognize such alternative sciences, about what might mark them *as* sciences.

Now this may seem a churlish complaint. Some may deem it enough that Harding takes the bold first step of declaring comparability, of challenging smug Western claims to know best. The next step – that of elaborating exactly how different cultural traditions compare, of actually situating them on a revised global map of sciences – would presumably require longer studies of a different kind, in-depth analyses of particular examples. Harding's short essay aims only to lay the theoretical groundwork. It paves the way.

But there are at least three reasons why this stance will not do. The first is logical. Harding opines that no eleventh commandment dictates what does or does not count as science, and she is surely right. But surely, too, if we wish to speak meaningfully of different sciences in different cultures, we must be prepared to articulate what makes them all sciences, to define the nature of their kinship. The proposition that two things are comparable is empty unless we specify in what respects they admit comparison. Blank assertions of comparability mean nothing.

Harding does offer vague hints. She proposes, for instance, that sciences “work.” But this criterion will not bear much weight: few would call all effective knowledge science. Fine cuisine works to satisfy the palate, and a great poem to alter the mind, but calling cooks and poets scientists is too loose. Further, judgments of what works vary greatly. In different periods and places, many have believed and still believe in the efficacy of astrology, magic, prayer.

Harding also speaks of science as “systematic knowledge of the natural world.” The difficulty with this, though, is that “the natural world” is not a natural

given. The formula already predefines in a culturally specific way what and how things can be known. It imposes distinctions – like those between the natural and the supernatural, the natural and the artificial – alien to most of the cultures in which Harding purports to find sciences.

We come here to a second problem with Harding's approach: it tends to obscure the deep differences between cultural traditions, to erase the very diversity promoted by the banner of multiculturalism. Commenting on how Western science borrowed knowledge from many non-Western cultures, Harding blithely observes: “There is nothing unusual about such scientific borrowing: it is evident in the ordinary, everyday borrowing that occurs when scientists revive models, metaphors, procedures, technologies, or other ideas from older European scientific traditions, or when they borrow such elements from the culture outside their laboratories and field stations, or from other contemporary sciences” (p. 307). Historically, many techniques and ideas have indeed migrated across cultures, and they still do. But as a rule, such cross-cultural transfers have been and are much rarer, more limited in scope, and more contested than the borrowing of models and metaphors from disciplines and periods within a cultural tradition. To ignore this is to forget how much of the most vital knowledge in any culture is vital precisely because it is cultural knowledge, because it reflects and is reflected in an extended web of shared beliefs, practices, and experiences – precisely for reasons that make the knowledge travel poorly.

Consider acupuncture. Twentieth-century Chinese have vaunted it as the paradigm of an indigenous science. But in the West, despite growing numbers of patients and practitioners, and despite the fact that enthusiastic reports about acupuncture first appeared in Europe more than three hundred years ago, doubts and uncertainties about its scientific legitimacy still prevail. The principal source of resistance is clear: traditional Chinese medicine presupposes a conception of the body and of the world that diverges radically from long-standing Western assumptions.

The vagaries of acupuncture in the West suggest that Harding speaks rather too casually of integrating knowledge from diverse traditions. Western researchers still struggle, now, to translate the discourse of qi and yin and yang into the language of biochemistry and neurophysiology, to discover the “true” anatomy underlying acupuncture conduits and points, to elucidate “what

is really going on.” Empirically, acupuncture seems efficacious, at least for certain conditions; but it does not make sense. It seems capable of producing remarkable, startling changes in the body; but the accounts of the body that guide acupuncturists as they induce and track these changes read like descriptions of a strange and imaginary land.

Time also impedes understanding, though not necessarily or even mainly in the form of the traditional/modern divide. In fact, the problem in the case of acupuncture is rather the opposite: it concerns assumptions so long taken for granted that they have come to seem like obvious, inescapable, natural truths. What makes acupuncture seem so fantastically alien is not bacteriology or immunology, the X ray, the CAT scan, or other innovations of the nineteenth or twentieth centuries; rather, it is primarily the equation of the body with the anatomical body – an equation whose origins in Greek medicine go back more than two thousand years. From a comparative perspective, much of modern Western science actually looks quite traditional. The characteristics that most decisively differentiate it from what we find in China are often not modern at all.

I do not mean by this to revert to a vision of timeless *mentalités*, or immutable cultural essences. History makes short work of such fictions: acupuncture and the theory of needling points and conduits became part of healing in China only around the late third century BCE; likewise, the Western insistence on the dissector’s point of view was a Hellenistic innovation. Moreover, if we turn to earlier Greek medicine, we find Hippocratic treatises postulating a network of veins that not only diverge markedly from the vasculature visible in dissection, but also manifest tantalizing parallels to the conduits of Chinese acupuncture. Hippocratic physicians seem to have inferred the course of these veins from their experiences with phlebotomy. But as it happens, bloodletting also contributed significantly to the origins of acupuncture. Once upon a time, European and Chinese medicine may well have been more alike than they later became.

My point, then, is that the abstract generality of Harding’s multiculturalism glosses over the depths and real complexities of cultural distinctiveness, and obscures how very hard it is, actually, to compare. Every culture apprehends reality in a singular manner, and not the least of the differences separating different ways of knowing are diverging conceptions of the world’s very makeup – of what there is to know. The shared commonalities that make comparison possible are thus always only

approximately common; the problem of comparison, like the problem of translation (with which it is intimately intertwined), never affords exact solutions. Comparisons are inevitably tentative, subject to revision and refinement.

This is not to say that we cannot or should not compare. Not at all: we can, and we must. The view that supposes Western science to be incomparably superior, to be the only authentic way to know the world, is arrogant, wrong-headed, and ignorant. In this I side with Harding. But there is also an arrogance and ignorance, albeit of a subtler kind, in flat assertions of comparability – a risk of merely substituting one prejudice for another, of replacing uninformed presumptions of superiority and otherness with assumptions of equality and commonality that are no more informed and, in the end, scarcely less condescending. This is the third problem with Harding’s conception of the multicultural: in its abstractness – in its focus on the *idea* of diversity rather than on its substance, on declaring comparability rather than on actually comparing – it lumps together the most diverse cultures into faceless, nonmodern, non-Western others. It diminishes them, instead of restoring their dignity.

Harding clearly means well. The ideology of modern science as universal knowledge has often been invoked to justify the right of “advanced” peoples who have mastered this science to intervene in the lives of the “developing” peoples who have not. In this context, attributing sciences to the latter, to peoples previously credited with only philosophies and belief systems, looks, at one level, like a gesture of respect, an expression of support for their claims to insight and autonomy. And this, undoubtedly, is how Harding intends the gesture.

But at a deeper level, the effort to elevate alternative ways of knowing by calling them sciences unintentionally reconfirms Western science as the gold standard to which these alternatives must measure up. Critics of Eurocentric hubris hail such achievements as Egyptian trigonometry, the Chinese compass and rudder, and Native American botany to prove the intellectual vitality of non-Western cultures and the importance of their contributions to history. But appraising achievement in this manner merely furthers the illusion of science as the universal way to know, and insinuates, ultimately, the inferiority of the cultures praised. There is a world of difference, after all, between the mathematics of the pyramids and Laplace’s celestial mechanics, between the magnetic needle and computerized navigation. No matter how sincerely one marvels at the precocity of Egyptian engineers or Chinese

mariners, a vision of scientific multiculturalism founded on such examples implicitly reaffirms – particularly when the examples are considered in isolation, abstracted from the contexts that produced them – an evolutionary narrative in which modern Western science absorbed all the useful but relatively primitive know-how found elsewhere, and then shot light-years ahead in technological power and theoretical insight.

It is fashionable today to criticize Eurocentric biases, and this criticism is no less justified for being fashionable.

But the focus on bias can itself become problematic – not just because of the relativist's facile objection that all perspectives are biased, but because it makes critical introspection the key to understanding others, because it perpetuates Western self-preoccupation. The only way to advance toward a genuinely pluralistic appreciation of knowledge in different cultures is actually to study these cultures, earnestly, humbly, in detail, over a long time. By itself, the most thoroughgoing critique of Western universalism contributes nothing.

The Task of a Philosophy of Technology

Introduction

In spite of the relatively recent emergence of philosophies of technology, an impressive diversity of approaches has already developed. In general, one can at least say that, not surprisingly, analytic philosophies of technology tend to reflect the characteristics of the predominantly empiricist-positivist tradition they inherit. Hence, for example, given this tradition's well-established suspicion of speculative systems and extra-scientific claims, its philosophers of technology tend to look first toward actual or real-world technological issues and problems and to eschew evaluations of anything like technology "as such." Also, given their tradition's preference for scientific, or at least science-like, models of knowledge, analytic philosophers of technology usually take the scientific basis of modern technology for granted and concentrate on the engineering know-how and ethical application of scientific knowledge in technology and by technologists. Continental philosophies of technology, on the other hand, tend to reflect their tradition's longstanding suspicion of Enlightenment conceptions of reason and of the scientific and utopian attitude toward technology that often accompanies these conceptions. As a result, Continental philosophies of technology frequently display considerable tolerance for holistic and extra-scientific evaluations of technological phenomena (e.g., Mumford, Ellul, and especially Heidegger for the former, social studies of science for the latter), and they rarely make a point of sharply distinguishing questions concerning what technology is (i.e., with respect to its logic and allegedly "essential" structure) and questions about its value and

valuation. All of these generalizations, however, are fairly high-level abstractions, and none of them capture adequately the plurality of actual positions. Moreover, in recent years some philosophers have complained that the very classification "analytic vs. continental" is no longer as informative as it once was. There is certainly some truth to this, although mostly at the level of explicit beliefs and doctrines once held and now discarded (e.g., formalism in epistemology, an exclusive focus on the verification of theories rather than their discovery), not regarding fundamental philosophical orientations, where significant differences remain. Then, too, most of complainants sympathize with the analytic tradition that has been dominant in North America and Great Britain since the 1940s. Finally, however, as the following selections make plain, many current approaches to the philosophy of technology (e.g., those inspired by historical and social studies of science, recent feminism, or classical pragmatism) cannot easily be classified as analytic or Continental.

Analytical philosophy of technology is exemplified by the selections from Mario Bunge and Maarten Franssen. Bunge, a former physicist whose writings reveal a substantial commitment to general systems theory, was a vocal participant in the so-called "science wars" alluded to in the previous section. He is a passionate opponent of Romanticism and of anti-technological attitudes in philosophy generally, and a severe critic of social constructivist and hermeneutical approaches to technology specifically. In order to show that technology, when properly conceptualized, is not by nature "soulless, aphistorical, or even antithetical to philosophy,"

Bunge describes the relations between technology and philosophy in terms of inputs and outputs (which is itself, of course, a technology-influenced terminology). On the output side, he notes that technology supplies system-theoretical ontologies (i.e., conceptual systems of the nature of scientifically knowable objects like the one Bunge himself produced in a multi-volume treatise). Technology, he adds, has also, and less fortunately, given us the philosophy of pragmatism. As a disciple of Karl Popper, Bunge is critical of pragmatism, at least as he understands it, but he admits it is obviously one of the major philosophies of the modern world. (For a much more subtle and favorable estimation of pragmatism, see Heelen and Schulkin, Chapter 12, and Hickman, Chapter 34.)

Franssen's essay presents a clear summary of the approach to technology one should expect in analytic philosophy. A few of its main features are identified at the outset, namely, its "abhorrence of system-building and speculation," its preference for inquiry regarding "clearly delineated problems," and a respect for science so profound that philosophy and science might best be viewed as merging, or at least as forming "in some sense a continuum." Unsurprisingly, then, the preferred model for philosophical inquiry is philosophy of science – both because the analysis of "knowledge and theories" is its primary focus, and because scientific theories are the primary source of knowledge. As Franssen rightly notes, analytic philosophy has only recently taken a professional interest in technology, but in some respects his explanation for this is similar to those given by other traditions which also had to explain being latecomers to the topic, only a bit earlier. He mentions, for example, the ubiquitous modern habit of understanding technology as applied science, which makes scientific knowledge and ethical choice interesting, but reduces technology to the merely neutral means for tying the latter to the former. What is different about Franssen's explanation for analytic philosophy's late but now growing interest in technology is that he mostly attributes it, not (as other traditions have) to the disquiet of recent technological experience or the unavoidable implications of historical and social scientific research or sociopolitical critiques of technoscientific life, but to the characteristics of analytic philosophy itself. The fact is, he says, analytic philosophers dislike not only large-scale theorizing but non-scientific epistemologies (e.g., Ryle's conceptually loose "knowing-how vs. knowing-that" dichotomy), so that it wasn't until some analytic philosophers began to see how thoroughly different technical engineering

knowledge is from the purely scientific that there was something "about technology specifically for philosophers to inquire about."

Franssen goes on to list some aspects of technological practice to which analytic philosophy has recently turned, including questions of the fundamental difference between scientifically substantive and technically operative theorizing (Bunge), the special nature of technical action, the "status of artifacts" and their functions, and meta-ethical issues about the social and political problems associated with technology. In general, Franssen does not see technology as presenting any "special challenges," even in relation to ethics. Analytic philosophy, he says, will treat technology in a way that "reflects [its] general orientation." This last phrase encapsulates the general approach that Franssen describes. In a voice that still echoes the older empiricist-positivist tradition, he portrays analytic philosophy as heir to "a way of doing philosophy" that defends a science-based model of clarity and precision for both natural knowledge and the rules of right action, and that stands as a deflationary guardian against all extravagant generalizations about reality and human life. It will now simply extend its outlook to include technology and treat the issues it finds there within the general framework of its established array of specializations – namely, analytic epistemology (What is technological "knowledge"?), metaphysics (What are technological "objects"?), philosophy of language (How does the "logic of propositions and judgments" apply to technology-related activity?), action theory (What is the structure and function of engineering design and artifactual use?), and meta-ethics (What, if anything, is distinctive about ethical judgments and propositions that involve technology?). One other striking feature of analytic philosophy thus characterized is its complete lack of reference to any of the other recent approaches to technology studies. For example, Franssen agrees that philosophers must "address" ethical and societal problems, but he simply asserts that the appropriate way for analytic philosophy to do so is to do what it always does, namely, clarify basic concepts, stress that "sensible" solutions must rest on empirical knowledge of the production and use of artifacts, and insist that all the ground-level terms typically used by those who make "sweeping claims" about technology and the good life (e.g., freedom, culture, thought, human being) be analyzed and made precise before we decide whether they can be "meaningfully proposed and discussed."

In the selections from various introductory notes to his famous *The Technological Society*, Jacques Ellul makes it plain that his approach to technology does not proceed by way of empirical descriptions of technological problems, techniques, and practitioners. Indeed, almost as if he were replying to Franssen, he suggests that such an approach will never arrive at an adequate conception of what technology is and how it functions. Only a characterization of “the real nature of the technological phenomenon” as a whole can shed light on its actual and pervasive – and, he thinks, also fundamentally dangerous – effect in the contemporary world. One especially provocative aspect of Ellul’s approach, however, is that although it clearly exemplifies the global, or holistic, outlook one expects from Continental philosophers, he explicitly denies that this makes it either speculative or evaluative. His approach, he insists, is entirely “descriptive.” Not only does he claim to deliberately avoid offering ethical and aesthetic evaluations of technology, he accuses those who interpret him as promoting a negative or pessimistic picture of technology as simply reacting out of their own prior (and extra-descriptive, “metaphysical”) value commitments. Moreover, he argues that, when critics accuse him of going beyond mere description in referring to “technology” as if it were a real phenomenon instead of, at best, a sociological abstraction, they simply reveal their commitment (common especially among non-Continental philosophers but also actor network theorists like Latour) to methodological individualism. “Describing” technology philosophically cannot mean just observing individuals and their practices. Society is not a mere sum of the actions of individuals; it has a collective reality. Without a proper account of the extra-individual character of the technological phenomenon, we will never understand its “deterministic” power in contemporary life, and we will continue to underestimate the extent to which we are currently deprived of our freedom by it.

In his essay, Hans Jonas resembles Ellul in presenting an unabashedly holistic account of the irreversibility and inevitability of technological change; but unlike Ellul, he combines this account with an appeal for us to shoulder the “cosmic task” of establishing ethical imperatives responsive to this change. Jonas distinguishes between the “formal dynamics” and the “substantive content” of technology. Formally, he argues, modern technology differs from premodern technology insofar as the former was “an enterprise and process,” where the latter is more of “a possession and a state.” Like Lynn White (see Chapter 44), Jonas stresses the fact that because modern

technology is driven by consciously developed plans and ideas, its innovations tend to build upon one another sequentially and spread rapidly across the globe. In this way, a concept of technology as involving genuine progress – a concept in which invention and change are understood as bringing about conditions of life that are superior to those of the present or past – replaces the older idea of using technology to reach an accommodation with a static and stable natural order. Today, observes Jonas, the traditional, premodern “unilinear” idea of knowable but fixed ends and accommodating means, according to which good theory always precedes successful practice, has been replaced by a “circular” one. Science and technology have become inseparably intertwined (cf. Latour and the postphenomenologists’ insistence on the term “technoscience”), and technological innovation is now just as likely to suggest new goals as do advances in scientific knowledge. Jonas sees the inherent “restlessness” of modern science and technology as leading to the disastrous situation in which the sheer process of production and alteration of objects and objectives itself becomes the end of life, thus threatening any substantial and extra-technoscientific idea of what we are like and what life is for. Hence, our most urgent philosophical need is for an ethics of averting disaster – an ethics that encourages a world in which diverse images of humanity and the quality of life legitimately contend, and people in power are as little beholden as possible to the interests generated by technology. Yet we must ask, says Jonas, echoing the problem Plato’s philosopher king faces in the *Republic*, Book 7 (see Chapter 1), what the role of the philosopher can be in such a world, and we must consider the inevitable compromises that a well-meaning person will have to make in order to be effectively involved in public policymaking.

Finally, in Wendy Faulkner’s essay, we see how radically the insertion of wider, extra-epistemological issues into the conversation has changed the traditional positivist landscape for the philosophy of technology as much as the philosophy of science. She acknowledges that too much feminist research still tends to succumb to the common tendency to view technology either too optimistically (i.e., as merely neutral and so in itself culturally and politically unthreatening) or too pessimistically (i.e., as intrusive, hopelessly gender-biased, even “deterministically patriarchal” and capitalistic). Faulkner’s version of an increasingly popular third way – identified here as “feminist technology studies” (indicating her indebtedness to social constructivist accounts of science) – begins

with the question, “How is technology gendered?” and seeks to determine not just why technology is so typically linked to men and maleness, but also why this link is so “tenaciously” maintained and how it might nevertheless be undermined. By focusing on the “co-production” of technology and gender, rather than mistakenly assuming one must give some sort of explanatory account that identifies which one is most responsible for the condition of the other, Faulkner draws liberally on recent research, especially on engineering practices, to show how masculinity tends to be linked with technical skill, as well as with the meaning and use of artifacts, the very language of everyday practice, and even (at least for some men) gender identity. However, her aim is not just to stress the fact of these linkages but to demonstrate through the details that they are far less uniform and intractable than a more detached and abstract (including some social constructivist?) account of technoscientific practice might lead us to expect. She argues that once we pay attention to all the “mismatches” between the image of maleness and the particular practices associated with it (e.g., it turns out that “the pleasures of engineering” are neither universally nor uniquely the experience of men), it becomes obvious that we must understand the gender–technology relation as a “co-production,” and thus less determined than a cause-and-effect explanatory account makes it seem.

Faulkner’s essay is not, however, entirely descriptive. The recognition that the relation between masculinity and technology is co-produced rather than determined gives us cause to look with fresh eyes at the ambivalence that many women have about technology. Certainly it is a relief to avoid the traditional forced option between

either uncritically endorsing the present arrangements and trying to make the best of it or practicing outright rebellion against current technoscientific existence. But then what course of action might realistically be available instead? Faulkner concludes with a seven-point summary of her answer to her original question of how technology is gendered, and then argues that all seven points taken together suggest what she provocatively calls (following Donna Haraway; see Chapter 51) the possibility of a “cyborgian” middle course. Of course, she says, this obviously means active engagement with technology, beginning with a sharpened recognition of how we are already inescapably enmeshed in a socially constructed technoscientific existence, but it is an engagement newly empowered by the understanding that whatever is constructed can also be “destabilized.” For example, if the male dominance of engineering does in fact “gender” the design of today’s artifacts, why not the other way around? Her concluding lines, however, highlight both what her essay accomplishes and what it is left open for coverage in other selections in this anthology. Increased engagement with technology, she concludes, will not amount to much “unless it is linked to a radical vision and agenda for the transformation of technology – into a practice that is more democratic and respectful of diversity, with products which are safer, friendlier, and more useful.” Yet as she herself demonstrates, the cultural “tenacity” with which the equation between masculinity and technology is maintained seems everywhere remarkably immune to even the best empirical evidence of its “fractured and contradictory” condition. Where, then, will “radical visions ... for transformation” get their power?

Philosophical Inputs and Outputs of Technology

Mario Bunge

Technology is often considered soulless, aphilosophical, or even antithetical to philosophy. This paper contends that such an image of technology is erroneous and that:

- (1) Far from being aphilosophical, let alone anti-philosophical, technology is permeated with some of the philosophy it has inherited from pure science along with scientific methods and theories – as exemplified by its reliance on the philosophical principle that we can get some knowledge of reality through experience and reason, and even improve on it.
- (2) Far from being philosophically passive or sterile, technology puts forth a number of philosophically significant theories, such as automata theory, and important (though perhaps mistaken) philosophical views, such as pragmatism.
- (3) Far from being ethically neutral, like pure science, technology is involved with ethics and wavers between good and evil.

In other words, this paper proposes the thesis that technology has a philosophical input and a philosophical output and, moreover, part of the latter controls the former. If this is true, then technology is not cut off from culture nor is it a detachable part of culture; technology is instead a major organ of contemporary culture. This being so, the philosopher must pay it far more attention than before; he

should build a fully developed philosophy of technology related to but distinct from the philosophy of science.

Tasks of the Philosophy of Technology

The concern of the philosophy of technology – one of the underdeveloped areas of philosophy – is the investigation of the philosophy inherent in technology as well as of the philosophical ideas suggested by the technological process. Some of the typical problems in the philosophy of technology are these: (a) Which characteristics does technological knowledge share with scientific knowledge, and which are exclusive of the former? (b) In what does the ontology of artifacts differ from that of natural objects? (c) What distinguishes a technological forecast from a scientific forecast? (d) How are rule of thumb, technological rule, and scientific law related? (e) Which philosophical principles play a heuristic, and which a blocking, role in technological research? (f) Does pragmatism account for the theoretical richness of technology? (g) What are the value systems and the ethical norms of technology? (h) What are the conceptual relations between technology and the other branches of contemporary culture?

Where are we to search for the philosophical components of technology? Clearly not among the products of

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technology – cars, drugs, healed patients, or victims of technological warfare – which are about the only technological items the anti-technological philosopher is acquainted with. We must search for philosophy among the ideas of technology – in technological research and in the planning of research and development. We are likely to find them here, as philosophy is found in every department of mature thinking. Indeed mature thinking is always guided (or misguided) and controlled (or exhilarated) by methodological rules as well as by epistemological, ontological, and ethical principles. Just think of the problems posed by the design of any new product. Is the relevant scientific knowledge reliable, and is it likely to be sufficient? Will the new product be radically new – that is, will it exhibit new emergent properties – or will it be just a rearrangement of existing components? Shall we design the product so as to maximize performance, social usefulness, profit, or what?

Since the philosophical components of technology must be searched for among technological ideas, we had better start by recalling what the loci of these ideas are. Moreover, since there is some uncertainty about what “technology” includes, we should enumerate the branches of technology as we understand it.

Branches of Contemporary Technology

We take technology to be that field of research and action that aims at the control or transformation of reality whether natural or social. (Pure science, if it is experimental, also controls and transforms reality but does so only on a small scale and in order to know it, not as an end in itself. Whereas science elicits changes in order to know, technology knows in order to elicit changes.) We discern the following branches of technology;

Material	Physical (civil, electrical, nuclear, and space engineering) Chemical engineering Biochemical (pharmacology) Biological (agronomy, medicine)
Social	Psychological (education, psychology, psychiatry) Psychosociological (industrial, commercial, and war psychologies) Sociological (politics, jurisprudence, city planning) Economic (management science, operations research) Warfare (military science)

Conceptual	Computer sciences
General	Automata theory, information theory, linear system theory, control theory, optimization theory, and so forth

This list is not exhaustive, and some technologists may feel ill at ease with the bed fellows I have chosen for them. The list is intended to be only a partial extensional definition of “technology.” It includes the miscellany I have called “general technology” because its theories can be applied almost everywhere regardless of the kind of system; we shall see later in the paper that it constitutes the great contribution of technology to metaphysics. On the other hand, the list does not include futurology, because the latter is just long-term planning and hence is part of social technology.

Let us now locate the areas of maximal conceptual density regardless of subject matter: there we must cast our net. To this end we must take a brief look at the technological process.

Technological Research and Policy

A technological process exhibits the stages shown in Figure 1.

Most technological ideas are found in two of the stages or aspects of a technological process: policy and decision making (largely in the hands of management) and research (in the hands of investigators). In any high-grade technological process, such as one taking place in a petroleum refinery, in a hospital, or in an army, managers as well as technological investigators (but not technicians and blue- and white-collar workers) employ a number of sophisticated conceptual tools – belonging, for example, to organic chemistry or operations research. If they are innovative or creative, policy makers and investigators will try out or even invent new theories or procedures. In sum, technology is not alien to theory, nor is it just an application of pure science; it has a creative component, which is particularly visible in the design of technological policies and in technological research.

Consider technological research for a moment. Methodologically, it is no different from scientific research. In either case, a research cycle looks schematically like this: (1) spotting the problem; (2) trying to solve the problem with available theoretical or empirical knowledge; (3) if that attempt fails, inventing hypotheses or even whole hypothetico-deductive systems capable

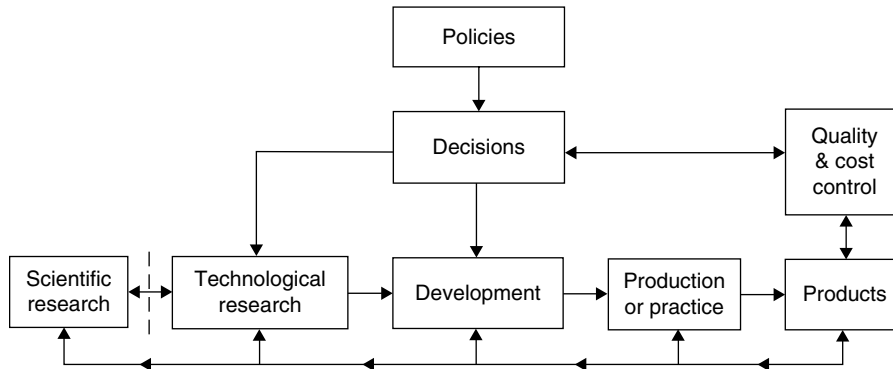


Figure 1. Flow Diagram of Technological Process. The first stage, scientific research, is occasionally missing or completed at a scientific institution – hence the dotted vertical line. The end product of a technological process need not be an industrial good or a service; it may be a rationally organized institution, a mass of docile consumers of material or ideological goods, a throng of grateful if fleeced patients, or a war cemetery.

of solving the problem; (4) finding a solution to the problem with the help of the new conceptual system; (5) checking the solution, for example by experiment; (6) making the required corrections in the hypotheses or even in the formulation of the original problem. Besides being methodologically alike, both kinds of research are goal-oriented; however, their goals are different. The goal of scientific research is truth for its own sake; that of technological research is useful truth.

The conceptual side of technology is neglected or even ignored by those who equate technology with its practice or even with its material outputs. (Curiously enough, not only idealist philosophers but also pragmatists ignore the conceptual richness of technology. Hence neither of them can be expected to give a correct account of the philosophy inherent in technology.) We must distinguish the various stages or aspects of the technological process and focus on technological research, as well as on the design of technological policies, if we are to discover the philosophical components of technology.

Before we face our specific problem we shall make one more preliminary investigation – this time into the conceptual relations among technology and a few other branches of culture, both alive and dead.

Near Neighbors of Technology

Nothing, especially not technology, comes out of nothing. Hence nothing, especially not technology, can be understood in isolation from its kin and neighbors.

Modern technology grows out of the very soil it fertilizes, industrial civilization and modern culture. The distinction between civilization and culture is particularly useful for understanding the nature of technology. One can have some modern industry without modern culture, provided one imports technological know-how and does not expect great technological innovations. One can have scraps of modern culture without modern industry – provided one is willing to put up with a one-sided and rickety culture. No creative technology, however, is possible outside modern civilization (which includes modern industry) and modern culture (which of course includes modern technology).

In particular, modern technology presupposes not only ordinary knowledge and artisanal skills but also scientific knowledge, hence mathematics. Technology is not a final product, either; it shades into technical practice – the practice of the general practitioner, the teacher, the manager, the financial expert, or the military expert. Things are not completely pure in or around technology; besides its artistic and philosophical components, one occasionally finds traces of pseudo science and pseudo technology. Table 1 shows some of the nearest neighbors of technology. To complete the picture, add mathematics, crafts, arts, and humanities, as in Figure 2, below.

Having sketched a map of technology and having listed some of its neighbors very schematically, we are now in a position to try to explore the philosophy inherent in technological research and policy making.

Table 1. The nearest neighbors of technology.

<i>Protoscience</i>	<i>Science</i>	<i>Technology</i>	<i>Technical Practice</i>	<i>Pseudotechnology</i>
Ancient & medieval physics & astronomy	Modern physics & astronomy	Physical engineering	Engineering practice	Astrology
Ancient & medieval mineralogy & part of alchemy	Chemistry	Chemical engineering	Chemical engineering practice	Alchemy
Ancient & medieval natural history	Biology	Agronomy, medicine	Agrotechnical & medical practices	Homeopathy, chiropractic, Lysenkoism
Philosophy of mind (partly)	Psychology	Psychopathology	Drug & behavior therapy	Psychoanalysis, graphology
	Economics	Economic & financial planning	Economic management	Economic miraclemanship
		Computer science	Computation & control	GIGO computeering

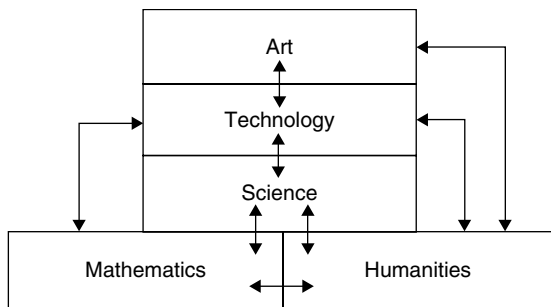


Figure 2. Flow Diagram of the System of Contemporary Culture. The noncreative components have been discarded.

The Epistemology of Technology

Technology shares with pure science a number of epistemological assumptions. We mention only the following: (1) there is an external world; (2) the external world can be known, if only partially; (3) every piece of knowledge of the external world can be improved upon if only we care to. These assumptions belong to epistemological realism. The classical technologist was not only a realist but usually a naive realist, in that he took our representations of reality for more or less accurate pictures of it. The modern technologist, involved as he is with constructing sophisticated mathematical models of things and processes, is still a realist but a critical one. He realizes that our scientific and technological theories are not pictures but symbolic representations that fail to cover every detail

(and sometimes the very essence) of their referents. He knows that those theories are over-simplifications and also that they contain many concepts – like the proverbial massless piston – which lack real counterparts.

However, the critical realism of technology is tempered and distorted by a strong instrumentalist or pragmatist attitude, the normal attitude among people intent on obtaining practical results. This attitude is obvious from the technologist’s way of dealing with both reality and the knowledge of it. For him, reality, the object of pure science, is the sum total of resources (natural and human), and factual knowledge, the aim of pure science, is chiefly a means.

In other words, whereas for the scientist an object of study is a *Ding an sich*, for the technologist it is a *Ding für uns*. Whereas to the scientist knowledge is an ultimate goal, to the technologist it is an intermediate goal, something to be achieved only in order to be used as a means for attaining a practical goal. It is no wonder that instrumentalism (pragmatism, operationalism) has such a great appeal both to technologists and to those who mistake technology for pure science.

Because of his pragmatic attitudes, the technologist will tend to disregard any sector of nature that is not or does not promise to become a resource. For the same reason he is prone to push aside any sector of culture unlikely to be instrumental for achieving his goals. This is just as well as long as he is open minded enough to tolerate whatever he disregards.

The pragmatic attitude toward knowledge is reflected, in particular, in the way the technologist treats the concept of

truth. Although in practice he adopts the correspondence conception of truth as adequacy of the intellect or mind to the thing, he will care for true data, hypotheses, and theories only as long as they are conducive to the desired outcomes. He will often prefer a simple half-truth to a complex truth. He must, because he is always in a hurry to get useful results. Besides, any error made in neglecting some factor (or some decimal figure) is likely to be overshadowed by unpredictable disturbances his real system may undergo. Unlike the physicist, the chemist, or the biologist, he cannot protect his systems against shocks other than by building shock-absorbing mechanisms into them. For similar reasons, the technologist cannot prefer deep but involved theories when superficial ones will do. However, unless he is a pseudo-technologist, he will not shy away from complex and deep theories if they promise success. (For example, he will employ the quantum theory of solids in the design of solid state components and genetics in obtaining improved varieties of corn.) The technologist, in sum, will adopt a mixture of critical realism and pragmatism, varying these ingredients according to his needs. He will seem to confirm first one and then another epistemology, while actually all he intends to do is to maximize his own efficiency regardless of philosophical loyalties.

The technologist's opportunistic conception of truth is just one – although major – epistemological component of technology. We shall now cite two specific items of epistemology that have taken part in technological developments, one in education, the other in artificial intelligence. It is well known that Pestalozzi's educational techniques were based on the slogan of British empiricism, "No concept without a percept." Likewise the philosophical basis of Dewey's educational techniques was the pragmatist thesis, "No concept without an action." The philosophy underlying artificial intelligence studies contains one major ontological hypothesis, "Whatever behaves like an intelligent being is intelligent," and a batch of epistemological hypotheses, among them "Every perception is the acceptance of an external stimulus" and "Some spatial patterns are perceptible and discrete."

There is more to the epistemology of technology, but we must hurry on to the metaphysics of technology.

The Metaphysics of Technology

Technology inherits some of the metaphysics of science and has in turn produced some remarkable metaphysics of its own. We shall list without discussion a few examples of each.

Here are some of the metaphysical hypotheses inherent in both scientific and technological research:

- (1) *The world is composed of things*, that is, it is not simple, and it is not made of ideas or of shades of ideas. (Were this not so, we could not get things done by cleverly manipulating things – people among them. Mere wishes or incantations would suffice.)
- (2) *Things get together in systems* (composed of things in more or less close interaction), and *some systems are fairly well isolated from others*. (Otherwise we would not be able to assemble and dismantle things, nor would we be capable of acting upon anything without at the same time disturbing everything else.)
- (3) *All things, all facts, all processes, whether in nature or in society, fit into objective stable patterns (laws)*. Some of these laws are deterministic, others are stochastic, and all are objective. (Otherwise we would not need to know any laws in order to transform nature and society: ordinary knowledge would have sufficed to bring forth modern technology.)
- (4) *Nothing comes out of nothing and nothing goes over into nothingness*. There are antecedents or causes for everything, and whatever is the case leaves some trace or other. If this were not so, there should be no need to work and no worries about energy.
- (5) *Determination is often multiple and probabilistic rather than simple or linear*. (If this were not so, we would be unable to attain most goals through different means, and there would be no point in searching for optimal means or in calculating probabilities of success.)

So much for the metaphysics that takes part in technological research and policy making. Now let us look at some of the metaphysical outputs of contemporary technology. While some of them are loose though important theses, others are full-blown ontological theories. Among the former we point out the following:

- (1) With the help of technology man can alter certain natural processes in a deliberate and planned fashion.
- (2) Thanks to technology man can create or wipe out entire natural kinds, thus increasing the variety of reality in some respects and decreasing it in others.

- (3) Because artifacts are under intelligent control or are endowed with control mechanisms which have not emerged spontaneously in a process of natural evolution, they constitute a distinct ontic level characterized by properties and laws of its own – whence the need for elaborating a technological ontology besides the ontologies of natural and of social science.

As for the metaphysical theories evolved by contemporary technology, they belong in what I have called general technology. They are high grade (though mathematically often simple) general theories such as automata theory, the general theory of machines, general network theory, linear system theory, information theory, control theory, and optimization theory. They qualify not only as technological (or scientific) theories but also as ontological theories for the following reasons. First, they are concerned with generic traits of entire genera (rather than species) of systems: they are cross-disciplinary theories. (Think of the variety of applications of automata theory and control theory.) Second, those theories are stuff-free (independent of any kind of material), hence independent of any particular physical or chemical law. (They focus on structure and behavior rather than on specific composition and mechanism.) Third, those theories are untestable without further effort, if only because they issue no predictions. (They can be made to issue projections and thus become testable upon conjoining them with items of specific information concerning the concrete systems they are applied to.)

In sum, whether they like it or not technologists have built a conceptual building which houses all of the metaphysics of science plus some distinctly technological metaphysics. Metaphysics, banned from philosophy departments, is alive and well in the schools of advanced technology.

[...]

The Value Orientation of Technology

To the scientist all concrete objects are equally worthy of study and devoid of value. Not so to the technologist: he partitions reality into resources, artifacts, and the rest – the set of useless things. He values artifacts more than resources and these in turn more than the rest. His, then, is not a value-free cosmology but one resembling the value-laden ontology of the primitive and archaic cultures. One example should suffice to bring this point home.

Let P and Q be two components or properties of a certain system of technological interest. Assume that, far from being mutually independent, Q interferes with or inhibits P. If P is desirable (in the eyes of the technologist) then Q will often be called an impurity. Unless the impurity is necessary to obtain a third desirable item R (such as conductivity, fluorescence, or a given color), the technologist will regard Q as a disvaluable item to be minimized or neutralized. To the scientist Q may be interesting or uninteresting in some respects, but never disvaluable.

This value orientation of technological knowledge and action contrasts with the value neutrality of pure science. True, social science does not ignore values but attempts to account for them. However, to pure science nothing is either pure or impure in an axiological sense, not even pollutants. In pure science valuation bears not on the objects of study but on the research tools (e.g., measurement techniques) and outcomes (e.g., theories). One lunar theory may be better (truer) than another, but the moon is neither good nor bad. That is not so for the space scientist and the politician behind him. Whereas the technologist evaluates everything, the scientist *qua* scientist evaluates only his own activity and its outcomes. He approaches even valuation in a value-free fashion.

The value orientation of technology gives the philosopher a splendid opportunity to analyze the valuation process in concrete cases rather than setting up a priori (or else conventional) “value tables.” It can even inspire him to build realistic value theories, where valuation appears as a human activity, largely rational, done in the light of definite antecedent knowledge and definite desiderata. As a matter of fact, technology has already had an impact on value theory; utility theory (the theory of subjective value), though originally proposed as a psychological theory, has recently been revived and elaborated in response to the needs of managers. One may also think of a theory of objective value even more closely in tune with technology – one defining value as the degree of satisfaction of an objective need.

We turn now to a few other instances of the impact of technology upon philosophy.

Technology as a Source of Inspiration for the Philosophy of History

We have seen that technology is both a consumer and a producer of philosophical ideas. In addition, it can inspire or suggest interesting new developments in the philosophy

of action, in particular ethics, legal philosophy, and the philosophy of history. Let us look into the last.

A number of historians are applying mathematics to problems in history. Here are a few examples of the mathematization of history: (a) cleansing historical data (such as chronologies) with the help of mathematical statistics; (b) finding historical trends or quasi-laws in a number of socioeconomic variables (notably by the French historians of the *Annales: Economies, Sociétés, Civilisations*); (c) building mathematical models of certain historical processes, such as the expansion and decline of empires; and (d) studying certain historical events and processes in the light of decision theory. This last approach, suggested partly by management science, is legitimate with reference to deliberate decisions affecting the life of entire communities. The passing of important new legislation, the launching of a war, the call to a nationwide strike, and the outbreak of a planned revolution are occasions for the application of decision theory. Indeed, all the necessary components are there or can be conjectured: the decision makers who are supposed to maximize their expected utilities, the goals, the utilities of them, the means or courses of action considered by the decision makers, and the probability of attaining a given goal with a certain means.

The philosophy of history can acquire a whole new dimension in the light of decision theory, provided, of course, it is not employed to resurrect the great hero theory of history. Certainly, important areas of historiography, such as the anonymous history studied by historical demography, historical geography, and economic history, remain beyond the decision-theory approach. However, in an increasingly technological society, rational (but, alas, often wicked) action, based on carefully designed policies, plays an increasingly important role and can therefore be partly understood with the help of decision theory.

Technology as a Source of Inspiration for Ethics and Legal Philosophy

Other fields of the philosophy of action that technology can fertilize are ethics and legal philosophy, by teaching them to spell out norms as grounded rules or even as conclusions of arguments. Thus, instead of issuing blind commands of the form “Do x ,” or blind ethical norms of the form “You ought to do x ,” the technologist will

proceed as follows. He will propose and test grounded rules of the form “Do x in order to get y ” on the basis of the knowledge that doing x does in fact bring about y either invariably or with a certain probability. By stating explicitly the ground for a rule of action, one kills three birds with one stone: (a) one breaks the fact/norm barrier, (b) one transforms moral decision making into a rational activity, and (c) one dispenses with the logic of norms.

This proposal, even if feasible, does not allow us to build a value-free ethics. This would be impossible, because moral decision making is as value-oriented as technological policy design. What technology can teach us is, rather, to render values explicit so as to be able to examine them critically instead of receiving them uncritically. In other words, it is impossible to translate a normative sentence into a value-free declarative sentence without loss. On the other hand, it is possible to spell out a norm into a pair law sentence–value sentence, in this way: “Do x ” or “You ought to do x ” may be construed as short for “There is a y such that x brings about y and (you value y or there is a z such that not doing x brings about z and you disvalue z).” The command (or the norm) and its expansion, though not logically equivalent, are related in that the former is just an abbreviation of the latter.

For example, “Do not cheat” can be expanded into “(Any) cheating does (some) harm and you do not want to do any harm.” But the same norm can also be expanded into “(Any) cheating jeopardizes your credit and you want to keep your credit in good standing.” This ambiguity is to be blamed on the norm itself and not on its rational translation. In any event, a norm, when grounded and formulated in the declarative mode, appears as a consequence of a set of premises. And at least one of these premises is a law statement while at least one other is a value judgment. Consequently, the handling of norms requires only ordinary logic (instead of the logic of norms) and value theory. In other words, we can reconstruct normative science without norms, but with values.

(Superficially, ordinary logic would seem to suffice. Thus, in the case of the injunction not to cheat because it causes harm and harm is undesirable, we would seem to have just an instance of *modus tollens*, namely: $C \rightarrow H$ & $\lceil H \rceil C$. However, the H occurring in the first premise differs from that occurring in the second: the latter is not really H but rather “ H is valuable.” Likewise, the conclusion is a value statement. A task of value theory is

to compute the value of the conclusion in terms of the values occurring in the premises. But we cannot go into this here.)

What holds for ethics holds for legal philosophy: here, too, norms are profitably expanded into complex statements or construed as consequences of sets of premises. For example, "Murderers must be put away" somehow follows from "Murder endangers the social structure and we value the social structure." However, the same norm also follows from premises in a different field, e.g., "Murderers are sick people and it is disvaluable to leave sick people at large," as well as from premises inspired in still other value systems. The advantage of such expansions is obvious: they force the law giver to lay bare the grounds of positive law – which is often cruel, unfair, or even absurd – and invite him to ground legal technology on sociology and psychology.

In sum, technology suggests that we replace every authoritarian set of imperatives with a grounded set of rules – rules based on laws and value judgments. In this way, whatever was implicit or even concealed can be analyzed, criticized, reconstructed, and systematized. Technology can thus act as a methodological model for the normative sciences, in particular ethics. Unfortunately, far from having served as a moral model, technology is in need of some ethical bridling. This deserves another section.

The Dubious Morals of Technology

Knowing is a good in itself. (Even knowing how to inflict pain may be valuable, as it can assist us in avoiding the act of inflicting pain.) However, there are ways and means of knowing, and some of them may be morally objectionable, such as torturing and killing people in order to find out more about fear. Hence scientific research gets somewhat involved with ethics. In practice, a few rather obvious strictures usually suffice to keep it unsoiled. There are, of course, uncertainty zones, but they can be bounded. For example, in research into fear mild torturing might be condoned provided it is done with the free consent of the experimental subject and it can be safely predicted that it will not be traumatic. In short, pure science needs only a mild external ethical control. As a matter of fact, scientific research has built into it an ethical code of honesty, responsibility, and hard work that can inspire other human activities.

Things are different in technology. Here not only some of the means and ways of knowing may be impure, but also the entire technological process may be morally objectionable for aiming exclusively at evil practical goals. For instance, it is wicked to conduct research into forest defoliation, the poisoning of water reservoirs, the maiming of civilians, the manipulating of consumers or voters, and the like, because the knowledge gained in research of this kind is likely to be used for evil purposes and unlikely to serve good purposes. It is not just a matter of an unexpected evil use of a piece of neutral knowledge, as is the ease with the misuse of a pair of scissors: the technique of evil doing is evil itself. The few valuable items it may deliver are by far outnumbered by its negative output. Try to find a good use for the stocks of lethal germs accumulated for chemical warfare, for example, or for plans for the rational organization of an extermination camp.

Technology can then be either a blessing or a curse. That it is always a blessing, if not in the short run then in the long run, is a tenet which has been preached by a number of progressive philosophers since the dawn of the modern period. Other philosophers claimed instead that technology is a curse, but they did so for the wrong reasons – because they were against social progress and cultural expansion. It is only very recently that most of us have come to realize that technology itself can in fact be wicked and must therefore be checked. We have learned that, while accelerating advance in some respects (such as the size of the GNP), technology is also accelerating our decline in other respects (such as the quality of life) and is even jeopardizing the very existence of the biosphere.

Of course, there is nothing unavoidable about the evils of technology. Except for isolated cases of unexpected bad side effects, technology could be all good instead of being half-saintly and half-devilish. It is up to the policy makers to have the technological investigator produce good or evil technological items. It is up to the technologist to take orders or to disobey them. In any event, technology is by its nature morally committed one way or another, and it needs some ethical bridling.

The Ethics of Technology

Every human activity is either explicitly controlled or criticizable by some behavior code which is partly legal and partly moral. In particular, the technological

process has usually been guided (or misguided) by the following maxims:

- (1) Man is separate from and more valuable than nature.
- (2) Man has a right (or even the duty) to subdue nature to his own (private or social) benefit.
- (3) Man has no responsibility toward nature: he may be the keeper (or even the prison warden) of his brother, but he is not the nanny of nature.
- (4) The ultimate task of technology is the fullest exploitation of natural and human resources (the unlimited increase in GNP) at the lowest cost without regard for anything else.
- (5) Technologists and technicians are morally irresponsible; they are to carry on their task without being distracted by any ethical or aesthetic scruples. The latter are the exclusive responsibility of the policy makers.

These maxims constitute the core of the ethics of the technology that has prevailed heretofore in all industrial societies, regardless of the type of social organization. Certainly those maxims are not justified by technology itself: rather, they justify boundless exploitation of the natural and social resources. Moreover, they have not evolved within technology or science but within certain religions, ideologies, and philosophies.

In recent years we have come to distrust these maxims or even reject them altogether because we have started to realize that they condone the dark side of technology. As yet, we have not offered an alternative ethical code. It is high time we attempted to build alternative ethics of technology, ones with different desiderata and based on our improved knowledge of both nature and society, which were largely unknown at the time the old code was formulated, toward the beginning of the seventeenth century. If we wish to keep most of modern technology while minimizing its evil components and negative side effects, we must design and enforce an ethical code for technology that covers every technological process and its repercussions at both the individual and the social levels. Such a code should consist of the following components: (1) *An individual ethical code* for the technologist *qua* investigator. This should include the ethics of science, namely the set of ethical norms securing the search for truth and its dissemination. It should also take into account the peculiar moral problems faced by the technologist bent on attaining noncognitive goals. These additional norms should emphasize the personal

responsibility of the technologist in his professional work and his duty to decline taking part in any project aiming for antisocial goals. Such moral imperatives, or rather grounded rules, should be consistent with (2) *a social ethical code* for technological policy making, research, and development of practices, disallowing the pursuit of unworthy goals and limiting any technological processes that, while pursuing worthy goals, interfere severely with further desiderata. This social ethical code should be inspired by the overall needs and desiderata of society rather than being dictated by any privileged group within it. Otherwise it would be unfair, and it might not be enforceable.

Such a two-tiered ethical code would make impossible, or at least reprehensible, the “Dr. Jekyll-Mr. Hyde” type of scientist who deserves both the Nobel prize for his contributions to elementary particle research and a hanging verdict for designing diabolical new means of mass murder. There would be no toleration of double ethical standards today if there were not two ethical codes, one for the pure scientist and the other for the impure technologist. If we are to keep technology in check, we need a single ethics of technology covering its whole wide spectrum, from knowledge to action.

Conclusion: The Centrality of Technology

Nobody denies that technology is central to industrial civilization. What is sometimes denied is that technology forms an essential part of modern intellectual culture. Indeed, it is often held that technology is alien or even inimical to culture. This is a mistake, one which betrays a total ignorance of the intellectual richness of the technological process, in particular of the innovating one. The mistake has obnoxious consequences, for it perpetuates the training of scholars with a traditional (preindustrial) cast of mind and conceptual equipment, contemptuous and afraid of whatever they do not understand about modern life. When they wield power in governmental or educational institutions, such people try to isolate the technologist as a skillful barbarian who must be kept in his modest place as the provider of material comfort. By behaving in this way, those scholars in fact deepen the gaps among the various subcultures and miss the chance of contributing to steering the course of technology along a path beneficial to society as a whole.

Like every other culture, ours is a complex system of heterogeneous interacting components. Some of them are already past their creative prime, others are blossoming, while still others are just budding. The creative components of our culture are some of the humanities, mathematics, science (natural and social), technology, and the arts. Modern technology is both an essential component and the youngest of all. Perhaps this is why we do not fully realize how central it is to our culture. In fact, instead of being an isolated component, technology interacts strongly with every other branch of culture. (On the other hand, art hardly interacts at all with mathematics.) Moreover, technology and the humanities (in particular philosophy) are the only components of living culture that interact vigorously with all the other components (see Figure 2). In particular, technology interacts fairly strongly with several branches of systematic philosophy: logic, epistemology, metaphysics, value theory, and ethics.

Not only does technology interact with every other living sector of contemporary culture, in particular philosophy, but it overlaps partially with some of them. Thus, architecture and industrial design are at the intersection of technology and art; much of physics and chemistry is as much engineering as it is science; applied genetics is hardly distinguishable from pure genetics; and even some of metaphysics is at the intersection of technology and philosophy, as was discussed above.

Like science, technology consumes, produces, and circulates philosophical goods. Some of these are the same as those activated by science; others are peculiar to technology. Thus, because of its emphasis on usefulness, the epistemology of technology has a pragmatist streak and is therefore coarser than the epistemology of scientific research. On the other hand, the metaphysics and the ethics of technology are richer than those of science.

Because of the conceptual richness of technological processes, and because of the multiple contacts between technology and the other creative components of modern culture, technology is central to that culture. We cannot ignore the organic integration of technology with the rest of modern culture if we wish to improve the health and even save the life of our culture. We cannot afford to ignore the nature of technology, let alone despise it, if we want to gain full control over technology in order to check its dark side. We must then build up all the disciplines dealing with technology, not least of them the philosophy of technology – the more so since it is often mistaken for the philosophy of science. The history, sociology, and psychology of technology tell us much about technologies and technologists, but only the philosophy of technology makes it its business to tell us what the methodological, epistemological, metaphysical, and ethical pennants of technology look like.

Analytic Philosophy of Technology

Maarten Franssen

The first thing that should be noted about analytic philosophy of technology is that there is not a more or less unified subfield of that name within philosophy with a consensus on a list of central problems and a canon of key writings, as is the case for (analytic) philosophy of science. It is only during the last four decades that analytic philosophers have turned to technology. Analytic philosophy of technology is, therefore, at best an emerging discipline, and it is still too early to be convinced that it will grow into a mature field comparable in extent to the philosophy of science. The contingencies of historical development play a large role in such matters.

Analytic philosophy is primarily a way of doing philosophy, or a view on what meaningful philosophy is about: what sorts of questions are worth asking and what sorts of answers to these questions are acceptable. Accordingly, it is defined by method, not by subject. Nevertheless, some subjects in philosophy are closer to the heart of analytic philosophy than others. What characterizes analytic philosophy is an abhorrence of system-building and speculation, a preference for a detailed treatment of clearly delineated problems, an emphasis on clear definitions of the concepts used to put a problem and to answer it, an emphasis on language, conceptualization and formalization, a general acknowledgment of the relevance of empirical facts, and a great respect ‘for the findings of science – to such an extent, even, that

science and philosophy are considered to merge into each other or to form in some sense a continuum. Given this general outlook, questions concerning knowledge and theories have traditionally been at the centre of analytic philosophy, and for an analytic philosopher the philosophy of science is a respectable field of inquiry *par excellence*, though fields like metaphysics and ethics, which were regarded with extreme suspicion by the earliest analytic philosophers, have since been taken up to be studied from the analytic perspective. The following overview of some core issues in analytic philosophy of technology – the character of technological knowledge, the study of design and action, and the status of technical artifacts – will show that they are close to the heart of analytic philosophy.

The neglect that the philosophy of technology for a long time had in analytic philosophy may be attributed in part to a lack of reflection on the relation between science and technology – an attitude that is often presented, perhaps somewhat dramatized, in the form of a claim that technology is “merely” applied science. Indeed, a questioning of this relation was the central issue in the earliest discussions among analytic philosophers of technology. In 1966, in a special issue of the journal *Technology and Culture*, Henryk Skolimowski pointed out that technology is something quite different from science. Science concerns itself with what *is*,

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whereas technology concerns itself with what is *to be*. A few years later, in his well-known book *The Sciences of the Artificial*, Herbert Simon emphasized this important distinction in almost the same words, stating that the scientist is concerned with how things *are* but the engineer with how things *ought* to be. Although it is difficult to imagine that earlier analytic philosophers, in particular the logical empiricists, were blind to this difference in orientation, their inclination to view knowledge primarily as a system of statements may have led to a conviction that in technology no knowledge claims play a role that cannot also be found in science, and that therefore the study of technology poses no new challenges and holds no surprises regarding the interests of analytic philosophy. Additionally it must be noted that a close relationship between scientists and philosophers had grown around several foundational issues – the reality of atoms, the status of causality and probability, questions of space and time, the nature of the quantum world – that were so lively discussed during the end of the nineteenth and the beginning of the twentieth century. No such intimacy existed between those same philosophers and technicians; their worlds barely touched. And as the saying goes: unknown, unloved.

In the same issue of *Technology and Culture*, Mario Bunge defended the view that technology is applied science, but in a subtle way that does justice to the differences between science and technology. Bunge acknowledges that technology is about action, but an action heavily underpinned by theory – that is what distinguishes technology from the arts and crafts and puts it on a par with science. According to Bunge, theories in technology come in two types: substantive theories, which provide knowledge about the object of action, and operative theories, which are concerned with action itself. The substantive theories of technology are indeed largely applications of scientific theories. The operative theories, in contrast, are not preceded by scientific theories but are born in applied research itself. Still, as Bunge claims, operative theories show a dependency on science in that in such theories the *method* of science is employed. This includes such features as modeling and idealization, the use of theoretical concepts and abstractions, and the modification of theories by the absorption of empirical data through predictions and retrodictions.

In his comment on Skolimowski's paper in *Technology and Culture*, Ian Jarvie proposed as important questions for an analytic philosophy of technology, what the epistemological status of technological statements is and

how technological statements are to be demarcated from scientific statements. This suggests a thorough investigation of the various forms of knowledge occurring in either practice. A distinction between “knowing that” – traditional propositional knowledge – and “knowing how” – non-articulated and even impossible-to-articulate knowledge – had earlier been introduced by Gilbert Ryle, one of the most important British analytic philosophers of the mid-twentieth century, but this distinction was not used to investigate the epistemological status of technological claims. Whether it would have been fruitful in this respect is still an open question. Not much progress seems to have been made in philosophy in this respect. These early analytic philosophers of technology still shared the philosophy of science as point of departure. As a result, they tended to miss an important, if not the most important, activity that sets technology apart from science, that of design. To understand this part of technology properly, a thorough acquaintance with engineering practice is required.

In his 1990 book *What Engineers Know and How They Know It*, the aeronautical engineer Walter Vincenti gave a sixfold categorization of engineering design knowledge (leaving aside production and operation as the other two basic constituents of engineering practice). Vincenti distinguishes (1) fundamental design concepts, including primarily the operational principle and the normal configuration of a particular device; (2) criteria and specifications; (3) theoretical tools; (4) quantitative data; (5) practical considerations; and (6) design instrumentalities. The third and fourth category can be assumed to include Bunge's substantive technological theories. Of the remaining four categories, Vincenti claims that they represent prescriptive forms of knowledge rather than descriptive ones. Here, the activity of design introduces an element of normativity, which fails in scientific knowledge. Take such a basic notion as “operational principle,” by which is meant the way in which the function of a device is realized – how it works, in short. This is still a purely descriptive notion. Subsequently, however, it plays a role in arguments that seek to prescribe a course of action to someone who has a goal that could be realized by the operation of such a device. At this stage, the issue changes from a descriptive to a prescriptive or normative one. In analytic philosophy, such arguments are studied under the headings of practical inference, instrumental rationality and means – ends reasoning. A lot of work still has to be done on the precise ways technological action, as included in the

activity of designing, is linked to the study that these fields present of action in general.

This task requires a clear view on the extent and scope of technology. If we follow Joseph Pitt in his 1999 book *Thinking about Technology* and define technology broadly as “humanity at work,” then to distinguish between technological action and action in general becomes difficult, and the study of technological action must absorb all descriptive and normative theories of action, including the theory of practical rationality, and much of theoretical economics in its wake. There have indeed been attempts within analytic philosophy at such an encompassing account of human action, for example Tadeusz Kotarbiński’s *Praxiology* (1955), but a perspective of such generality makes it difficult to arrive at results of sufficient depth. It is a challenge for analytic philosophy in general to specify the differences among action forms and the reasoning grounding them in, to single out three prominent practices, technology, organization and management, and economics.

Another issue of central concern to analytic philosophers of technology is the status of artifacts. Philosophy of science has emphasized that the concept of natural kind, such as exemplified by “water” or “atom,” lies at the basis of science. In technology, artifacts are similarly represented as forming kinds, but such kinds – in particular functional kinds like “knife” or “aeroplane” – lack the property that makes them so important in science, that of supporting natural laws. There are no regularities that all knives or all aeroplanes answer to. In fact the character itself of a functional kind is unclear: is a knife everything that can be used to cut, or everything that was made with the intention that it be used for cutting? The former would classify splinters of glass and sharp rocks as knives; the latter would have us include in the class of knives all failed attempts at designing a knife and all remnants of knives worn beyond recognition. Neither alternative is attractive. This broad concept of functional kind is, however, not the only relevant notion of a kind in technology, nor the most important one. It can be argued that engineering design is aimed at creating a *kind* or *type* rather than one or several individual artifacts. Since these kinds are specified in terms of physical and geometrical parameters, they are much closer to the natural kinds of science, in that they support law-like regularities.

The contrast between these two sorts of kinds reflects the more general problem of the relation between structure and function in technical artifacts. Structure and function mutually constrain each other, but the

constraining is only partial, and it is therefore unclear whether a general account of this relation is possible. In relation to this it is equally problematic whether a unified account of the notion of function as such is possible. This notion is of paramount importance for an understanding of artifacts. An artifact’s function is, roughly, what it is for, where it is open whether this for-ness is based ultimately on what the artifact is designed for or being used for. Several researchers have emphasized that an adequate description of artifacts must refer both to their status as tangible physical objects and to the intentions of their users and designers. Peter Kroes and Anthonie Meijers (2006) have dubbed this view “the dual nature of technical artifacts.” They suggest that the two aspects are “tied up,” so to speak, in the notion of artifact function. Function, however, is also a key concept in biology, where no intentionality plays a role. Up till now there is no accepted general account of function under which both the intentionality-oriented notion of artifact function and the non-intentional notion of biological function – not to speak of other areas where the concept plays a role, such as the social sciences – can be subsumed. The collection of essays edited by Ariew, Cummins and Perlman (2002) presents a recent introduction to this topic.

This presentation of some of the core issues addressed by analytic philosophers of technology might suggest that they are not interested in ethical and social problems in connection with technology, just as the ethical and social dimensions of science are almost completely ignored in analytic philosophy of science. This is not so, however, but their interest is triggered more by the engagement of analytic philosophers of technology in engineering practice than by the interests of philosophical ethics. Analytic ethics is primarily a form of meta-ethics, that is, it discusses the character of ethical judgments and ethical statements and the way these are related, through rules of inference, for instance, with other types of statements. It is not apparent that technology presents special challenges to meta-ethics – none, at least, that do not already occur within the philosophy of action and the theory of rationality. Rather, analytic philosophers of technology share in a broadly felt conviction that any form of philosophical reflection on technology must address the ethical and societal problems raised by technology. The way they address these problems reflects the general orientation of analytic philosophy. In line with the central place they give to conceptual analysis, analytical philosophers stress the importance of clarifying

key notions like responsibility. And, in line with their urge to take the empirical facts into account, they argue that a thorough acquaintance with the way engineering design is organized and the way technical artifacts are implemented and used is crucial to an understanding of the way in which ethical problems related to technology emerge, an understanding that must precede any sensible proposal to deal with such problems. Similarly, with

regard to the sweeping claims concerning the meaning of technology in human culture and the good or bad ways in which it shapes human life that can so readily be found in traditional philosophy of technology, analytic philosophers of technology point to the need to analyze and make more precise concepts like man, mankind, culture, thought, freedom, and the like, before such statements can be meaningfully proposed and discussed.

References

- Ariew, A., Cummins, R. and Perlman, M. (eds) (2002). *Functions: New Essays in the Philosophy of Psychology and Biology* (Oxford: Oxford University Press).
- Kotarbiński, T. (1955). *Traktat o dobrej robocie*, English translation (1965), *Praxiology: An Introduction to the Sciences of Efficient Action* (Oxford: Pergamon Press).
- Kroes, P. A. and Meijers, A. W. M. (eds) (2006), "The Dual Nature of Technical Artefacts," *Studies in History and Philosophy of Science*, 37 (special issue): 1–158.
- Mitcham, C. (1994). *Thinking through Technology: The Path between Engineering and Philosophy* (Chicago, Ill.: University of Chicago Press).
- Pitt, J. C. (1999). *Thinking about Technology: Foundations of the Philosophy of Technology* (New York: Seven Bridges Press).
- Ryle, G. (1949). *The Concept of Mind* (London: Hutchinson).
- Simon, H. A. (1969). *The Sciences of the Artificial* (Cambridge, Mass./London: MIT Press).
- Vincenti, W. G. (1991). *What Engineers Know and How They Know It: Analytical Studies from Aeronautical History* (Baltimore, Md./London: Johns Hopkins University Press).

On the Aims of a Philosophy of Technology

Jacques Ellul

Author's Preface to the French Edition of *The Technological Society* [1954]

Let us, first of all, clear up certain misunderstandings that inevitably arise in any discussion of technique.

It is not the business of this book to describe the various techniques which, taken together, make up the technological society. It would take a whole library to describe the countless technical means invented by man; and such an undertaking would be of little value. Moreover, quite enough elementary works describing the various techniques are already available. I shall frequently allude to some of these techniques on the assumption that their applications or their mechanics are familiar to the reader.

I do not intend to draw up a balance sheet, positive or negative, of what has been so far accomplished by means of these techniques, or to compare their advantages and disadvantages. I shall not repeat what has so often been stated, that through technology the work week has been materially shortened, that living standards have risen, and so forth; or, on the other side of the ledger, that the worker has encountered many difficulties in adapting to the machine. Indeed, no one is capable of making a

true and itemized account of the total effect of existing techniques. Only fragmentary and superficial surveys are possible.

Finally, it is not my intention to make ethical or aesthetic judgments on technique. A human being is, of course, human and not a mere photographic plate, so that his own point of view inevitably appears. But this does not preclude a deeper objectivity. The sign of it will be that worshippers of technique will no doubt find this work pessimistic and haters of technique will find it optimistic.

I have attempted simply to present, by means of a comprehensive analysis, a concrete and fundamental interpretation of technique.

That is the sole object of this book.

Note to the Reader [1963]

I think the task of the reader will be lightened if at the outset I attempt a definition of *technique*. The whole first chapter is devoted to making clear what constitutes technique in the present-day world, but as a preliminary there must be a simple idea, a definition.

The term *technique*, as I use it, does not mean machines, technology, or this or that procedure for attaining an end.

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In our technological society, *technique* is the *totality of methods rationally arrived at and having absolute efficiency* (for a given stage of development) in *every* field of human activity. Its characteristics are new; the technique of the present has no common measure with that of the past.

This definition is not a theoretical construct. It is arrived at by examining each activity and observing the facts of what modern man calls technique in general, as well as by investigating the different areas in which specialists declare they have a technique.

In the course of this work, the word *technique* will be used with varying emphasis on one or another aspect of this definition. At one point, the emphasis may be on rationality, at another on efficiency or procedure, but the over-all definition will remain the same.

Finally, we shall be looking at technique in its sociological aspect; that is, we shall consider the effect of technique on social relationships, political structures, economic phenomena. Technique is not an isolated fact in society (as the term *technology* would lead us to believe) but is related to every factor in the life of modern man; it affects social facts as well as all others. Thus technique itself is a sociological phenomenon, and it is in this light that we shall study it.

Author's Foreword to the Revised American Edition [1964]

At the beginning I must try to make clear the direction and aim of this book. Although descriptive, it is not without purpose. I do not limit myself to describing my findings with cold objectivity in the manner of a research worker reporting what he sees under a microscope. I am keenly aware that I am myself involved in technological civilization, and that its history is also my own. I may be compared rather with a physician or physicist who is describing a group situation in which he is himself involved. The physician in an epidemic, the physicist exposed to radioactivity: in such situations the mind may remain cold and lucid, and the method objective, but there is inevitably a profound tension of the whole being.

Although I have deliberately not gone beyond description, the reader may perhaps receive an impression of pessimism. I am neither by nature, nor doctrinally, a pessimist, nor have I pessimistic prejudices. I am concerned only with knowing whether things are so or not. The reader tempted to brand me a pessimist should

begin to examine his own conscience, and ask himself what causes him to make such a judgment. For behind this judgment, I believe, will always be found previous metaphysical value judgments, such as: "Man is free"; "Man is lord of creation"; "Man has always overcome challenges" (so why not this one too?); "Man is good." Or again: "Progress is always positive"; "Man has an eternal soul, and so cannot be put in jeopardy." Those who hold such convictions will say that my description of technological civilization is incorrect and pessimistic. I ask only that the reader place himself on the factual level and address himself to these questions: "Are the facts analyzed here false?" "Is the analysis inaccurate?" "Are the conclusions unwarranted?" "Are there substantial gaps and omissions?" It will not do for him to challenge factual analysis on the basis of his own ethical or metaphysical presuppositions.

The reader deserves and has my assurance that I have not set out to prove anything. I do not seek to show, say, that man is determined, or that technique is bad, or anything else of the kind.

Two other factors may lead the reader to the feeling of pessimism. It may be that he feels a rigorous determinism is here described that leaves no room for effective individual action, or that he cannot find any solution for the problems raised in the book. These two factors must now engage our attention.

As to the rigorous determinism, I should explain that I have tried to perform a work of sociological reflection, involving analysis of large groups of people and of major trends, but not of individual actions. I do not deny the existence of individual action or of some inner sphere of freedom. I merely hold that these are not discernible at the most general level of analysis, and that the individual's acts or ideas do not *here and now* exert any influence on social, political, or economic mechanisms. By making this statement, I explicitly take a partisan position in a dispute between schools of sociology. To me the sociological does not consist of the addition and combination of individual actions. I believe that there is a collective sociological reality, which is independent of the individual. As I see it, individual decisions are always made within the framework of this sociological reality, itself pre-existent and more or less determinative. I have simply endeavored to describe technique as a sociological reality. We are dealing with collective mechanisms, with relationships among collective movements, and with modifications of political or economic structures. It should not be

surprising, therefore, that no reference is made to the separate, independent initiative of individuals. It is not possible for me to treat the individual sphere. But I do not deny that it exists. I do not maintain that the individual is more determined today than he has been in the past; rather, that he is differently determined. Primitive man, hemmed in by prohibitions, taboos, and rites, was, of course, socially determined. But it is an illusion – unfortunately very widespread – to think that because we have broken through the prohibitions, taboos, and rites that bound primitive man, we have become free. We are conditioned by something new: technological civilization. I make no reference to a past period of history in which men were allegedly free, happy, and independent. The determinisms of the past no longer concern us; they are finished and done with. If I do refer to the past, it is only to emphasize that present determinants did not exist in the past, and men did not have to grapple with them then. The men of classical antiquity could not have found a solution to our present determinisms, and it is useless to look into the works of Plato or Aristotle for an answer to the problem of freedom.

Keeping in mind that sociological mechanisms are always significant determinants – of more or less significance – for the individual, I would maintain that we have moved from one set of determinants to another. The pressure of these mechanisms is today very great; they operate in increasingly wide areas and penetrate more and more deeply into human existence. Therein lies the specifically modern problem.

This determinism has, however, another aspect. There will be a temptation to use the word *fatalism* in connection with the phenomena described in this book. The reader may be inclined to say that, if everything happens as stated in the book, man is entirely helpless – helpless either to preserve his personal freedom or to change the course of events. Once again, I think the question is badly put. I would reverse the terms and say: if man – if each one of us – abdicates his responsibilities with regard to values; if each of us limits himself to leading a trivial existence in a technological civilization, with greater adaptation and increasing success as his sole objectives; if we do not even consider the possibility of making a stand against these determinants, then everything *will* happen as I have described it, and the determinants *will* be transformed into inevitabilities. But, in describing sociological currents, I obviously cannot take into account the contingent decisions of this or that individual, even if these decisions could modify the course of

social development. For these decisions are not visible, and if they are truly personal, they cannot be foreseen. I have tried to describe the technical phenomenon as it exists at present and to indicate its *probable* evolution. Fatalism is not involved; it is rather a question of probability, and I have indicated what I think to be its most likely development.

What is the basis for this most likely eventuality? I would say that it lies in social, economic, and political phenomena, and in certain chains of events and sequences. If we may not speak of laws, we may, at any rate, speak of repetitions. If we may not speak of mechanisms in the strict sense of the word, we may speak of interdependencies. There is a certain logic (though not a formal logic) in economic phenomena which makes certain forecasts possible. This is true of sociology and, to a lesser degree, of politics. There is a certain logic in the evolution of institutions which is easily discernible. It is possible, without resorting to imagination or science fiction, to describe the path that a social body or institutional complex will follow. An extrapolation is perfectly proper and scientific when it is made with care. Such an extrapolation is what we have attempted. But it never represents more than a probability, and may be proved false by events.

External factors could change the course of history. The probable development I describe might be forestalled by the emergence of new phenomena. I give three examples – widely different, and deliberately so – of possible disturbing phenomena:

- (1) If a general war breaks out, and if there are any survivors, the destruction will be so enormous, and the conditions of survival so different, that a technological society will no longer exist.
- (2) If an increasing number of people become fully aware of the threat the technological world poses to man's personal and spiritual life, and if they determine to assert their freedom by upsetting the course of this evolution, my forecast will be invalidated.
- (3) If God decides to intervene, man's freedom may be saved by a change in the direction of history or in the nature of man.

But in sociological analysis these possibilities cannot be considered. The last two lie outside the field of sociology, and confront us with an upheaval so vast that its consequences cannot be assessed. But *sociological* analysis

does not permit consideration of these possibilities. In addition, the first two possibilities offer no analyzable fact on which to base any attempt at projection. They have no place in an inquiry into facts; I cannot deny that they may occur, but I cannot take them rationally into account. I am in the position of a physician who must diagnose a disease and guess its probable course, but who recognizes that God may work a miracle, that the patient may have an unexpected constitutional reaction, or that the patient – suffering from tuberculosis – may die unexpectedly of a heart attack. The reader must always keep in mind the implicit presupposition that *if* man does not pull himself together and assert himself (or if some other unpredictable but decisive phenomenon does not intervene), *then* things will go the way I describe.

The reader may be pessimistic on yet another score. In this study no solution is put forward to the problems raised. Questions are asked, but not answered. I have indeed deliberately refrained from providing solutions. One reason is that the solutions would necessarily be theoretical and abstract, since they are nowhere apparent in existing facts. I do not say that no solutions will be found; I merely aver that in the present social situation there is not even a beginning of a solution, no breach in the system of technical necessity. Any solutions I might propose would be idealistic and fanciful. In a sense, it would even be dishonest to suggest solutions: the reader might think them real rather than merely literary. I am acquainted with the “solutions” offered by Emmanuel Mounier, Pierre Teilhard de Chardin, Ragnor Frisch, Jean Fourastié, Georges Friedmann, and others. Unfortunately, all these belong to the realm of fancy and have no bearing on reality. I cannot rationally consider them in analyzing the present situation.

However, I will not make a final judgment on tomorrow before it arrives. I do not presume to put chains around man. But I do insist that a distinction be made between diagnosis and treatment. Before a remedy can be found, it is first necessary to make a detailed study of the disease and the patient, to do laboratory research, and to isolate the virus. It is necessary to establish criteria that will make it possible to recognize the disease when it occurs, and to describe the patient’s symptoms at each stage of his illness. This preliminary work is indispensable for eventual discovery and application of a remedy.

By this comparison I do not mean to suggest that technique is a disease of the body social, but rather to indicate a working procedure. Technique presents man with

multiple problems. As long as the first stage of analysis is incomplete, as long as the problems are not correctly stated, it is useless to proffer solutions. And, before we can pose the problems correctly, we must have an exact description of the phenomena involved. As far as I know, there is no over-all and exact description of the facts which would make it possible to formulate the problems correctly.

The existing works on the subject either are limited to a single aspect of the problem – the effect of motion pictures on the nervous system, for example – or else propose solutions without the requisite preliminary study. I offer these pages as a first effort in laying the necessary ground; much more work will have to follow before we can see what man’s true response is to the challenge before him.

But this must not lead the reader to say to himself: “All right, here is some information on the problem, and other sociologists, economists, philosophers, and theologians will carry on the work, so I have simply got to wait.” This will not do, for the challenge is not to scholars and university professors, but to all of us. At stake is our very life, and we shall need all the energy, inventiveness, imagination, goodness, and strength we can muster to triumph in our predicament. While waiting for the specialists to get on with their work on behalf of society, each of us, in his own life, must seek ways of resisting and transcending technological determinants. Each man must make this effort in every area of life, in his profession and in his social, religious, and family relationships.

In my conception, freedom is not an immutable fact graven in nature and on the heart of man. It is not inherent in man or in society, and it is meaningless to write it into law. The mathematical, physical, biological, sociological, and psychological sciences reveal nothing but necessities and determinisms on all sides. As a matter of fact, reality is itself a combination of determinisms, and freedom consists in overcoming and transcending these determinisms. Freedom is completely without meaning unless it is related to necessity, unless it represents victory over necessity. To say that freedom is graven in the nature of man, is to say that man is free because he obeys his nature, or, to put it another way, because he is conditioned by his nature. This is nonsense. We must not think of the problem in terms of a choice between being determined and being free. We must look at it dialectically, and say that man is indeed determined, but that it is open to him to overcome necessity, and that this *act is* freedom. Freedom is not static but dynamic; not a vested interest, but a prize continually to be won. The moment man stops and resigns himself, he becomes subject to

determinism. He is most enslaved when he thinks he is comfortably settled in freedom.

In the modern world, the most dangerous form of determinism is the technological phenomenon. It is not a question of getting rid of it, but, by an act of freedom, of transcending it. How is this to be done? I do not yet know. That is why this book is an appeal to the individual's sense of responsibility. The first step in the quest, the first act of freedom, is to become aware of the necessity. The very fact that man can see, measure, and analyze the determinisms that press on him means that he can

face them and, by so doing, act as a free man. If man were to say: "These are not necessities; I am free because of technique, or despite technique," this would prove that he is totally determined. However, by grasping the real nature of the technological phenomenon, and the extent to which it is robbing him of freedom, he confronts the blind mechanisms as a conscious being.

At the beginning of this foreword I stated that this book has a purpose. That purpose is to arouse the reader to an awareness of technological necessity and what it means. It is a call to the sleeper to awake.

Toward a Philosophy of Technology

Hans Jonas

Are there philosophical aspects to technology? Of course there are, as there are to all things of importance in human endeavor and destiny. Modern technology touches on almost everything vital to man's existence – material, mental, and spiritual. Indeed, what of man is *not* involved? The way he lives his life and looks at objects, his intercourse with the world and with his peers, his powers and modes of action, kinds of goals, states and changes of society, objectives and forms of politics (including warfare no less than welfare), the sense and quality of life, even man's fate and that of his environment: all these are involved in the technological enterprise as it extends in magnitude and depth. The mere enumeration suggests a staggering host of potentially philosophic themes.

To put it bluntly: if there is a philosophy of science, language, history, and art; if there is social, political, and moral philosophy; philosophy of thought and of action, of reason and passion, of decision and value – all facets of the inclusive philosophy of man – how then could there not be a philosophy of technology, the focal fact of modern life? And at that a philosophy so spacious that it can house portions from all the other branches of philosophy? It is almost a truism, but at the same time so immense a proposition that its challenge staggers the mind. Economy and modesty require that we select, for

a beginning, the most obvious from the multitude of aspects that invite philosophical attention.

The old but useful distinction of “form” and “matter” allows us to distinguish between these two major themes: (1) the *formal dynamics* of technology as a continuing collective enterprise, which advances by its own “laws of motion”; and (2) the *substantive content* of technology in terms of the things it puts into human use, the powers it confers, the novel objectives it opens up or dictates, and the altered manner of human action by which these objectives are realized.

The first theme considers technology as an abstract whole of movement; the second considers its concrete uses and their impact on our world and our lives. The formal approach will try to grasp the pervasive “process properties” by which modern technology propels itself – through our agency, to be sure – into ever-succeeding and superseding novelty. The material approach will look at the species of novelties themselves, their taxonomy, as it were, and try to make out how the world furnished with them looks. A third, overarching theme is the *moral* side of technology as a burden on human responsibility, especially its long-term effects on the global condition of man and environment. This – my own main preoccupation over the past years – will only be touched upon.

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I The Formal Dynamics of Technology

First some observations about technology's form as an abstract whole of movement. We are concerned with characteristics of *modern* technology and therefore ask first what distinguishes it *formally* from all previous technology. One major distinction is that modern technology is an enterprise and process, whereas earlier technology was a possession and a state. If we roughly describe technology as comprising the use of artificial implements for the business of life, together with their original invention, improvement, and occasional additions, such a tranquil description will do for most of technology through mankind's career (with which it is coeval), but not for modern technology. In the past, generally speaking, a given inventory of tools and procedures used to be fairly constant, tending toward a mutually adjusting, stable equilibrium of ends and means, which – once established – represented for lengthy periods an unchallenged optimum of technical competence.

To be sure, revolutions occurred, but more by accident than by design. The agricultural revolution, the metallurgical revolution that led from the neolithic to the iron age, the rise of cities, and such developments, *happened* rather than were consciously created. Their pace was so slow that only in the time-contraction of historical retrospect do they appear to be “revolutions” (with the misleading connotation that their contemporaries experienced them as such). Even where the change was sudden, as with the introduction first of the chariot, then of armed horsemen into warfare – a violent, if short-lived, revolution indeed – the innovation did not originate from within the military art of the advanced societies that it affected, but was thrust on it from outside by the (much less civilized) peoples of Central Asia. Instead of spreading through the technological universe of their time, other technical breakthroughs, like Phoenician purple-dyeing, Byzantine “greek fire,” Chinese porcelain and silk, and Damascene steel-tempering, remained jealously guarded monopolies of the inventor communities. Still others, like the hydraulic and steam playthings of Alexandrian mechanics, or compass and gunpowder of the Chinese, passed unnoticed in their serious technological potentials.¹

On the whole (not counting rare upheavals), the great classical civilizations had comparatively early-reached a point of technological saturation – the aforementioned “optimum” in equilibrium of means with acknowledged needs and goals – and had little cause later to go beyond

it. From there on, convention reigned supreme. From pottery to monumental architecture, from food growing to shipbuilding, from textiles to engines of war, from time measuring to stargazing: tools, techniques, and objectives remained essentially the same over long times; improvements were sporadic and unplanned. Progress therefore – if it occurred at all² – was by inconspicuous increments to a universally high level that still excites our admiration and, in historical fact, was more liable to regression than to surpassing. The former at least was the more noted phenomenon, deplored by the epigones with a nostalgic remembrance of a better past (as in the declining Roman world). More important, there was, even in the best and most vigorous times, no proclaimed *idea* of a future of *constant progress* in the arts. Most important, there was never a deliberate method of going about it like “research,” the willingness to undergo the risks of trying unorthodox paths, exchanging information widely about the experience, and so on. Least of all was there a “natural science” as a growing body of theory to guide such semi-theoretical, prepractical activities, plus their social institutionalization. In routines as well as panoply of instruments, accomplished as they were for the purposes they served, the “arts” seemed as settled as those purposes themselves.³

Traits of modern technology

The exact opposite of this picture holds for modern technology, and this is its first philosophical aspect. Let us begin with some manifest traits.

- (1) Every new step in whatever direction of whatever technological field tends *not* to approach an equilibrium or saturation point in the process of fitting means to ends (nor is it meant to), but, on the contrary, to give rise, if successful, to further steps in all kinds of direction and with a fluidity of the ends themselves. “Tends to” becomes a compelling “is bound to” with any major or important step (this almost being its criterion); and the innovators themselves expect, beyond the accomplishment, each time, of their immediate task, the constant future repetition of their inventive activity.
- (2) Every technical innovation is sure to spread quickly through the technological world community, as also do theoretical discoveries in the sciences. The spreading is in terms of knowledge and of practical adoption, the first (and its speed) guaranteed by the

universal intercommunication that is itself part of the technological complex, the second enforced by the pressure of competition.

- (3) The relation of means to ends is not unilinear but circular. Familiar ends of long-standing may find better satisfaction by new technologies whose genesis they had inspired. But equally – and increasingly typical – new technologies may suggest, create, even impose new ends, never before conceived, simply by offering their feasibility. (Who had ever wished to have in his living room the Philharmonic orchestra, or open heart surgery, or a helicopter defoliating a Vietnam forest? or to drink his coffee from a disposable plastic cup? or to have artificial insemination, test-tube babies, and host pregnancies? or to see clones of himself and others walking about?) Technology thus adds to the very objectives of human desires, including objectives for technology itself. The last point indicates the dialectics or circularity of the case: once incorporated into the socioeconomic demand diet, ends first gratuitously (perhaps accidentally) generated by technological invention become necessities of life and set technology the task of further perfecting the means of realizing them.
- (4) Progress, therefore, is not just an ideological gloss on modern technology, and not at all a mere option offered by it, but an inherent drive which acts willy-nilly in the formal automatics of its *modus operandi* as it interacts with society. “Progress” is here not a value term but purely descriptive. We may resent the fact and despise its fruits and yet must go along with it, for – short of a stop by the fiat of total political power, or by a sustained general strike of its clients or some internal collapse of their societies, or by self-destruction through its works (the last, alas, the least unlikely of these) – the juggernaut moves on relentlessly, spawning its always mutated progeny by coping with the challenges and lures of the now. But while not a value term, “progress” here is not a neutral term either, for which we could simply substitute “change.” For it is in the nature of the case, or a law of the series, that a later stage is always, in terms of technology itself, *superior* to the preceding stage.⁴ Thus we have here a case of the entropy-defying sort (organic evolution is another), where the internal motion of a system, left to itself and not interfered with, leads to ever “higher,” not “lower” states of itself. Such at

least is the present evidence.⁵ If Napoleon once said, “Politics is destiny,” we may well say today, “Technology is destiny.”

These points go some way to explicate the initial statement that modern technology, unlike traditional, is an enterprise and not a possession, a process and not a state, a dynamic thrust and not a set of implements and skills. And they already adumbrate certain “laws of motion” for this restless phenomenon. What we have described, let us remember, were formal traits which as yet say little about the contents of the enterprise. We ask two questions of this descriptive picture: *why* is this so, that is, what *causes* the restlessness of modern technology; what is the nature of the thrust? And, what is the philosophical import of the facts so explained?

The nature of restless technology

As we would expect in such a complex phenomenon, the motive forces are many, and some causal hints appeared already in the descriptive account. We have mentioned *pressure of competition* – for profit, but also for power, security, and so forth – as one perpetual mover in the universal appropriation of technical improvements. It is equally operative in their origination, that is, in the process of invention itself, nowadays dependent on constant outside subsidy and even goal-setting: potent interests see to both. War, or the threat of it, has proved an especially powerful agent. The less dramatic, but no less compelling, everyday agents are legion. To keep one’s head above the water is their common principle (somewhat paradoxical, in view of an abundance already far surpassing what former ages would have lived with happily ever after). Of pressures other than the competitive ones, we must mention those of population growth and of impending exhaustion of natural resources. Since both phenomena are themselves already by-products of technology (the first by way of medical improvements, the second by the voracity of industry), they offer a good example of the more general truth that to a considerable extent technology itself begets the problems which it is then called upon to overcome by a new-forward jump. (The Green Revolution and the development of synthetic substitute materials or of alternate sources of energy come under this heading.) These compulsive pressures for progress, then, would operate even for a technology in a noncompetitive, for example, a socialist setting.

A motive force more autonomous and spontaneous than these almost mechanical pushes with their “sink or swim” imperative would be the pull of the quasi-utopian *vision* of an ever better life, whether vulgarly conceived or nobly, once technology had proved the open-ended capacity for procuring the conditions for it: perceived possibility whetting the appetite (“the American dream,” “the revolution of rising expectations”). This less palpable factor is more difficult to appraise, but its playing a role is undeniable. Its deliberate fostering and manipulation by the dream merchants of the industrial-mercantile complex is yet another matter and somewhat taints the spontaneity of the motive, as it also degrades the quality of the dream. It is also moot to what extent the vision itself is *post hoc* rather than *ante hoc*, that is, instilled by the dazzling feats of a technological progress already underway and thus more a response to than a motor of it.

Groping in these obscure regions of motivation, one may as well descend, for an explanation of the dynamism as such, into the Spenglerian mystery of a “Faustian soul” innate in Western culture, that drives it, nonrationally, to infinite novelty and unplumbed possibilities for their own sake; or into the Heideggerian depths of a fateful, metaphysical decision of the will for boundless power over the world of things – a decision equally peculiar to the Western mind: speculative intuitions which do strike a resonance in us, but are beyond proof and disproof.

Surfacing once more, we may also look at the very sober, functional facts of industrialism as such, of production and distribution, output maximization, managerial and labor aspects, which even apart from competitive pressure provide their own incentives for technical progress. Similar observations apply to the requirements of *rule* or control in the vast and populous states of our time, those giant territorial super-organisms which for their very cohesion depend on advanced technology (for example, in information, communication, and transportation, not to speak of weaponry) and thus have a stake in its promotion: the more so, the more centralized they are. This holds for socialist systems no less than for free-market societies. May we conclude from this that even a communist world state, freed from external rivals as well as from internal free-market competition, might still have to push technology ahead for purposes of control on this colossal scale? Marxism, in any case, has its own inbuilt commitment to technological progress beyond necessity. But even disregarding all dynamics of these conjectural kinds, the most monolithic case imaginable would, at any rate, still be exposed to those noncompetitive, natural

pressures like population growth and dwindling resources that beset industrialism as such. Thus, it seems, the compulsive element of technological progress may not be bound to its original breeding ground, the capitalist system. Perhaps the odds for an eventual stabilization look somewhat better in a socialist system, provided it is worldwide – and possibly totalitarian in the bargain. As it is, the pluralism we are thankful for ensures the constancy of compulsive advance.

We could go on unravelling the causal skein and would be sure to find many more strands. But none nor all of them, much as they explain, would go to the heart of the matter. For all of them have one premise in common without which they could not operate for long: the premise that there *can* be indefinite progress because there *is* always something new and better to find. The, by no means obvious, givenness of this objective condition is also the pragmatic conviction of the performers in the technological drama; but without its being true, the conviction would help as little as the dream of the alchemists. Unlike theirs, it is backed up by an impressive record of past successes, and for many this is sufficient ground for their belief. (Perhaps holding or not holding it does not even greatly matter.) What makes it more than a sanguine belief, however, is an underlying and well-grounded, theoretical view of the nature of things and of human cognition, according to which they do not set a limit to novelty of discovery and invention, indeed, that they of themselves will at each point offer another opening for the as yet unknown and undone. The corollary conviction, then, is that a technology tailored to a nature and to a knowledge of this indefinite potential ensures its indefinitely continued conversion into the practical powers, each step of it begetting the next, with never a cutoff from internal exhaustion of possibilities.

Only habituation dulls our wonder at this wholly unprecedented belief in virtual “infinity.” And by all our present comprehension of reality, the belief is most likely true – at least enough of it to keep the road for innovative technology in the wake of advancing science open for a long time ahead. Unless we understand this ontologic-epistemological premise, we have not understood the inmost agent of technological dynamics, on which the working of all the adventitious causal factors is contingent in the long run.

Let us remember that the virtual infinitude of advance we here seek to explain is in essence different from the always avowed perfectibility of every human accomplishment. Even the undisputed master of his craft always

had to admit as possible that he might be surpassed in skill or tools or materials; and no excellence of product ever foreclosed that it might still be bettered, just as today's champion runner must know that his time may one day be beaten. But these are improvements within a given genus, not different in kind from what went before, and they must accrue in diminishing fractions. Clearly, the phenomenon of an exponentially growing *generic* innovation is qualitatively different.

Science as a source of restlessness

The answer lies in the interaction of *science* and *technology* that is the hallmark of modern progress, and thus ultimately in the kind of nature which modern science progressively discloses. For it is here, in the movement of *knowledge*, where relevant novelty first and constantly occurs. This is itself a novelty. To Newtonian physics, nature appeared simple, almost crude, running its show with a few kinds of basic entities and forces by a few universal laws, and the application of those well-known laws to an ever greater variety of composite phenomena promised ever widening knowledge indeed, but no real surprises. Since the mid-nineteenth century, this minimalist and somehow finished picture of nature has changed with breathtaking acceleration. In a reciprocal interplay with the growing subtlety of exploration (instrumental and conceptual), nature itself stands forth as ever more subtle. The progress of probing makes the object grow richer in modes of operation, not sparer as classical mechanics had expected. And instead of narrowing the margin of the still-undiscovered, science now surprises itself with unlocking dimension after dimension of new depths. The very essence of matter has turned from a blunt, irreducible ultimate to an always reopened challenge for further penetration. No one can say whether this will go on forever, but a suspicion of intrinsic infinity in the very being of things obtrudes itself and therewith an anticipation of unending inquiry of the sort where succeeding steps will not find the same old story again (Descartes' "matter in motion"), but always add new twists to it. If then the art of technology is correlative to the knowledge of nature, technology too acquires from this source that potential of infinity for its innovative advance.

But it is not just that indefinite scientific progress offers the *option* of indefinite technological progress, to be exercised or not as other interests see fit. Rather the cognitive process itself moves by interaction with the

technological, and in the most internally vital sense: for its own *theoretical* purpose, science must generate an increasingly sophisticated and physically formidable technology as its tool. What it finds with this help initiates new departures in the practical sphere, and the latter as a whole, that is, technology at work provides with its experiences a large-scale laboratory for science again, a breeding ground for new questions, and so on in an unending cycle. In brief, a mutual feedback operates between science and technology; each requires and propels the other; and as matters now stand, they can only live together or must die together. For the dynamics of technology, with which we are here concerned, this means that (all external promptings apart) an agent of restlessness is implanted in it by its functionally integral bond with science. As long, therefore, as the cognitive impulse lasts, technology is sure to move ahead with it. The cognitive impulse, in its turn, culturally vulnerable in itself, liable to lag or to grow conservative with a treasured canon – that theoretical eros itself no longer lives on the delicate appetite for truth alone, but is spurred on by its hardier offspring, technology, which communicates to it impulsions from the broadest arena of struggling, insistent life. Intellectual curiosity is seconded by interminably self-renewing practical aim.

I am conscious of the conjectural character of some of these thoughts. The revolutions in science over the last fifty years or so are a fact, and so are the revolutionary style they imparted to technology and the reciprocity between the two concurrent streams (nuclear physics is a good example). But whether those scientific revolutions, which hold primacy in the whole syndrome, will be typical for science henceforth – something like a law of motion for its future – or represent only a singular phase in its longer run, is unsure. To the extent, then, that our forecast of incessant novelty for technology was predicated on a guess concerning the future of science, even concerning the nature of things, it is hypothetical, as such extrapolations are bound to be. But even if the recent past did not usher in a state of permanent revolution for science, and the life of theory settles down again to a more sedate pace, the scope for technological innovation will not easily shrink; and what may no longer be a revolution in science, may still revolutionize our lives in its practical impact through technology. "Infinity" being too large a word anyway, let us say that present signs of potential and of incentives point to an indefinite perpetuation and fertility of the technological momentum.

The philosophical implications

It remains to draw philosophical conclusions from our findings, at least to pinpoint aspects of philosophical interest. Some preceding remarks have already been straying into philosophy of science in the technical sense. Of broader issues, two will be ample to provide food for further thought beyond the limitations of this paper. One concerns the status of knowledge in the human scheme, the other the status of technology itself as a human goal, or its tendency to become that from being a means, in a dialectical inversion of the means-end order itself.

Concerning knowledge, it is obvious that the time-honored division of theory and practice has vanished for both sides. The thirst for pure knowledge may persist undiminished, but the involvement of knowing at the heights with doing in the lowlands of life, mediated by technology, has become inextricable; and the aristocratic self-sufficiency of knowing for its own (and the knower's) sake has gone. Nobility has been exchanged for utility. With the possible exception of philosophy, which still can do with paper and pen and tossing thoughts around among peers, all knowledge has become thus tainted, or elevated if you will, whether utility is intended or not. The technological syndrome, in other words, has brought about a thorough *socializing* of the theoretical realm, enlisting it in the service of common need. What used to be the freest of human choices, an extravagance snatched from the pressure of the world – the esoteric life of thought – has become part of the great public play of necessities and a prime necessity in the action of the play.⁶ Remotest abstraction has become enmeshed with nearest concreteness. What this pragmatic functionalization of the once highest indulgence in impractical pursuits portends for the image of man, for the restructuring of a hallowed hierarchy of values, for the idea of “wisdom,” and so on, is surely a subject for philosophical pondering.

Concerning technology itself, its actual role in modern life (as distinct from the purely instrumental definition of technology as such) has made the relation of means and ends equivocal all the way up from the daily living to the very vocation of man. There could be no question in former technology that its role was that of humble servant – pride of workmanship and esthetic embellishment of the useful notwithstanding. The Promethean enterprise of modern technology speaks a different language. The word “enterprise” gives the clue, and its unendingness another. We have mentioned that

the effect of its innovations is disequilibrating rather than equilibrating with respect to the balance of wants and supply, always breeding its own new wants. This in itself compels the constant attention of the best minds, engaging the full capital of human ingenuity for meeting challenge after challenge and seizing the new chances. It is psychologically natural for that degree of engagement to be invested with the dignity of dominant purpose. Not only does technology dominate our lives in fact, it nourishes also a belief in its being of predominant worth. The sheer grandeur of the enterprise and its seeming infinity inspire enthusiasm and fire ambition. Thus, in addition to spawning new ends (worthy or frivolous) from the mere invention of means, technology as a grand venture tends to establish *itself* as the transcendent end. At least the suggestion is there and casts its spell on the modern mind. At its most modest, it means elevating *homo fiber* to the essential aspect of man; at its most extravagant, it means elevating *power* to the position of his dominant and interminable goal. To become ever more masters of the world, to advance from power to power, even if only collectively and perhaps no longer by choice, *can* now be seen to be the chief vocation of mankind. Surely, this again poses philosophical questions that may well lead unto the uncertain grounds of metaphysics or of faith.

I here break off, arbitrarily, the formal account of the technological movement in general, which as yet has told us little of what the enterprise is about. To this subject I now turn, that is, to the new kinds of powers and objectives that technology opens to modern man and the consequently altered quality of human action itself.

II The Material Works of Technology

Technology is a species of power, and we can ask questions about how and on what object any power is exercised. Adopting Aristotle's rule in *de anima* that for understanding a faculty one should begin with its objects, we start from them too – “objects” meaning both the visible *things* technology generates and puts into human use, and the *objectives* they serve. The objects of modern technology are first everything that had always been an object of human artifice and labor: food, clothing, shelter, implements, transportation – all the material necessities and comforts of life. The technological intervention changed at first not the product but its

production, in speed, ease, and quantity. However, this is true only of the very first stage of the industrial revolution with which large-scale scientific technology began. For example, the cloth for the steam-driven looms of Lancashire remained the same. Even then, one significant new product was added to the traditional list – the machines themselves, which required an entire new industry with further subsidiary industries to build them. These novel entities, machines – at first capital goods only, not consumer goods – had from the beginning their own impact on man's symbiosis with nature by being consumers themselves. For example: steam-powered water pumps facilitated coal mining, required in turn extra coal for firing their boilers, more coal for the foundries and forges that made those boilers, more for the mining of the requisite iron ore, more for its transportation to the foundries, more – both coal and iron – for the rails and locomotives made in these same foundries, more for the conveyance of the foundries' product to the pitheads and return, and finally more for the distribution of the more abundant coal to the users outside this cycle, among which were increasingly still more machines spawned by the increased availability of coal. Lest it be forgotten over this long chain, we have been speaking of James Watt's modest steam engine for pumping water out of mine shafts. This syndrome of self-proliferation – by no means a linear chain but an intricate web of reciprocity – has been part of modern technology ever since. To generalize, technology exponentially increases man's drain on nature's resources (of substances and of energy), not only through the multiplication of the final goods for consumption, but also, and perhaps more so, through the production and operation of its own mechanical means. And with these means machines – it introduced a new category of goods, not for consumption, added to the furniture of our world. That is, among the objects of technology a prominent class is that of technological apparatus itself.

Soon other features also changed the initial picture of a merely mechanized production of familiar commodities. The final products reaching the consumer ceased to be the same, even if still serving the same age-old needs; new needs, or desires, were added by commodities of entirely new kinds which changed the habits of life. Of such commodities, machines themselves became increasingly part of the consumer's daily life to be used directly by himself, as an article not of production but of consumption. My survey can be brief as the facts are familiar.

New kinds of commodities

When I said that the cloth of the mechanized looms of Lancashire remained the same, everyone will have thought of today's synthetic fibre textiles for which the statement surely no longer holds. This is fairly recent, but the general phenomenon starts much earlier, in the synthetic dyes and fertilizers with which the chemical industry – the first to be wholly a fruit of science – began. The original rationale of these technological feats was substitution of artificial for natural materials (for reasons of scarcity or cost), with as nearly as possible the same properties for effective use. But we need only think of plastics to realize that art progressed from substitutes to the creation of really new substances with properties not so found in any natural one, raw or processed, thereby also initiating uses not thought of before and giving rise to new classes of objects to serve them. In chemical (molecular) engineering, man does more than in mechanical (molar) engineering which constructs machinery from natural materials; his intervention is deeper, redesigning the infra-patterns of nature, making substances to specification by arbitrary disposition of molecules. And this, be it noted, is done deductively from the bottom, from the thoroughly analyzed last: elements, that is, in a real *via compositiva* after the completed *via resolutiva*, very different from the long-known empirical practice of coaxing substances into new properties, as in metal alloys from the bronze age on. Artificiality or creative engineering with abstract construction invades the heart of matter. This, in molecular biology, points to further, awesome potentialities.

With the sophistication of molecular alchemy we are ahead of our story. Even in straightforward hardware engineering, right in the first blush of the mechanical revolution, the objects of use that came out of the factories did not really remain the same, even where the objectives did. Take the old objective of travel. Railroads and ocean liners are relevantly different from the stage coach and from the sailing ship, not merely in construction and efficiency but in the very feel of the user, making travel a different experience altogether, something one may do for its own sake. Airplanes, finally, leave behind any similarity with former conveyances, except the purpose of getting from here to there, with no experience of what lies in between. And these instrumental objects occupy a prominent, even obtrusive place in our world, far beyond anything wagons and boats ever did. Also they are constantly subject to improvement of

design, with obsolescence rather than wear determining their life span.

Or take the oldest, most static of artifacts: human habitation. The multistoried office building of steel, concrete, and glass is a qualitatively different entity from the wood, brick, and stone structures of old. With all that goes into it besides the structures as such – the plumbing and wiring, the elevators, the lighting, heating, and cooling systems – it embodies the end products of a whole spectrum of technologies and far-flung industries, where only at the remote sources human hands still meet with primary materials, no longer recognizable in the final result. The ultimate customer inhabiting the product is ensconced in a shell of thoroughly derivative artifacts (perhaps relieved by a nice piece of driftwood). This transformation into utter artificiality is generally, and increasingly, the effect of technology on the human environment, down to the items of daily use. Only in agriculture has the product so far escaped this transformation by the changed modes of its production. We still eat the meat and rice of our ancestors.⁷

Then, speaking of the commodities that technology injects into private use, there are machines themselves, those very devices of its own running, originally confined to the economic sphere. This unprecedented novum in the records of individual living started late in the nineteenth century and has since grown to a pervading mass phenomenon in the Western world. The prime example, of course, is the automobile, but we must add to it the whole gamut of household appliances – refrigerators, washers, dryers, vacuum cleaners – by now more common in the lifestyle of the general population than running water or central heating were one hundred years ago. Add lawn mowers and other power tools for home and garden: we are mechanized in our daily chores and recreations (including the toys of our children) with every expectation that new gadgets will continue to arrive.

These paraphernalia are machines in the precise sense that they perform work and consume energy, and their moving parts are of the familiar magnitudes of our perceptual world. But an additional and profoundly different category of technical apparatus was dropped into the lap of the private citizen, not labor-saving and work-performing, partly not even utilitarian, but – with minimal energy input – catering to the senses and the mind: telephone, radio, television, tape recorders, calculators, record players – all the domestic terminals of the electronics industry, the latest arrival on the technological scene. Not only by their insubstantial,

mind-addressed output, also by the subvisible, not literally “mechanical” physics of their functioning do these devices differ in kind from all the macroscopic, bodily moving machinery of the classical type. Before inspecting this momentous turn from power engineering, the hallmark of the first industrial revolution, to communication engineering, which almost amounts to a second industrial-technological revolution, we must take a look at its natural base: electricity.

In the march of technology to ever greater artificiality, abstraction, and subtlety, the unlocking of electricity marks a decisive step. Here is a universal force of nature which yet does not naturally appear to man (except in lightning). It is not a datum of uncontrived experience. Its very “appearance” had to wait for science, which contrived the experience for it. Here, then, a technology depended on science for the mere providing of its “object,” the entity itself it would deal with – the first case where theory alone, not ordinary experience, wholly preceded practice (repeated later in the case of nuclear energy). And what sort of entity! Heat and steam are familiar objects of sensuous experience, their force bodily displayed in nature; the matter of chemistry is still the concrete, corporeal stuff mankind had always known. But electricity is an abstract object, disembodied, immaterial, unseen; in its usable form, it is entirely an artifact, generated in a subtle transformation from grosser forms of energy (ultimately from heat via motion). Its theory indeed had to be essentially complete before utilization could begin.

Revolutionary as electrical technology was in itself, its purpose was at first the by now conventional one of the industrial revolution in general: to supply motive power for the propulsion of machines. Its advantages lay in the unique versatility of the new force, the ease of its transmission, transformation and distribution – an unsubstantial commodity, no bulk, no weight, instantaneously delivered at the point of consumption. Nothing like it had ever existed before in man’s traffic with matter, space, and time. It made possible the spread of mechanization to every home; this alone was a tremendous boost to the technological tide, at the same time hooking private lives into centralized public networks and thus making them dependent on the functioning of a total system as never before, in fact, for every moment. Remember, you cannot hoard electricity as you can coal and oil, or flour and sugar for that matter.

But something much more unorthodox was to follow. As we all know, the discovery of the universe of electromagnetics caused a revolution in theoretical physics that

is still underway. Without it, there would be no relativity theory, no quantum mechanics, no nuclear and subnuclear physics. It also caused a revolution in technology beyond what it contributed, as we noted, to its classical program. The revolution consisted in the passage from electrical to electronic technology which signifies a new level of abstraction in means and ends. It is the difference between power and communication engineering. Its object, the most impalpable of all, is information. Cognitive instruments had been known before – sextant, compass, clock, telescope, microscope, thermometer, all of them for information and not for work. At one time, they were called “philosophical” or “metaphysical” instruments. By the same general criterion, amusing as it may seem, the new electronic information devices, too, could be classed as “philosophical instruments.” But those earlier cognitive devices, except the clock, were inert and passive, not generating information actively, as the new instrumentalities do.

Theoretically as well as practically, electronics signifies a genuinely new phase of the scientific-technological revolution. Compared with the sophistication of its theory as well as the delicacy of its apparatus, everything which came before seems crude, almost natural. To appreciate the point, take the man-made satellites now in orbit. In one sense, they are indeed an imitation of celestial mechanics – Newton’s laws finally verified by cosmic experiment: astronomy, for millennia the most purely contemplative of the physical sciences, turned into a practical art! Yet, amazing as it is, the astronomic imitation, with all the unleashing of forces and the finesse of techniques that went into it, is the least interesting aspect of those entities. In that respect, they still fall within the terms and feats of classical mechanics (except for the remote-control course corrections).

Their true interest lies in the instruments they carry through the voids of space and in what these do, their measuring, recording, analyzing, computing, their receiving, processing, and transmitting abstract information and even images over cosmic distances. There is nothing in all nature which even remotely foreshadows the kind of things that now ride the heavenly spheres. Man’s imitative practical astronomy merely provides the vehicle for something else with which he sovereignly passes beyond all the models and usages of known nature.⁸ That the advent of man portended, in its inner secret of mind and will, a cosmic event was known to religion and philosophy: now it manifests itself as such by fact of things and acts in the visible universe. Electronics indeed creates

a range of objects imitating nothing and progressively added to by pure invention.

And no less invented are the ends they serve. Power engineering and chemistry for the most part still answered to the natural needs of man: for food, clothing, shelter, locomotion, and so forth. Communication engineering answers to needs of information and control solely created by the civilization that made this technology possible and, once started, imperative. The novelty of the means continues to engender no less novel ends – both becoming as necessary to the functioning of the civilization that spawned them as they would have been pointless for any former one. The world they help to constitute and which needs computers for its very running is no longer nature supplemented, imitated, improved, transformed, the original habitat made more habitable. In the pervasive mentalization of physical relationships it is a *trans-nature* of human making, but with this inherent paradox: that it threatens the obsolescence of man himself, as increasing automation ousts him from the places of work where he formerly proved his humanhood. And there is a further threat: its strain on nature herself may reach a breaking point.

The last stage of the revolution?

That sentence would make a good dramatic ending. But it is not the end of the story. There may be in the offing another, conceivably the last, stage of the technological revolution, after the mechanical, chemical, electrical, electronic stages we have surveyed, and the nuclear we omitted. All these were based on physics and had to do with what man can put to his use. What about biology? And what about the user himself? Are we, perhaps, on the verge of a technology, based on biological knowledge and wielding an engineering art which, this time, has man himself for its object? This has become a theoretical possibility with the advent of molecular biology and its understanding of genetic programming; and it has been rendered morally possible by the metaphysical neutralizing of man. But the latter, while giving us the license to do as we wish, at the same time denies us the guidance for knowing what to wish. Since the same evolutionary doctrine of which genetics is a cornerstone has deprived us of a valid image of man, the actual techniques, when they are ready, may find us strangely unready for their responsible use. The anti-essentialism of prevailing theory, which knows only of *de facto* outcomes of evolutionary accident and of no valid essences

that would give sanction to them, surrenders our being to a freedom without norms. Thus the technological call of the new microbiology is the twofold one of physical feasibility and metaphysical admissibility. Assuming the genetic mechanism to be completely analyzed and its script finally decoded, we can set about rewriting the text. Biologists vary in their estimates of how close we are to the capability; few seem to doubt the right to use it. Judging by the rhetoric of its prophets, the idea of taking our evolution into our own hands is intoxicating even to many scientists.

In any case, the idea of making over man is no longer fantastic, nor interdicted by an inviolable taboo. If and when *that* revolution occurs, if technological power is really going to tinker with the elemental keys on which life will have to play its melody in generations of men to come (perhaps the only such melody in the universe), then a reflection on what is humanly desirable and what should determine the choice – a reflection, in short, on the image of man, becomes an imperative more urgent than any ever inflicted on the understanding of mortal man. Philosophy, it must be confessed, is sadly unprepared for this, its first cosmic task.

III Toward an Ethics of Technology

The last topic has moved naturally from the descriptive and analytic plane, on which the objects of technology are displayed for inspection, onto the evaluative plane where their ethical challenge poses itself for decision. The particular case forced the transition so directly because there the (as yet hypothetical) technological object was man directly. But once removed, man is involved in all the other objects of technology, as these singly and jointly remake the worldly frame of his life, in both the narrower and the wider of its senses: that of the artificial frame of civilization in which social man leads his life proximately, and that of the natural terrestrial environment in which this artifact is embedded and on which it ultimately depends.

Again, because of the magnitude of technological effects on both these vital environments in their totality, both the quality of human life and its very preservation in the future are at stake in the rampage of technology. In short, certainly the “image” of man, and possibly the survival of the species (or of much of it), are in jeopardy. This would summon man’s duty to his cause even if the jeopardy were not of his own making. But it is, and, in

addition to his ageless obligation to meet the threat of things, he bears for the first time the responsibility of prime agent in the threatening disposition of things. Hence nothing is more natural than the passage from the objects to the ethics of technology, from the things made to the duties of their makers and users.

A similar experience of inevitable passage from analysis of fact to ethical significance, let us remember, befell us toward the end of the first section. As in the case of the matter, so also in the case of the form of the technological dynamics, the image of man appeared at stake. In view of the quasi-automatic compulsion of those dynamics, with their perspective of indefinite progression, every existential and moral question that the objects of technology raise assumes the curiously eschatological quality with which we are becoming familiar from the extrapolating guesses of futurology. But apart from thus raising all challenges of present particular matter to the higher powers of future exponential magnification, the despotic dynamics of the technological movement as such, sweeping its captive movers along in its breathless momentum, poses its own questions to man’s axiological conception of himself. Thus, form and matter of technology alike enter into the dimension of ethics.

The questions raised for ethics by the objects of technology are defined by the major areas of their impact and thus fall into such fields of knowledge as ecology (with all its biospheric subdivisions of land, sea, and air), demography economics, biomedical and behavioral sciences (even the psychology of mind pollution by television), and so forth. Not even a sketch of the substantive problems, let alone of ethical policies for dealing with them, can here be attempted. Clearly, for a normative rationale of the latter, ethical theory must plumb the very foundations of value, obligation, and the human good.

The same holds of the different kind of questions raised for ethics by the sheer fact of the formal dynamics of technology. But here, a question of another order is added to the straightforward ethical questions of both kinds, subjecting any resolution of them to a pragmatic proviso of harrowing uncertainty. Given the mastery of the creation over its creators, which yet does not abrogate their responsibility nor silence their vital interest, what are the chances and what are the means of gaining *control* of the process, so that the results of any ethical (or even purely prudential) insights can be translated into effective action? How in short can man’s freedom prevail against the determinism he has created for himself? On this most clouded question, whereby hangs not only the

effectuality or futility of the ethical search which the facts invite (assuming it to be blessed with *theoretical* success!), but perhaps the future of mankind itself, I will make a few concluding, but – alas – inconclusive, remarks. They are intended to touch on the whole ethical enterprise.

Problematic preconditions of an effective ethics

First, a look at the novel state of determinism. *Prima facie*, it would seem that the greater and more varied powers bequeathed by technology have expanded the range of choices and hence increased human freedom. For economics, for example, the argument has been made⁹ that the uniform compulsion which scarcity and subsistence previously imposed on economic behavior with a virtual denial of alternatives (and hence – conjoined with the universal “maximization” motive of capitalist market competition – gave classical economics at least the appearance of a deterministic “science”) has given way to a latitude of indeterminacy. The plenty and powers provided by industrial technology allow a pluralism of choosable alternatives (hence disallow scientific prediction). We are not here concerned with the status of economics as a science. But as to the altered state of things alleged in the argument. I submit that the change means rather that one, relatively homogeneous determinism (thus relatively easy to formalize into a law) has been supplanted by another, more complex, multifarious determinism, namely, that exercised by the human artifact itself upon its creator and user. We, abstractly speaking the possessors of those powers, are concretely subject to their emancipated dynamics and the sheer momentum of our own multitude, the vehicle of those dynamics.

I have spoken elsewhere¹⁰ of the “new realm of necessity” set up, like a second nature, by the feedbacks of our achievements. The almighty we, or Man personified is, alas, an abstraction. *Man* may have become more powerful; *men* very probably the opposite, enmeshed as they are in more dependencies than ever before. What ideal Man now can do is not the same as what real men permit or dictate to be done. And here I am thinking not only of the immanent dynamism, almost automatism, of the impersonal technological complex I have invoked so far, but also of the pathology of its client society. Its compulsions, I fear, are at least as great as were those of unconquered nature. Talk of the blind forces of nature! Are those of the sorcerer’s

creation less blind? They differ indeed in the serial shape of their causality: the action of nature’s forces is cyclical, with periodical recurrence of the same, while that of the technological forces is linear, progressive, cumulative, thus replacing the curse of constant toil with the threat of maturing crisis and possible catastrophe. Apart from this significant vector difference, I seriously wonder whether the tyranny of fate has not become greater, the latitude of spontaneity smaller; and whether man has not actually been weakened in his decision-making capacity by his accretion of collective strength.

However, in speaking, as I have just done, of “his” decision-making capacity, I have been guilty of the same abstraction I had earlier criticized in the use of the term “man.” Actually, the subject of the statement was no real or representative individual but Hobbes’ “Artificial Man,” “that great Leviathan, called a Common-Wealth,” or the “large horse” to which Socrates likened the city, “which because of its great size tends to be sluggish and needs stirring by a gadfly.” Now, the chances of there being such gadflies among the numbers of the commonwealth are today no worse nor better than they have ever been, and in fact they are around and stinging in our field of concern. In that respect, the free spontaneity of personal insight, judgment, and responsible action by speech can be trusted as an ineradicable (if also incalculable) endowment of humanity, and smallness of number is in itself no impediment to shaking public complacency. The problem, however, is not so much complacency or apathy as the counterforces of active, and anything but complacent, interests and the complicity with them of all of us in our daily consumer existence. These interests themselves are factors in the determinism which technology has set up in the space of its sway. The question, then, is that of the possible chances of unselfish insight in the arena of (by nature) selfish *power*, and more particularly; of one long-range, interlocking insight against the short-range goals of many incumbent powers. Is there hope that wisdom itself can become power? This renews the thorny old subject of Plato’s philosopher-king and – with that inclusion of realism which the Utopian Plato did not lack – of the role of myth, not knowledge, in the education of the guardians. Applied to our topic: the *knowledge* of objective dangers and of values endangered, as well as of the technical remedies, is beginning to be there and to be disseminated: but to make it prevail in the marketplace is a matter less of the rational dissemination of truth than of public relations techniques, persuasion, indoctrination, and manipulation,

also of unholy alliances, perhaps even conspiracy. The philosopher's descent into the cave may well have to go all the way to "if you can't lick them, join them."

That is so not merely because of the active resistance of special interests but because of the optical illusion of the near and the far which condemns the long-range view to impotence against the enticement and threats of the nearby: it is this incurable shortsightedness of animal-human nature more than ill will that makes it difficult to move even those who have no special axe to grind, but still are in countless ways, as we all are, beneficiaries of the untamed system and so have something dear in the present to lose with the inevitable cost of its taming. The taskmaster, I fear, will have to be actual pain beginning to strike, when the far has moved close to the skin and has vulgar optics on its side. Even then, one may resort to palliatives of the hour. In any event, one should try as much as one can to forestall the advent of emergency with its high tax of suffering or, at the least, prepare for it. This is where the scientist can redeem his role in the technological estate.

The incipient knowledge about technological danger trends must be developed, coordinated, systematized, and the full force of computer-aided projection techniques be deployed to determine priorities of action, so as to inform preventive efforts wherever they can be elicited, to minimize the necessary sacrifices, and at the worst to preplan the saving measures which the terror of beginning calamity will eventually make people willing to accept. Even now, hardly a decade after the first stirrings of "environmental" consciousness, much of the requisite knowledge, plus the rational persuasion, is available inside and outside academia for any well-meaning powerholder to draw upon. To this, we – the growing band of concerned intellectuals – ought persistently to contribute our bit of competence and passion.

But the real problem is to get the well-meaning into power and have that power as little as possible beholden to the interests which the technological colossus generates on its path. It is the problem of the philosopher-king compounded by the greater magnitude and complexity (also sophistication) of the forces to contend with. Ethically, it becomes a problem of playing the game by its impure rules. For the servant of truth to join in it means to sacrifice some of his time-honored role: he may have to turn apostle or agitator or political operator. This raises moral questions beyond those which technology itself poses, that of sanctioning immoral means for a surpassing end, of giving unto Caesar so as to promote

what is not Caesar's. It is the grave question of moral casuistry, or of Dostoevsky's Grand Inquisitor, or of regarding cherished liberties as no longer affordable luxuries (which may well bring the anxious friend of mankind into odious political company) – questions one excusably hesitates to touch but in the further tide of things may not be permitted to evade.

What is, prior to joining the fray, the role of philosophy, that is, of a philosophically grounded ethical knowledge, in all this? The somber note of the last remarks responded to the quasi-apocalyptic prospects of the technological tide, where stark issues of planetary survival loom ahead. There, no philosophical ethics is needed to tell us that disaster must be averted. Mainly, this is the case of the ecological dangers. But there are other, noncatastrophic things afoot in technology where not the existence but the image of man is at stake. They are with us now and will accompany us and be joined by others at every new turn technology may take. Mainly, they are in the biomedical, behavioral, and social fields. They lack the stark simplicity of the survival issue, and there is none of the (at least declaratory) unanimity on them which the spectre of extreme crisis commands. It is here where a philosophical ethics or theory of values has its task. Whether its voice will be listened to in the dispute on policies is not for it to ask; perhaps it cannot even muster an authoritative voice with which to speak – a house divided, as philosophy is. But the philosopher must try for normative knowledge, and if his labors fall predictably short of producing a compelling axiomatics, at least his clarifications can counteract rashness and make people pause for a thoughtful view.

Where not existence but "quality" of life is in question, there is room for honest dissent on goals, time for theory to ponder them, and freedom from the tyranny of the lifeboat situation. Here, philosophy can have its try and its say. Not so on the extremity of the survival issue. The philosopher, to be sure, will also strive for a theoretical grounding of the very proposition that there ought to be men on earth, and that present generations are obligated to the existence of future ones. But such esoteric, ultimate validation of the perpetuity imperative for the species – whether obtainable or not to the satisfaction of reason – is happily not needed for consensus in the face of ultimate threat. Agreement in favor of life is pretheoretical, instinctive, and universal. Averting disaster takes precedence over everything else, including pursuit of the good, and suspends otherwise inviolable prohibitions and rules. All moral standards for individual

or group behavior, even demands for individual sacrifice of life, are premised on the continued existence of human life. As I have said elsewhere,¹¹ “No rules can be devised for the waiving of rules in extremities. As with the famous shipwreck examples of ethical theory, the less said about it, the better.”

Never before was there cause for considering the contingency that all mankind may find itself in a lifeboat, but this is exactly what we face when the viability of the planet is at stake. Once the situation becomes desperate, then what there is to do for salvaging it must be done, so that there be life – which “then,” after the storm has been weathered, can again be adorned by ethical conduct. The moral inference to be drawn from this lurid eventuality of a moral pause is that we must never allow a lifeboat situation for humanity to arise.¹²

One part of the ethics of technology is precisely to guard the space in which any ethics can operate. For the rest, it must grapple with the cross-currents of value in the complexity of life.

A final word on the question of determinism versus freedom which our presentation of the technological syndrome has raised. The best hope of man rests in his most troublesome gift: the spontaneity of human acting which confounds all prediction. As the late Hannah Arendt never tired of stressing: the continuing arrival of newborn individuals in the world assures ever-new beginnings. We should expect to be surprised and to see our predictions come to naught. But those predictions themselves, with their warning voice, can have a vital share in provoking and informing the spontaneity that is going to confound them.

Notes

- 1 But as serious an actuality as the Chinese plough “wandered” slowly westward with little traces of its route and finally caused a major, highly beneficial revolution in medieval European agriculture, which almost no one deemed worth recording when it happened (cf. Paul Leser, *Entstehung und Verbreitung des Pfluges*, Münster, 1931; reprint: The International Secretariate for Research on the History of Agricultural Implements, Brede-Lingby, Denmark, 1971).
- 2 Progress did, in fact, occur even at the heights of classical civilizations. The Roman arch and vault, for example, were distinct engineering advances over the horizontal entablature and flat ceiling of Greek (and Egyptian) architecture, permitting spanning feats and thereby construction objectives not contemplated before (stone bridges, aqueducts, the vast baths and other public halls of Imperial Rome). But materials, tools, and techniques were still the same, the role of human labor and crafts remained unaltered, stone-cutting and brickbaking went on as before. An existing technology was enlarged in its scope of performance, but none of its means or even goals made obsolete. [Ed.]
- 3 One meaning of “classical” is that those civilizations had somehow implicitly “defined” themselves and neither encouraged nor even allowed to pass beyond their innate terms. The – more or less – achieved “equilibrium” was their very pride. [Ed.]
- 4 This only seems to be but is not a value statement, as the reflection on, for example, an ever more destructive atom bomb shows. [Ed.]
- 5 There may conceivably be internal degenerative factors – such as the overloading of finite information-processing capacity – that may bring the (exponential) movement to a halt or even make the system fall apart. We don’t know yet. [Ed.]
- 6 There is a paradoxical side effect to this change of roles. That very science which forfeited its place in the domain of leisure to become a busy toiler in the field of common needs, creates by its toils a growing domain of leisure for the masses, who reap this with the other fruits of technology as an additional (and no less novel) article of forced consumption. Hence leisure, from a privilege of the few, has become a problem for the many to cope with. Science, not idle, provides for the needs of this idleness too: no small part of technology is spent on filling the leisure-time gap which technology itself has made a fact of life. [Ed.]
- 7 Not so, objects my colleague Robert Heilbroner in a letter to me; “I’m sorry to tell you that meat and rice are both *profoundly* influenced by technology. Not even they are left untouched.” Correct, but they are at least generically the same (their really profound changes lie far back in the original breeding of domesticated strains from wild ones – as in the case of all cereal plants under cultivation). I am speaking here of an order of transformation in which the results bear no resemblance to the natural materials at their source, nor to any naturally occurring state of them. [Ed.]
- 8 Note also that in radio technology, the medium of action is nothing material, like wires conducting currents, but the entirely immaterial electromagnetic “field”, i.e., space itself. The symbolic picture of “waves” is the last remaining link to the forms of our perceptual world. [Ed.]
- 9 I here loosely refer to Adolph Lowe, “The Normative Roots of Economic Values,” in Sidney Hook, ed., *Human Values and Economic Policy* (New York: New York University Press, 1967) and, more perhaps, to the many discussions

- I had with Lowe over the years. For my side of the argument, see "Economic Knowledge and the Critique of Goals," in R. L. Heilbroner, ed., *Economic Means and Social Ends*, (Englewood Cliffs, N.J.: Prentice-Hall, 1969), reprinted in Hans Jonas, *Philosophical Essays* (Englewood Cliffs, N.J.: Prentice-Hall, 1969), reprinted in Hans Jonas, *Philosophical Essays* (Englewood Cliffs, N.J.: Prentice-Hall, 1974).
- 10 "The Practical Uses of Theory," *Social Research* 26 (1959), reprinted in Hans Jonas, *The Phenomenon of Life* (New York, 1966). The reference is to pp. 209–10 in the latter edition.
- 11 "Philosophical Reflections on Experimenting with Human Subjects," in Paul A. Freund, ed., *Experimentation with Human Subjects* (New York: George Braziller, 1970), reprinted in Hans Jonas, *Philosophical Essays*. The reference is to pp. 124–25 in the latter edition.
- 12 For a comprehensive view of the demands which such a situation or even its approach would make on our social and political values, see Geoffrey Vickers, *Freedom in a Rocking Boat* (London, 1970).

The Technology Question in Feminism: A View from Feminist Technology Studies

Wendy Faulkner

I Introduction

I offer this paper in the belief that what we might, with apologies to Sandra Harding (1986), call “the technology question in feminism” has been generally neglected. While there exist several established streams of feminist scholarship on technologies, technology per se has been undertheorized in much of this literature, with serious implications for feminist praxis. I was to suggest that one stream – the feminist scholarship that has emerged within the field of technology studies, or *feminist technology studies* – provides a more nuanced and politically helpful framework for analyzing the relationship between technology and gender, which could usefully be generalized.

One obvious stream within feminist scholarship on technology concerns “women in technology” most commonly the question “why so few?” women in engineering. Despite nearly two decades of government and industry backed “women into engineering” campaigns, the numbers entering engineering are still derisory in most countries, even compared with those going into science. Quite apart from any discrimination or discouragement they may face, most girls and young women are voting with their feet: it does not occur to them to get into either craft or professional engineering; they just are not interested. The virtual failure of these initiatives indicates a failure to critically analyze the ways in which technology itself gets gendered in the eyes of would-be

technologists. In particular, I believe the continued male dominance of engineering is due in large measure to the enduring symbolic association of masculinity and technology by which cultural images and representations of technology converge with prevailing images of masculinity and power (e.g., Balsamo, 1998; Burfoot, 1997; Caputi, 1988). Yet, consistent with the liberal feminist tradition, the “women in technology” literature and campaigns view technology as gender neutral and as unequivocally “a good thing,” which women would enter into if only early socialization (e.g., to play with mechanical toys) and workplace structures (e.g., concerning childcare) were changed (Henwood, 1996).

Other streams of feminist scholarship on technology fall under the rubric of “women *and* technology,” which focusses on specific technologies or technological arenas encountered by women, for example, in the workplace or in the course of reproduction. Understandably there is a larger body of work under this rubric, because vastly more women are “on the receiving end” of technologies that create them (Arnold & Faulkner, 1985). These encounters are often marked by extraordinary juxtapositions of positive and negative feelings about technologies. For example, women generally feel reassured by the diagnostic techniques used during pregnancy and believe that the existence of so much technology in hospitals means they are safer giving birth there than at home; while they often experience the technologies used to intervene in the

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birth itself as signalling danger and denying them control over their baby's delivery (Evans, 1985). Similarly, the opening up of the internet is greeted enthusiastically by some women as an exciting tool and a means of gaining technical confidence, while others want nothing to do with yet another "toy for the boys." It is notable that much of the available scholarship on women and technology fails to capture or explain women's ambivalence about technologies; it is characteristically either pessimistic or optimistic. In the latter case, there is a tendency to present technology as deterministically patriarchal (or capitalist) and to portray women as victims of men's technology (Berg, 1997, ch. 1). An example of this is provided by much of the early writing on new reproductive technologies, especially that coming from supporters of Finrage (e.g., Arditti, Duelli Klien, & Minden, 1984; Corea et al., 1985). Here, technology is seen as an inevitable extension of a male desire to control, and potentially eliminate, women's biological role in reproduction (Stanworth, 1987, p. 4; Wajcman, 1991; ch. 3). Similarly, a literal reading of some ecofeminist tracts (e.g., Merchant, 1980; Mies & Shiva, 1993) would dismiss the entire modernist technological project as being hopelessly bound up with a masculine world view that is detached from nature and from people. At the other extreme, where technology is seen as neutral, the converse occurs: overly optimistic political conclusions are drawn – as, for example, in the techno-enthusiasm of much cyber-feminism (e.g., Plant, 1997; Spender, 1995; criticized in Adam, 1997, 1998, pp. 166–181; Oldenziel, 1994).

By contrast, the view that emerges from feminist scholarship within the field of technology studies is self-consciously neither pessimistic nor optimistic (e.g., Berg, 1997, ch. 1). From early on, feminists in this tradition framed their concerns in terms of "gender and technology" rather than "women and technology," signalling (among other things) an insistence that both technology and gender be understood as socially shaped and so potentially reshapeable. The constructivist approach to technology (of which more below) is paradigmatic in social studies of technology and, crucially, challenges both technological determinism and any presumed neutrality of technology. Much of the "gender and technology" stream of research has focussed on the use and users of technologies in everyday life (e.g., Cockburn & Dilić, 1994; Cockburn & Ormrod, 1993; Lerman et al., 1997; Lie & Sørensen, 1996; Silverstone & Hirsch, 1992; Sørensen & Berg, 1991; *Technology and Culture*, 1997), providing a valuable corrective to the often exclusive focus on the design of radically

new military or industrial technologies in mainstream technology studies (Cockburn, 1992; Faulkner, 1998). There is, nonetheless, important gender aware work beginning to be done specifically on men's relationships with technology, addressing both users and designers; hence, the newly emerging, related stream of research on "men/masculinities and technology" (e.g., Faulkner, 2000a; Lie, 1995, 1998; Lie & Sørensen, 1996, various chs; Lohan, 1998; Mellström, 1995; Oldenziel, 1999).

It is not my intention here to survey each of the streams of research flagged up above, or the various specific technologies that feminists have analyzed. Judy Wajcman's admirable review in *Feminism Confronts Technology* (Wajcman, 1991) remains an important source, and a recent paper by her (Wajcman, 2000) provides an updated commentary on past debates and present issues. My aim here is to elaborate and illustrate the broad framework developed by feminist technology studies. I do so in the belief that the constructivist approach to technology on which this framework builds provides a more realistic and useful basis for feminist action, precisely because it resonates with the ambivalence that women experience in encounters with technology. By the same token, I would argue, this approach helps to explain the tenacity of the equation between masculinity and technology while at the same time providing a basis for destabilizing that equation,

A useful way to approach the subject matter is to ask the question "how is technology gendered?" There are two fairly obvious aspects of this that feminism has taken on board, and so can be taken as read. First, it is primarily men who take the key decisions that shape technologies (albeit most men, like most women, are remote from these decisions). Second, men have generally had greater success than women in claiming skilled status, especially technical competence – including that mobilized in the construction, maintenance, marketing, and design of technologies (Cockburn, 1983a, 1985; Elson & Pearson, 1981; McNeil, 1987; Phillips & Taylor, 1980). The body of this paper explores some of the less obvious ways in which technology is gendered. It first explores gender "in and of" technological artifacts, arguing that even the nuts and bolts of technology justify a feminist gaze. Second, it identifies some of the masculine images technology that contribute to the continued male dominance of technological occupations even though these images are frequently not upheld in practice. Third, it looks in more detail at the often complex and contradictory gendering that takes place at the level of technical

knowledge and practice – both symbolically and in terms of gender differences in “styles” of work. And fourth, the tenacity of the equation between masculinity and technology is further explored with reference to the place of technology in the gender identities of men who work and play with technology. The paper starts by outlining the basic theoretical framework that feminist technology studies broadly share, in particular the key tenet of the “co-production of gender and technology,” and it concludes by exploring tentatively the implications of a constructivist analysis of technology for a praxis which, in the spirit of Haraway’s cyborg manifesto (Haraway, 1991), seeks to steer a course between outright endorsement or rejection of technology.

Theoretical Underpinnings: The Coproduction of Gender and Technology

Early efforts to theorize gender-technology relations took differing stances about, crudely put, whether technology is male dominated because it demands some essentially masculine traits, or “simply” because technology is where the power is. On the more gender essentialist end of this debate, Brian Easlea (1981, 1983) argued that men gravitate to science and technology to compensate for a shared “womb envy”; ecofeminists emphasized men’s emotional detachment from the natural world (e.g., Cox, 1992; Merchant, 1992); while others have drawn on psychoanalytical theory to explain the tenacious links between masculinity, abstraction and objectivity (Keller, 1990; Turkle & Papert, 1990). The alternative “power” position in the gender-technology debate appealed instead to an understanding of the social context within which particular gender constructions and particular technologies appear. Thus, Cynthia Cockburn demonstrated how groups of men have positioned themselves in key technological roles historically: metal working in feudal times, and machine tooling in industrial times (1985, ch. 1). And Judy Wajcman (1991, ch. 7) reminded us that modern technology is supported and directed by powerful institutions and interests.

Cockburn (1983a, 1985) and Wajcman (1991) between them laid two key foundations of feminist technology studies. First, in line with social studies of technology, they assumed a two-way mutually shaping relationship between gender and technology in

which technology is both a source and consequence of gender relations and *vice versa*. Ruth Schwartz Cowan’s seminal study of the relationship between changes in domestic technology and domestic labor since industrialization (Cowan, 1983) provides a sophisticated example of empirical work in this tradition. Second, in line with then current trends in feminist scholarship, Cockburn and Wajcman identified ways in which gender-technology relations are manifest not only in gender structures but also in gender symbols and identities. The value of using this simple triad for analyzing gender relations was of course first spelt out by Sandra Harding (1986, ch. 1) and Joan Scott (1988), and continues to be acknowledged by many feminist scholars of technology (e.g., Berg, 1997; Faulkner, 2000a; Lerman, Mohun, & Oldenziel, 1997). The framework reminds us that there is more to the male dominance of technology than power. It also obliges us to explore much more closely the distinct-but-related links between structures, symbols, and identities in the gender-technology relation – as Meret Lie (1998) and Anne-Jorunn Berg (1997) have begun to do.

The wider links between gender and technology, in structures, symbols, and identities, have long been acknowledged by feminists. Because both modern technology and hegemonic masculinity (Connell, 1987) are historically associated with industrial capitalism, they are linked symbolically by themes of control and domination. Achieving control and domination over nature was a central plank in the Baconian project (Easlea, 1981; Merchant, 1980; Noble, 1991), and the “mastery of nature” remains a powerful emblem of technology (and science) – both within engineering (e.g., Florman, 1976, pp. 121–126) and in wider culture (e.g., Caputi, 1988). In this sense, technology is understood as a “masculine culture” (Wajcman, 1991, ch. 7).

During the 1990s, however, writers in the feminist technology studies tradition became increasingly sensitized to the dangers of essentializing either gender or technology by such formulations (e.g., Grint & Gill, 1995, ch. 1; Grint & Woolgar, 1995). Accordingly, the mutual shaping of gender and technology framework has been recast in a poststructural trope in which gender and technology are seen as *co-produced* (e.g., Berg, 1997, ch. 1; Lerman et al, 1997). Here a parallel is drawn between the social construction of gender and the social construction of technology, in which each are seen as performed and processual in character, rather than given and unchanging. The social construction of gender does not need

rehearsing in a feminist journal, but it is necessary to outline some key tenets and concepts from constructivist technology studies – precisely, because, as this paper argues, this framework warrants greater familiarity and usage in wider feminist scholarship.

The starting point of social studies of technology is a rejection of technological determinism, in particular a rejection of the views (i) that technologies develop in pre-determined directions, and (ii) that technologies determine social change (MacKenzie & Wajcman, 1999, ch. 1). An important step was taken in constructivist technology studies with the adoption of Thomas Hughes' notion of the *socio-technical* (1986). The unusual step of creating a composite, nonhyphenated word is intended to convey that technology is never “just” technical or “just” social. Rather, the relationship between technology and society is a densely interactive *seamless web* (Hughes, 1986). This means that the expertise and choices involved in designing and developing new technologies are necessarily *heterogeneous* (Law, 1987). Thomas Edison's success with the electric light bulb, for example, rested not only on technical inventiveness about filaments, but also on the economic calculations about what properties the filament needed to have for electric lighting to compete with gas lighting, and on his having the entrepreneurial and political acumen to mobilize financiers and city authorities to back the establishment of the requisite infrastructure (Hughes, 1983). Heterogeneity also means that artifacts are understood as being thoroughly part of the social fabric: so electric lighting is a sociotechnical system encompassing a myriad conventions in social organization as well as the complexly configured artifacts of power generation, distribution, and use (Hughes, 1983). Bruno Latour has argued that artifacts need to be viewed as *nonhuman actors* (Latour, 1992) which are *in-scripted* (Akrich, 1992) to have certain material (sociotechnical) “effects,” self-closing fire doors being his classic example.

In a very real sense, constructivist technology studies argue, those who design technologies are by the same stroke *designing society* (Bijker & Law, 1992; Latour, 1988), and for this reason, sociology cannot afford to ignore what Latour calls the “missing masses” of “mundane artifacts” (1992). But the process of designing societies and technologies is not straightforward, for at least two good reasons. First, in the development of a new technology there is considerable *interpretative flexibility* (and contests) about the meaning of the putative artifact and, thus, its eventual shape (Pinch & Bijker, 1984). For instance, there were numerous, bizarre configurations of frame,

wheels, pedals, and seats before the modern bicycle emerged in its now familiar shape. These reflected in part the divergent interests of different users: for some the bicycle represented a potentially dangerous but daring sport; for others, it represented a safe means of getting around (Pinch & Bijker, 1984). Second, artifacts do not always simply reflect the intentions of their designers or even the interests of their paymasters. They can have *unintended consequences* – as, for example, in the way that Victorian buildings exclude wheelchair users. And there can be considerable scope for interpretative flexibility in the context of *use* as well as *design* (as this paper demonstrates below).

The poststructural turn is palpable in constructivist technology studies as elsewhere, prompting some to argue that the more action oriented methodologies and frameworks too often lose sight of power (e.g., Williams & Russell, 1989; Winner, 1993). Similarly, within feminist technology studies, there is a tension between, on the one hand, the structuralist emphasis on the historical roots and durability of equations between masculinity and technology and, on the other hand, the antiessentialist refusal to see either technology or men as necessarily about control and domination (Grint & Gill, 1995; *Science, Technology, & Human Values*, 1995). My own response is to embrace this tension: to adopt some of the principles of poststructuralism – in particular, its emphasis on complexity and contingency, and on multiple, decentered agencies with no singular lines of causation – without losing sight of “power” altogether: like Cockburn (1992), I believe that the perception of power as “capacity” embedded in actor network approaches just misses the point that many women (and men) experience power as domination. This position is consistent with a common juxtaposition in feminist technology studies (and familiar in feminist scholarship more widely) of a refusal to abandon gender as an analytical category (e.g., Cockburn, 1992) and an insistence on the possibility of change and diversity in gender-technology relations (e.g., Berg, 1997).

Technological Artifacts as Gendered

Social constructivism holds within it the possibility that technological artifacts could be other: once their social basis has been deconstructed, they can be reconstructed along different assumptions and priorities (Bijker & Law, 1992; Bijker, Hughes, & Pinch, 1988; MacKenzie &

Wajcman, 1999). But it is also acknowledged that in practice many sociotechnical arrangements are quite stable, irrespective of the (in principle) potential for fluidity. The field of technology studies has produced divergent evidence on the malleability or otherwise of specific technological artifacts, with some appearing almost entirely tool-like, devoid of politics, while others seem to be quite literally instruments of oppression (e.g., Winner, 1999). The question this raises here is *how much, and in what ways, are technological artifacts gendered?*

It is useful to distinguish between gender *in* technology and gender *of* technology. In the former case, gender relations are both *embodied* in and constructed or reinforced by artifacts to yield a very material form of the mutual shaping of gender and technology. In the latter, the gendering of artifacts is more *by association* than by material embodiment. In practice, various forms of gendering can be identified between these two scenarios – as I now demonstrate.

One aspect of the gendering by association lies in the symbolism that attaches to technology. In the language of “male” and “female” parts used in all electromechanical technologies, for example, the mutual shaping of gender symbols and technological discourses is quite apparent: the use of this sexual metaphor to label technological artifacts both reflects and reinforces the message that heterosexuality is the norm; it acts to “naturalize” heterosexual relations.

Another aspect of gendering by association is that the technologies we encounter are often strongly gendered in terms of prevailing divisions of labor. Thus, of the technologies present in the modern household, only a small number are used equally by women and men; those used in the routine tasks of cleaning and cooking are more commonly used by women and girls, while those used in the nonroutine tasks of home maintenance and gardening, plus the more “high-tech” music systems, are more commonly used by men (Gershuny, 1982). Similarly, in a rare study of gender symbols in computers, the late Julia Shaffner (1993) found that some computer scientists saw the number key pad on the computer as masculine, because they associated it with mathematics, which more men than women do, while others saw it as feminine, because they associated it with data entry, which more women than men do.

Often, such gendered associations are not merely “added on” by users “after the event.” Designers themselves make gendered assumptions about the user, assumptions that can be “designed in” to the artefact.

This moves us closer to gender *in* artifacts, as is nicely illustrated in Cynthia Cockburn and Susan Ormrod’s (1993; Ormrod, 1994) excellent study of the microwave. Initially designed and marketed as a “brown good” – for the heating of prepared meals – to appeal to single men who were assumed to be more interested in and knowledgeable about hi-fi equipment than cooking, this product was then redesigned as a “white good” – with more complex “combi” cooking facilities – and sold to family households in which it was assumed that the woman does most of the cooking, and is both skilled and interested in cooking. Again, the mutual shaping of gender and technology is evident: features designed in to artifacts tailored specifically for women or men users tend to reflect and reinforce gender stereotypes, which in turn, play in to design choices.

But while the gendering described above may encourage certain gendering of use, there is nothing materially determining going on here: women and men use both types of microwaves. A more embodied form of gendering is clearly going on in the case of those medical technologies of reproduction specifically designed for either women’s or men’s bodies, and many of these technologies clearly do have material consequences for gender relations: the obstetric forceps, for example, were a material manifestation historically of the medical profession’s interests in gaining control over childbirth (Versluisen, 1981). Similarly, diagnostic technologies like ultrasound scanning used during pregnancy have encouraged a tendency for pregnant women to be seen as “walking wombs” (Oakley, 1987) because they reduce doctors’ reliance on women’s knowledge (e.g., about when they conceived).

Gender can also be embodied *in* artifacts in the case of industrial technology designed to automate the labor process where the gender segregation of labor is extreme.¹ Cockburn’s seminal study of technical change and compositing work in the print industry provides a now classic example (1983a). When the industry began to mechanize typesetting, with the introduction of Linotype technology in the 1880s, the Monotype Corporation introduced a machine for the book trade with the aim of helping employers to break the craft strength of the male compositors’ union and so reduce labor costs. It sought to do this by splitting the tasks of keyboarding and casting into different machines, and by using a QWERTY keyboard to facilitate the entry of women into the former (typewriting had by then become feminized). Because the Linotype machine did

both tasks, and used a keyboard that was completely different from that of the typewriter, the compositors' trade union supported *its* technological development and blocked the diffusion of the Monotype. By so doing, they effectively blocked a possible avenue for women to enter a high-status, well-paid area of work.

In cases like this one the gendering of the artefact is more than symbolic or contextual; its very design rules out malleability. By contrast, some technologies are barely gendered at all: it is hard to "see" gender in the cassette tape machine, for instance, although we may readily impute gender in the words or music that the machine is used to play. As Anne-Jorunn Berg and Merete Lie (1995; Berg, 1994) among others stress, many artifacts may be *reinterpreted*, or subject to multiple constructions, by users long after they have left the factory gates; they are more tool-like. The telephone is a classic illustration: first introduced for domestic use on the assumption that businessmen would find it useful to call colleagues from the home, it was rapidly appropriated (or "domesticated") by the wives of businessmen as an adjunct to their social and family life (Frissen, 1994).

For me it is important to explore the various ways in which artifacts are gendered, because it serves to underline the otherwise (to many) improbable point that even the "nuts and bolts" of technology warrant a feminist gaze. But the exercise also warns against any temptation to simplistic theorising since artifacts are clearly gendered to *varying degrees*. On the one hand, I have shown that while some artifacts do manifest the interests of (some) men in a material way, most are gendered by association, symbolically rather than materially, and many are not obviously gendered at all. On the other hand, I believe that the constructivist emphasis on reinterpretation may be overoptimistic, even idealistic: prevailing social relations (especially gender relations) are often far harder to change than material technologies (Soper, 1995). So, while we may conclude *in principle* that technology can aid female empowerment, appropriating individual technologies is unlikely to be effective in practice if we ignore the wider gender contexts within which they are designed and used.

Masculine Images of Technology

The symbolic gendering of technology extends beyond the artifactual, but may still have material consequences. In this section, I highlight some aspects of the association

between masculinity and technology – an association that operates largely at the level of the *image* technology holds for outsiders, and that I argue contributes to the continued male dominance of many technological occupations.

Within the masculinity-technology association, one can discern a series of highly gendered dichotomies (Faulkner, 2000b). Most obvious of these is the distinction between being people-focussed and machine-focussed – one version of the sociological distinction between feminine expressiveness and masculine instrumentalism. Sherry Turkle (1988) shows that women starting out in computing are often reticent about computing, because they see hobbyist hackers as the only model for intimacy with computers, and so many hackers appear to eschew or be incapable of human intimacy. Similarly, Tove Håpnes and Bente Rasmussen demonstrate that a central reason for the declining intake of young women into computer science in Norway is girls' rejection of the "nerd" image of computer hackers (Håpnes & Rasmussen, 1991). It seems that for a woman to opt to work so closely with technology is potentially to reject any meaningful engagement in the social world and so face "gender inauthenticity" (Cockburn, 1983b; Keller, 1987).

This reveals a key feature of the people-technology dichotomy, namely that it is assumed to be mutually exclusive. Yet, most women routinely interact with people *and* technologies; some even develop strong emotional attachment to artifacts they use a lot, be it a washing machine or a pager (Berg, 1997, chs. 4 and 5). As feminists scholars of technology have long argued, however, women's everyday encounters with technological artifacts are rarely recognized as such (Berg & Lie, 1995). Computers aside, our most common cultural images of technology – industrial plants, space rockets, weapon systems, and so on – are large technological systems associated with powerful institutions. Here we meet a second interesting dichotomy, in this case one that categorizes artifacts symbolically and is implicitly rather than explicitly gendered. "Hard" technology is inert and powerful like the examples above; this is *real* technology. "Soft" technology is smaller scale, like kitchen appliances, or more organic, like drugs; most people do not readily identify such products as "technology." So the world of technology is made to feel remote and overwhelmingly powerful because the hard-soft dualism *factors out* those other technologies that we all meet on a daily basis, and can, in some sense, "relate to."

The hard-soft dichotomy also extend to styles of thought in technology (Edwards, 1996, pp. 167–72), because the association of engineering with scientific methods brings with it longstanding gender dualisms: on the masculine side of those dualisms we have an objectivist rationality associated with emotional detachment and with abstract theoretical (especially mathematical) and reductionist approaches to problem solving. On the feminine side we have a more subjective rationality associated with emotional connectedness and with concrete, empirical, and holistic approaches to problem solving. As we will see in the next section, abstract “styles” of thinking and working are often associated more with men and concrete ones with women, yet both sides of the concrete-abstract dualism are required within engineering and computing practice.

I return to these familiar dualisms for the same reason Evelyn Fox Keller does in relation to science (1990): they are widely held as truths by technical and nontechnical people, women and men, alike. This was very clearly illustrated in the 1993 Special Issue of *Science* (*Science*, 1993) on Women in Science, where the testimony of several scientists was mobilized to support the claim that women bring a different “style” to science (Barinaga, 1993; Morell, 1993). The fact that popular images of both science and technology are strongly associated with the masculine side of these dualisms must be one of the reasons why, in a deeply gender divided world, most girls and women do not even consider a career in engineering.

This assertion is supported by evidence from studies of technology education in UK schools. Early differences in interests and role playing developed outside school shape how girls and boys respond to, and are interpreted as responding to, technology in school. For example, girls are more likely than boys to feel confident about, and to succeed in, working with tables of data concerning health, reproduction, or domestic situations, but anticipate failure – “I don’t know anything about that” – when faced with tables of data on machinery, building sites, or cars (Murphy, 1990). The reverse holds for most boys: the task is the same but the content is gendered. Girls are usually less confident than boys in handling “real” technology – and this extends to the use of all sorts of equipment in school, which boys tend to monopolize. The greater people-centeredness of most girls is also reflected in *how* they approach technical tasks. Recent surveys undertaken in UK schools reveal that teenage girls in design and technology classes are more likely than boys to “identify the issues that underlie tasks in empathising with users and evaluating products and systems in terms of how well

they might perform for the user,” whereas boys are more likely to approach technical tasks in isolation and judge the context to be irrelevant (Kimbell, Stables, & Green, 1996, p. 94; Murphy, 1990). For example, in a group of 13–15-year-old pupils asked which of two materials would make the warmest jacket for a person stranded on a cold windy mountainside, many girls but none of the boys took context into account – by cutting out prototype jackets to see how appropriate the materials were for making a jacket, and by dipping them into water to see how effective their insulating properties would be if it rained (Murphy, 1990).

This is an astounding finding: it seems that girls demonstrate greater potential in precisely those heterogeneous approaches so necessary to success in technological design. Yet their different learning styles were read by teachers as off task and irrelevant (Murphy, 1990). Similarly, in their study on the acquisition of programming skills by schools and college students, Sherry Turkic and Seymour Papert (1990) found that girls and women tend to adopt an interactive or relational “bricolage” approach, while boys and men tend to adopt a formal and hierarchical “planning” approach. Both approaches “work,” yet the bricoleurs found themselves actively discouraged by their teachers, forced to pursue this approach surreptitiously or unlearn it or give up on computing. Such findings indicate aspects of the exclusion of would be female technologists rarely grasped by equal opportunity campaigns.

Of course, many of the ways of thinking and doing, which we stereotypically deem feminine, are useful if not essential in technical work: linguistic abilities in computer programming, for instance. And plenty of women now do jobs that are extremely technical, just as plenty of men are technically incompetent. In short, there are huge mismatches between the image and practice of technology with respect to gender. This crucial point is often missed. Yet I believe it obliges us to look more closely at the relationship between the continued male dominance of engineering and masculine images of technology, and at how these images are sustained.

[...]

Gender Identity in Relation to Technology

Finally, technology is gendered in relation to individual gender identities – how we go about being men and women. Here, I elaborate an argument in relation to

professional engineering, which I suspect holds in broad terms for all male-dominated areas of technical work including those where manual rather than mental prowess is privileged. I argue that engineers' pleasure in technology, their close identification with technology, and their pride in technical competence are all crucial elements in the individual identities and shared culture of engineers. They provide some solace and reward to engineers whose everyday work and lives often offer only limited excitement or power. And they cement a fraternity that effectively excludes women engineers from important informal networks.

The "glint in the eyes" of engineers is evident to all who have cared to look. In *The existential pleasures of engineering*, Samuel Florman (1976) extols at length the sensual absorption, spiritual connection, emotional comfort, and aesthetic pleasures to be found in engineers' intimacy with technical artifacts. As a civil engineer, he described a "yearning for immensity" inspired by nature, an existential impulse for the "vanity of pyramids or dams" (1976, pp. 122, 126). Similarly, Sally Hacker both witnessed and experienced the sensual, even erotic, pleasures to be had in making things work. She perceived that part of the pleasure of engineering is a pleasure in domination and control – over workers as well as the natural world – which she saw as echoing prominent themes in present-day eroticism (1989, ch. 3; 1990, ch. 9).

The connection with eroticism is frequently hinted at by feminists, not least because it is overwhelming in the language of potency and birth that surrounds military technology (Easlea, 1983). In her very thoughtful and illuminating ethnography of defense intellectuals, Carol Cohn (1986) suggests that this language does not necessarily reflect individual motivations; rather, it may function to tame or make tenable "thinking the unthinkable" – of nuclear annihilation. Eroticism surrounding technology is nonetheless an important theme in cultural studies of technology (e.g., Balsamo, 1998; Burfoot, 1997), and warrants further investigation. However, I want to pick up here an argument suggested by Hacker, that the fun engineers have the technology is a *compensation* for contributing to larger systems of dominance and control – an especially important "reward" when so many engineers occupy fragmented roles in the labor process, and when other sources of job satisfaction may be limited (1989, ch. 3). I see a resonance with Florman's (1976) rhetoric about dams: the power of the technology symbolically extends engineers' limited sense of strength or potency.

As Downey and Lucena note, "engineers routinely feel powerless themselves but are viewed as highly empowered by outsiders" (Downey & Lucena, 1995, p. 187). This is reflected in engineers' frequent complaints about the imposition of business perspectives and priorities, which are seen as "as threatening the technical core of their professional identity" (Mellström, 1995, p. 54). On a wider stage, the men who take most pleasure in technology are often far less powerful than engineers – hackers and other technical hobbyists are obvious examples. Maureen McNeil asks, "couldn't the obsessive knowledge of some working class lads who are car buffs, or some of the avid readers of mechanics or computer magazines, be interpreted as evidence of impotence?" (1987, p. 194). Flis Flenwood responds that in such cases technology offers a *symbolic promise* of power, as well as the potential to compensate materially for their relative lack of class power by acquiring technical expertise and so "strengthening their gender power" (1993, p. 41). Perhaps another kind of symbolic power promised by engineering is power over wayward emotions. The drills of mathematical problem solving in engineering education described earlier might be seen as encouraging a split between emotionality and rationality in which abstraction offers the promise of control or mastery over emotions (Hacker, 1990, ch. 4). Paul Edwards suggests that the "microworlds" of computer programming offer a retreat from "unwanted emotional complexity . . . For men, to whom power is an icon of identity and an index of success, a microworld can become a challenging arena for an adult quest for power and control" (1996, p. 172). It is, of course, commonplace to find at least some engineers and computer specialists who seek refuge from human relationships in technology (e.g., Håpnes, 1996; Mellström, 1995).

Engineers both identify with technology and share pleasure and pride in their technical competence. Judith McIlwee and Gregg Robinson comment on the basis of interviewing U.S. engineers:

The culture of engineering involves a preoccupation with tinkering that goes beyond the requirements of the job. Vocation becomes avocation, and, in turn, devotion. It is not enough to be competent in the hands-on aspects of engineering: one should be obsessed with them. It is not enough to know the difference between a piston and a rod: one should take obvious joy in this knowledge. The engineers must be ready not only to engage in technical exchanges during work periods, but interested in participating in them during breaks as well. To be seen as a competent engineer means throwing one's self into these rituals of tinkering (1992, p. 139).

Ethnographies reveals that engineer's humor typically celebrates their technical prowess and ridicules the lack of it in others (Hacker, 1990, ch. 4; Mellström, 1995, ch. 5). By this stroke, technical prowess is what defines them as engineers *and* what gives them a sense of power.

The pleasures men take in technology are a very important factor in the continued male dominance of technical work. Boys are far more likely than girls to engage in technical hobbies (Haddon, 1990; Kleif, 1999). Frequently, such interests strengthen during adolescence – in the classic case of taking cars apart, technology provides a rare focus for bonding between fathers and sons – with the result that engineering is a “self-evident” career choice for most male engineers (1995, ch. 7). As Ulf Mellström observed among Swedish engineers, ritualistic displays of hands-on technical competence are a homosocial enactment and “engineering practice tends to reproduce patterns of homosociality” (Mellström 1995, p. 152). The women engineers studied by McIlwee and Robinson did not share their male colleagues’ obsession; they had other topics of conversations and sources of joy. In organizations and disciplines where engineers enjoy high status, they benefit from the “power to create a workstyle comfortable to them as men” and (by the same token) alien to women. The centrality of technology is stressed, and aggressive displays of competence are the accepted means of landing the more interesting assignments and jobs (McIlwee & Robinson, 1992, p. 138 and ch. 1). In this situation, it is hardly surprising that women engineers tend to drop out or to lose out in career terms: they never really “belong to the club,” and it is hardly surprising that the entry of women is (still) greeted with hostility by many engineers: it challenges what it means to be a man (Murray, 1993) and, perhaps, it threatens to spoil their fun (Faulkner, 2000a).

Summary and Tentative Conclusions

Cynthia Cockburn once argued that “technology itself cannot be fully understood without reference to gender” (1992, p. 32). This paper has elaborated Cockburn’s claim in terms of the question “how is technology gendered?” We may summarize its conclusions as follows:

- (1) technology is gendered because *key specialist actors* – especially in the design of new technological artifacts and systems – *are predominantly men*
- (2) there are strong *gender divisions of labor around technology*, based in part on an equation between masculinity and technical skill
- (3) *technological artifacts can be gendered*, both materially and symbolically, although there often remains considerable interpretative flexibility in their use
- (4) *cultural images of technology are strongly associated with hegemonic masculinity*, although there is a huge mismatch between image and practice
- (5) the very detail of technical knowledge and practice is gendered, *albeit in complex and contradictory ways*
- (6) *styles of technical work may be gendered* somewhat, although there are strong normative pressures to conform
- (7) technology is an important element in the *gender identities of men who work and play with technologies*

The constructivist framework elaborated here defies the kind of simplistic treatments in which technology is seen as either unproblematically a product of male interests, or as neutral. It obliges us to view gender as *an integral part* of the social shaping of technology. It, thus, challenges any presumed neutrality of technology by focusing on how gender might enter or be expressed in the very design of the technologies women encounter. And it challenges determinist views of technology by acknowledging that individual technologies are subject to considerable interpretative flexibility in both use and design. Even more profoundly, the notion of the “socio-technical” in technology studies captures the sense that technology and society are mutually constituting – hence, the coproduction of gender and technology.

The symmetry of this analytical framework suggest that just as one cannot understand technology without reference to gender, so one cannot understand gender without reference to technology. This I would suggest is the huge challenge of the technology question in feminism. There are at least three important implications of this challenge for feminism.

First, I maintain that technology is – both materially and symbolically – a huge, often critical, element of hegemonic masculinity. In this context, the undertheorization of technology in feminist scholarship, and its virtual neglect in research on men and masculinities, are surprising and serious lacunae. I would suggest that further research on the durability of the technology-masculinity equation, and on the diverse interactions between technologies and masculinities found in practice, would both deepen our understanding about gender

identities and power relations more broadly, and help to destabilize that equation.

Second, I believe that the notion of the sociotechnical, especially Latour's insistence that artifacts are nonhuman actors integral to the social fabric (1992), provide valuable tools for feminist scholarship more broadly. Although they come from very different political traditions, there is a resonance between this aspect of the sociotechnical and Haraway's conceptualization of our cyborg-like existence (1991). In our growing understanding of the body, for example, the notion of the sociotechnical allows us to hold on to the materiality of the embodied body as we also acknowledge its constructedness and discursive elements. Recent work of Alison Adam (1998) and Anne Balsamo (1998) builds on this approach (without "naming" it sociotechnical) to good effect.

Third, moving from scholarship to praxis, the challenge of the technology question in feminism means that *we cannot transform gender relations without engaging in technology*. This is not a straightforward matter – precisely because the ambivalence evident in feminist analyses of technology and in women's encounters with technology is a recurring theme in the area of praxis also. For individual women, the effect of the felt ambivalence about technology is often either immobilising or polarising. And in collective feminist responses to and strategies for technology, two ends of a spectrum can be discerned. At one end, we see liberal feminist campaigns to get more women into engineering in which the current shape of modern technology is broadly endorsed. At the other end, we see the rejection of the whole technological project implicitly (if not explicitly) suggested by ecofeminism, and apparently reflected in the armies of girls and women who vote with their feet away from any career in technology. In the spirit of Donna Haraway's cyborg manifesto (1991), I believe the tension between optimism and pessimism that necessarily characterizes feminist technology studies obliges feminist activists to steer a difficult course somewhere in between complete rejection and uncritical endorsement of technology. I, therefore, finish by exploring briefly the possibilities for feminist action that have emerged to date.

Feminist Strategies for Technology

One available tactic in the terrain between rejection and endorsement is to look for non-threatening ways of enabling women to increase their technical competence

so that they are less reliant on men's expertise. The "mend your own car" and IT classes, which became popular in the 1980s, sought to challenge stereotyped equations of men and skill, while women's self-help health groups sought to develop and share alternatives to medical knowledge and practices. Another set of tactics has been for women to organize as active consumers of technologies – from the women's peace camp at Greenham Common against the siting of nuclear 'Cruise' missiles, to the ground swell of outrage about the technologized management of hospital births in the late 1970s and early 1980s in the United Kingdom (Boyd & Sellers, 1982), which catalyzed the introduction of birth plans and other "informed choice" procedures in the National Health Service.

There are inevitable limitations to women's likely impact as consumers of technology, however skilled or informed, because most women are very remote from the design process. The gains are thus invariably small-scale improvements, because "choice" is always constrained by what technologies are currently in use. The general problem here has been dubbed the "Collingridge dilemma": the consequences of new technologies can not always be predicted, and by the time it becomes apparent that something is wrong with a technology, both its artifactual form and the social interests surrounding it, have become so entrenched that they represent major barriers to change (Collingridge & Reeve, 1986). The conclusion for feminists has to be that we need to develop strategies to intervene in the process of designing new technologies *as well as* in the context of use.

Some interesting experiments have taken place along these lines: for example, attempts to involve women office workers in "human-centered" systems design (Green, Owen, & Pain, 1993). The evidence suggests that such initiatives rarely allow for more radical changes in either the organization of work or technological design. Janine Morgall (1993) suggests an approach that might prove more radical: critical feminist technology assessment seeks to extend existing technology assessment procedures² by, first, giving voice to the full range of interested groups in technological design and, second, starting from a critical debate about what and whose needs are to be met, rather than from existing technologies.

Taken together, these tactics amount to a strategy for democratising technology from the "outside in." No one, certainly not me, is suggesting that this is an alternative to getting more women into engineering, or to feminists

and other progressives working to change technology from the “inside out” (e.g., Suchman, 1995). The need for technologists to exercise social responsibility for the impact of their products has been a recurring theme since Mary Shelley’s *Frankenstein*. Many feminists and sociologists have read into this parable the lesson that the hapless inventor should have thought *in advance* of the consequences of his actions and *cared for* his creation once it was made; indeed, the creation himself eloquently makes this point during the stunning meeting in the glacier. Knut Sørensen, for example, argues that what is required, as part of any strategy to democratize technology, is for engineers to adopt a “professional ethic of caring” such that they nurture and “bring up” new technologies, much as parents do their children, learning along the way how best to do the job (see Andersen & Sørensen, 1994).

This vision resonates strongly with Hilary Rose’s memorable call for a “unity of hand, brain, and heart” in a transformed practice of science (Rose, 1983). Rose argues that women are more likely to bring a caring ethic and rationality to technical work because their position in the sexual division of labor means that they generally do (or are socialized to do) more caring work than men (Rose, 1983, 1994, ch. 2). Feminist standpoint epistemology has not been formally applied to technology, theoretically or empirically, although it has long been an article of faith of

many feminist activists including myself (Arnold & Faulkner, 1985) that women’s entry into technology – specifically the design and development of technologies – would, by itself, begin to transform both the products of technology and its *modus operandi*. These days such claims are (rightly) seen as dangerously essentialist. But we should not lose site of the significance of “situatedness” (Haraway, 1988) with respect to technology. As some of the better research in feminist technology studies has revealed, the male dominance of engineering does gender the design of artifacts³ – so why not the other way around? At the very least, few would argue with the notion that women designers should be more likely to “see” the needs of particular female users (e.g., for wider gangways on buses, to allow for women with young children in buggies, or for air bags that are not lethal to short women and children). As indicated earlier, however, there is very little evidence that women and men bring different styles or perspectives to engineering, and the opportunities for this may be limited as yet.

What remains crystal clear is that liberal campaigns to increase the participation of women in technology will amount to little unless they are linked to a radical vision and agenda for the transformation of technology – into a practice that is more democratic and respectful of diversity, with products which are safer, friendlier, and more useful.

Notes

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1 Marxist research on the labor process has generally emphasized how social relations can be embodied in production technologies. Some constructivists do not accept such formulations. Grint and Woolgar, for example, emphasize instead our “interpretative engagement” with technology, and insist that “The politics and values of technology result

from the gaze of the human; they do not lie in the gauze of the machine” (1995, pp. 292, 305).

- 2 Technology assessment is practised in some countries as a means of anticipating harmful consequences of new technologies (usually harmful environmental or health impacts) and suggesting appropriate modifications or alternatives. See Rip, Misa, & Schott (1995) for critical discussion and case studies.
- 3 The gendering of design more widely-encompassing aesthetic as well as engineering design – is a topic worthy of further attention, and one that could usefully be subject to the kind of approach outlined in this paper.

References

- Adam, Alison. (1997). What should we do with cyberfeminism? In Rachel Lander & Alison Adam (Eds.), *Women in computing* (pp. 17–27). Exeter: Intellect.
- Adam, Alison. (1998). *Artificial knowing: Gender and the thinking machine*. London: Routledge.
- Akrich, Madelaine. (1992). The de-scription of technical objects. In Wiebe Bijker & John Law (Eds.), *Shaping technology/building society* (pp. 205–224). Cambridge, MA: MIT Press.
- Andersen, H. W., & Sørensen, Knut H. (1994). *Frankenstein’s dilemma: En bok om teknologi, miljø og verdier*. Oslo: Ad Notam Glydendal.

- Arditti, Rita, Duelli Klien, Renate, & Minden, Shelley (Eds.). (1984). *Test-tube women: What future for motherhood?* London: Routledge & Kegan Paul.
- Arnold, Erik, & Faulkner, Wendy. (1985). Smothered by invention: The masculinity of technology. In Wendy Faulkner & Erik Arnold (Eds.), *Smothered by invention: Technology in women's lives* (pp. 18–50). London: Pluto Press.
- Balsamo, Anne. (1998). *Technologies of the gendered body: Reading cyborg women*. Durham: Duke University Press.
- Barinaga, Marcia. (1993). Is there a “female style” in science? *Science*, 260, 384–91.
- Berg, Anne-Jorunn. (1997). *Digital feminism*. Dragvoll, Norway: Senter for Teknologi of Samfunn, Norwegian University of Science and Technology, Rapport No. 28.
- Berg, Anne-Jorunn. (1994). Technological flexibility: Bringing gender into technology (or was it the other way round?). In Cynthia Cockburn & Ruth Fürst Dilic (Eds.), *Bringing technology home: Gender and technology in a changing Europe* (pp. 94–110). Buckingham: Open University Press.
- Berg, Anne-Jorunn, & Lie, Merete. (1995). Feminism and constructivism: Do artifacts have gender? *Science, Technology, & Human Values*, Special Issue on Feminist and Constructivist Perspectives on New Technology, 20(3), 332–351.
- Bijker, Wiebe, & Law, John. (Eds.). (1992). *Shaping technology/building society*. Cambridge, MA: MIT Press.
- Bijker, Wiebe, Hughes, Thomas, & Pinch, Trevor. (Eds.). (1988). *The social construction of technological systems*. Cambridge, MA: MIT Press.
- Boyd, Catherine, & Sellers, Lea. (1982). *The British way of birth*. London: Pan Books.
- Burfoot, Annette. (1997). Through the eyes of Mary: Maternity and Modernity in Italy Canadian Womens Studies. *Les Cahiers de la Femme*, 18(4), 32–38.
- Caputi, Jane. (1988). Seeing elephants: The myths of phallo-technology. *Feminist Studies*, 14(3), 487–524.
- Cockburn, Cynthia. (1983a). *Brothers: Male dominance and technological change*. London: Pluto.
- Cockburn, Cynthia. (1983b). Caught in the wheels: The high cost of being a female cog in the male machinery of engineering. *Marxism Today*, November, 16–20.
- Cockburn, Cynthia. (1985). *Machinery of dominance: Women, men and technical know-how*. London: Pluto.
- Cockburn, Cynthia. (1992). The circuit of technology: Gender, identity and power. In Roger Silverstone & Erik Hirsch (Eds.), *Consuming technology: Media and information in domestic spaces* (pp. 32–47). London: Routledge.
- Cockburn, Cynthia, & Dilić, Ruth Fürst. (Eds.). (1994). *Bringing technology home: Gender and technology in a changing Europe*. Buckingham: Open University Press.
- Cockburn, Cynthia, & Ormrod, Susan. (1993). *Gender and technology in the making*. London: Sage.
- Cohn, Carol. (1986). Sex and death in the rational world of defense intellectuals. *Signs*, 12(4), 687–718.
- Collingridge, David, & Reeve, Colin. (1986). *Science speaks to power: The role of experts in policy making*. London: Frances Pinter.
- Connell, Robert W. (1987). *Gender and power: Society, the person and sexual politics*. Cambridge: Polity Press.
- Constant, Edward. (1984). Communities and hierarchies: Structures in the practice of science and technology. In Rachel Laudan (Ed.), *The nature of technological knowledge: Are models of scientific change relevant?* (pp. 27–43). Dordrecht: Reidel.
- Corea, Gena, Duelli Klein, Renae, Harnner, Jalna, Holmes, Helen B., Hoskins, Betty, Kishwar, Madhu, Raymond, Janice, Rowland, Robyn, Skinbacher, Roberta. (1985). *Man-made women: How new reproductive technologies affect women*. London: Hutchinson.
- Cowan, Ruth Schwartz. (1983). *More work for mother: The ironies of household technology from the open hearth to the microwave*. New York: Chatto and Windus.
- Cox, Cat. (1992). Eco-feminism. In Gill Kirkup & Laurie Smith Keller (Eds.), *Inventing women: Science, technology and gender* (pp. 282–294). Cambridge: Polity Press.
- Downey, Gary L., & Lucena, Juan A. (1995). Engineering studies. In Sheila Jasanoff, Gerald E. Markle, James C. Petersen, & Trevor Pinch (Eds.), *Handbook of science and technology studies* (pp. 167–88). Thousand Oaks, CA: Sage.
- Easlea, Brian. (1981). *Science and sexual oppression*. London: Weidenfeld & Nicolson.
- Easlea, Brian. (1983). *Fathering the unthinkable: Masculinity, scientists and the nuclear arms race*. London: Pluto.
- Edwards, Paul N. (1996). *The closed world: Computers and the politics of discourse in cold war America*. Cambridge, MA: MIT Press.
- Elson, Diane, & Pearson, Ruth. (1981). Nimble fingers make cheap workers: An analysis of women's employment in third world manufacturing. *Feminist Review*, 7, 87–107.
- Evans, Frances. (1985). Managers and labourers: Women's attitudes to reproductive technologies. In Wendy Faulkner & Erik Arnold (Eds.), *Smothered by invention: Technology in women's lives* (pp. 109–127). London: Pluto Press.
- Faulkner, Wendy. (1998). Extraordinary journeys around ordinary technologies in ordinary lives. *Social Studies of Science*, 28(3), 484–489.
- Faulkner, Wendy. (2000a). The power and the pleasure? A research agenda for “making gender slick” to engineers. *Science, Technology, & Human Values*, 25(1), 88–120.
- Faulkner, Wendy. (2000b). Dualisms, hierarchies and gender in engineering. *Social Studies of Science*, 30(5), 759–792.
- Florman, Samuel. (1976). *The existential pleasures of engineering*. New York: St Martin's.
- Frissen, Valerie. (1994). The domestication of the telephone. In Anne-Jorunn Berg & Margrethe Aune (Eds.), *Domestic technology and everyday life: Mutual shaping processes*. Proceedings from COST A4 workshop in Trondheim, Norway, October 28–30, 1993, Brussels: EC.

- Gershuny, Jeremy I. (1982). Household tasks and the use of time. In Sandra Wallman (Ed.), *Living in South London* (pp. 149–207). London: Gower.
- Green, Eileen, Owen, Jenny, & Pain, Den. (Eds.). (1993). *Gendered by design? Information technology and office systems*. London: Taylor & Francis.
- Grint, Keith, & Gill, Ros. (Eds.). (1995). *The gender-technology relation: Contemporary theory and research*. London: Taylor and Francis.
- Grint, Keith, & Woolgar, Steve. (1995). On some failures of nerve in constructivist and feminist analyses of technology. *Science, Technology, & Human Values*, 20(3), 286–310.
- Hacker, Sally. (1989). *Pleasure, power and technology: Some tales of gender, engineering, and the cooperative workplace*. Boston: Unwin Hyman.
- Hacker, Sally. (1990). *Doing it the hard way: Investigations of gender and technology*. Boston: Unwin Hyman.
- Haddon, Lesley. (1990). Researching gender and home computers. In Knut H. Sørensen, & Anne-Jorunn Berg (Eds.), *Technology and everyday life: Trajectories and transformations* (pp. 89–108). Report No 5: Proceedings from a Workshop in Trondheim, 28–29 May, Oslo: Norwegian Research Council for Science and Humanities.
- Håpnes, Tove. (1996). Not in their machines: How hackers transform computers into subcultural artefacts. In Merete Lie & Knut H. Sørensen (Eds.), *Making technology our own? Domesticating technology into everyday life* (pp. 121–150). Oslo: Scandinavian University Press.
- Håpnes, Tove, & Rasmussen, Bente. (1991). Excluding women from the technologies of the future? *Futures*, December, 1107–1119.
- Harding, Sandra. (1986). *The science question in feminism*. Ithaca, NY: Cornell University Press.
- Haraway, Donna. (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies*, 14(3), 575–599.
- Haraway, Donna. (1991). *Simians, cybords and women: The reinvention of nature*. London: Free Association Books.
- Henwood, Flis. (1993). Establishing gender perspectives on information technology: Problems, issues and opportunities. In Eileen Green, Jenny Owen, & Den Pain (Eds.), *Gendered by design? Information technology and office systems* (pp. 31–52). London: Taylor and Francis.
- Henwood, Flis. (1996). WISE choices? Understanding occupational decision-making in a climate of equal opportunities for women in science and technology. *Gender and Education*, 8(2), 199–214.
- Hughes, Thomas. (1983). *Networks of power: Electrification in Western society 1880–1930*. Baltimore: The John Hopkins University Press.
- Hughes, Thomas. (1986). The seamless web: Technology, science, etcetera, etcetera. *Social Studies of Science*, 16, 281–292.
- Keller, Evelyn F. (1987). Learning about women, gender, politics and power. *Daedalus, Journal of the American Academy of Arts and Sciences*, 116(4), 77–91.
- Keller, Evelyn F. (1990). From secrets of life to secrets of death. In Mary Jacobus, Evelyn F. Keller, & Sally Shuttleworth (Eds.), *Body/Politics: Women and the discourses of science* (pp. 177–191). New York: Routledge.
- Kimbell, Richard, Stables, Kay, & Green, Richard. (1996). *Understanding practice in design and technology*. Buckingham: Open University Press.
- Kleif, Tine. (1999). Making machines: Pleasure, play and power. Unpublished MSc dissertation. Edinburgh: Science Studies Unit, University of Edinburgh.
- Latour, Bruno. (1992). Where are the missing masses? The sociology of a few mundane artifacts. In Wiebe Bijker & John Law (Eds.), *Shaping technology/building society* (pp. 225–257). Cambridge, MA: MIT Press.
- Latour, Bruno. (1988). The prince for machines as well as for machinations. In Brian Elliot (Ed.), *Technology and Social Process* (pp. 20–43). Edinburgh: Edinburgh University Press.
- Law, John. (1987). Technology, closure and heterogeneous engineering: The case of the Portuguese expansion. In Wiebe Bijker, Thomas Hughes, & Trevor Pinch (Eds.), *The social construction of technological systems* (pp. 111–134). Cambridge, MA: MIT Press.
- Lerman, Nina E., Mohun, Arwen P., & Oldenziel, Ruth. (1997). The shoulders we stand on and the view from here: Historiography and directions for research. *Technology and Culture*, Special Issue on Gender Analysis and the History of Technology, 38(1), 9–30.
- Lie, Merete. (1995). Technology and masculinity: The case of the computer. *The European Journal of Women's Studies*, Special Issue on Technology, 2(3), 379–394.
- Lie, Merete. (1998). *Computer dialogues: Technology, gender and change*. Trondheim, Norway: Senter for kvinneforskning, Norges Teknisk-naturvitenskapelige Universitet.
- Lie, Merete, & Sørensen, Knut H. (Eds.). (1996). *Making technology our own? Domesticating technology into everyday life*. Oslo: Scandinavian University Press.
- Lohan, Maria. (1998). The transvestite telephone: A male technology dressed up in feminine clothes? Unpublished PhD thesis. Dublin: University of Dublin, Trinity College.
- MacKenzie, Donald, & Wajcman, Judy. (1999). Introductory essay: The social shaping of technology. In Donald MacKenzie & Judy Wajcman (Eds.), *The social shaping of technology* (pp. 3–28). Milton Keynes: Open University Press.
- McNeil, Maureen. (1987). Being reasonable feminists. In Maureen McNeil (Ed.), *Gender and expertise* (pp. 13–61). London: Free Association Books.
- Mellström, Ulf. (1995). *Engineering lives: Technology, time and space in a male-centered world*. Department of Technology and Social Change: Linköping University, Linköping, Sweden.

- Merchant, Carolyn. (1980; 1982 2nd ed). *The death of Nature: Women, ecology and the scientific revolution*. London: Wildwood House.
- Merchant, Carolyn. (1992). *Radical economy: The search for a livable world*. New York: Routledge.
- Mies, Maria, & Shiva, Vandana. (1993). *Ecofeminism*. Halifax, Nova Scotia: Fernwood Publications, London: Zed Books.
- Morell, Virginia. (1993). Called "trimates," Three bold women shaped their field. *Science*, 260, 420-425.
- Morgall, Janine M. (1993). *Technology assessment: A feminist perspective*. Philadelphia: Temple University Press.
- Murphy, Patricia. (1990). Gender differences in pupils' reactions to practical work. In Brian E. Woolnough (Ed.), *Practical science: The role and reality of practical work in school science* (pp. 112-122). Milton Keynes: Open University Press.
- Murray, Fergus. (1993). A separate reality: Science, technology and masculinity. In Eileen Green, Jenny Owen, & Den Pain (Eds.), *Gendered by design? Information technology and office systems* (pp. 64-80). London: Taylor and Francis.
- Noble, David. (1991). *A world without women: The evolution of the masculine culture of science*. New York: Knopf.
- Oakley, Anne. (1987). From walking wombs to test-tube babies. In Michelle Stanworth (Ed.), *Reproductive technologies: Gender, motherhood and medicine* (pp. 36-56). Oxford: Polity.
- Oldenziel, Ruth. (1999). *Making technology masculine: Men, women and modern machines in America*. Amsterdam: Amsterdam University Press.
- Oldenziel, Ruth. (1994). Of old and new cyborgs: Feminist narratives of technology. *Literature D'America*, 14(55), 95-111.
- Ormrod, Susan. (1994). "Let's nuke the dinner": Discursive practices of gender in the creation of a new cooking process. In Cynthia Cockburn & Ruth Fülrst Dilic (Eds.), *Bringing technology home: Gender and technology in a changing Europe* (pp. 42-58). Buckingham: Open University Press.
- Plant, Sadie. (1997). *Zeros and ones: Digital women and the new technoculture*. London: Fourth Estate.
- Phillips, Anne, & Taylor, Barbara. (1980). Sex and skill: Notes towards a feminist economics. *Feminist Review*, 6, 79-88.
- Pinch, Trevor, & Bijker, Wiebe. (1984). The social construction of facts and artifacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social Studies of Science*, 14, 399-441.
- Rip, Arie, Misa, Thomas J., & Schott, Johan. (Eds.). (1995). *Managing technology in society: The approach of constructive technology assessment*. London: Pinter.
- Rose, Hilary. (1983). Hand, brain, and heart. *Signs: Journal of Women in Culture and Society*, 9(1), 73-96.
- Rose, Hilary. (1994). *Love, power and knowledge: Towards a feminist transformation of the sciences*. Cambridge: Polity Press.
- Science Technology and Human Values*. (1995). Special Issue on Feminist and Constructivist Perspectives on New Technology, 20(3).
- Scott, Joan. (1988). *Gender and the politics of history*. New York: Columbia University Press.
- Shaffner, Julia. (1993). Gender and politics in the machine: Computer scientists and social change. Unpublished MPhil Thesis. Edinburgh, Scotland: University of Edinburgh.
- Silverstone, Roger, & Hirsch, Erik. (Eds.). (1992). *Consuming technologies: Media and information in domestic spaces*. London: Routledge.
- Soper, Kate. (1995). Feminism and ecology: Realism and rhetoric in the discourses of nature. *Science, Technology, & Human Values*, 20(3), 311-331.
- Sørensen, Knut H. (1997). The masculine mystique: Engineering tales. Paper presented to Network of European Centres in Science and Technology Studies workshop on Gender, Science and Technology, Trondheim, Norway: NTNU, May.
- Sørensen, Knut H., & Berg, Anne-Jorunn. (1987). Genderization of technology among Norwegian engineering students. *Acta Sociologica*, 30(2), 151-171.
- Science*. (1993). Special Issue on Women in Science, 260.
- Sørensen, Knut H., & Levold, Nora. (1992). Tacit networks, heterogeneous engineers, and embodied technology. *Science, Technology, & Human Values*, 17(1), 13-35.
- Spender, Dale. (1995). *Nattering on the Net: Women, power and cyberspace*. Melbourne: Spinifex.
- Stanworth, Michelle. (1987). Reproductive technologies and the deconstruction of motherhood. In Michelle Stanworth (Ed.), *Reproductive technologies: Gender, motherhood and medicine* (pp. 10-35). Oxford: Blackwell.
- Suchman, Lucy. (1995). Opportunities for disruption: Reflections on technology and authority. Presented at workshop on The Mutual Shaping of Gender and Technology, Twente, The Netherlands, October.
- Technology and Culture*. (1997). Special Issue on Gender Analysis and the Plistory of Technology. 38(1), 1-272.
- Trescott, Martha M. (1984). Women engineers in history: Profiles in persistence and holism. In Violet B. Hass & Carolyn C. Perucci (Eds.), *Women in scientific and engineering professions* (pp. 181-204). Ann Arbor: University of Michigan Press.
- Turkle, Sherry, & Papert, Seymour. (1990). Epistemological pluralism: Styles and voices within the computer culture. *Signs: Journal of Women in Culture and Society*, 16(1), 128-258.
- Turkle, Sherry. (1988). Computational reticence: Why women fear the intimate machine. In Cheri Kramarae (Ed.), *Technology and women's voices* (pp. 41-61). London: Routledge.
- Verluisen, Margaret C. (1981). Midwives, medical men and poor women labouring of child: Lying-in hospitals in eighteenth century London. In Helen Roberts (Ed.), *Women, health and reproduction* (pp. 18-49). London: Routledge & Kegan Paul.
- Wajcman, Judy. (1991). *Feminism confronts technology*. Cambridge: Polity Press.

- Wajcman, Judy. (2000). Reflections on gender and technology studies: In what state is the art? *Social Studies of Science*, 30(3), 447–464.
- Williams, Robin, & Russell, Stewart. (1989). Opening the black box and closing it behind you: On microsociology in the social analysis of technology. *Edinburgh PC1T Working Paper No 3*. Edinburgh: Research Centre for Social Sciences, University of Edinburgh.
- Winner, Langdon. (1993). Social constructivism: Opening the black box and finding it empty. *Science as Culture*, 3(16), 427–452.
- Winner, Langdon. (1999). Do artifacts have politics? In Donald MacKenzie & Judy Wajcman (Eds.), *The social shaping of technology* (pp. 28–40). Milton Keynes: Open University Press.

Part III

Defining Technology

Introduction

Efforts to define “technology” face at least three serious difficulties. First, as several previous essays have suggested, there is the problem of trying to assign technology a general “nature” at all – a problem that seems all the harder to solve because any proposed definition faces the task of explaining away the already numerous competing alternatives. Second, there is the question of how, or even whether, to distinguish prescientific from modern scientific technology. And third, there are the special difficulties associated with criticizing the widely popular but deeply problematic characterizations of technology as equipment or as applied science.

In the introduction to *Living in a Technological Culture*, whose first chapter is reprinted below, Mary Tiles and Hans Oberdiek not only acknowledge the definition problem but reject the idea of starting with one – precisely because no definition is obviously the right one. Hence, any definition offered in advance would in effect settle issues before one has tried to understand them. The authors begin instead where they, like us, actually are – namely, fully embedded in, contextualized by, and concerned about living in a technological culture. Their questioning of what this situation means and how to understand it can thus proceed without prematurely foreclosing the consideration of any issues or phenomena.

Of course, a few things are obvious right away. Whatever else may be involved, asking about life in a technological culture must certainly include discussion of “technological devices (artifacts), techniques for their production and use, the relative roles played in each of these by technical and manual skills, practical knowledge

(know-how) and theoretical knowledge,” plus, in order to understand what all of this politically, socially, personally means to us, some consideration of the history of technological development. However, Tiles and Oberdiek note that what is perhaps most striking is not all these specific topics but the way we all tend to oscillate between optimistic and pessimistic “visions” of being in a technological culture. In the present selection, they describe these two visions, identify some of the main features of each one, and explain the philosophical significance of our ultimately being unable to accept or reject either vision. In the end, they argue, the problem is not just that each vision is partially right but overdrawn but that both accept the same basic ontological and epistemological “framing assumptions” of the modern Western tradition, and these assumptions make it impossible to properly characterize our actual relations with technologies and technological systems.

Technological optimism – identified here especially through references to Mesthene (see Chapter 56) – is found everywhere in the progressive, “instrumentalist” ideologies in both the capitalist and communist West. (On the optimism, see, e.g., Mitcham, Chapter 45; for the instrumentalism, see, e.g., Hickman, Chapter 34.) This vision’s plausibility rests, of course, on the obvious and dramatic transformations in our relations with nature that science-based technologies have actually effected. From this perspective, it appears as if we are fulfilling a destiny depicted everywhere from Genesis (1:28) and the ancient Greeks to Bacon and Marx – namely, that we should get to know nature through the

use of reason and then apply what we learn to subdue and/or dominate it. (“From knowledge comes prevision; from prevision comes action,” says the thoroughly optimistic Comte.) Here the key concepts of modern philosophy function positively. As Tiles and Oberdiek explain, behind the optimistic vision lies a pair of (Cartesian) dichotomies – facts vs. values, and nature vs. humans. Being *rational* and exercising *autonomy* manifest our essence. Reason (in the form of science) reveals nature in its factual reality. Value is given to the whole process by our decisions concerning what we want. And given this cluster of philosophical root concepts, technology is the process of applying science in order to get what we value. And the whole process is working.

Technological pessimism – exemplified here especially by Ellul (see Chapter 36) – gets its plausibility precisely from all the ways in which this process of fulfilling our destiny seems disastrous. The whole instrumentalist, technoscientific process is supposed to be a rational and orderly affair with chosen and predictable outcomes, but in the social world in which it plays itself out, the effects of this process are often unexpected, frequently unfair or destructive, and yet all too often apparently inevitable. The authors put the point starkly: the optimistic picture of ever greater control of nature through technology “contains within it the seeds of social paranoia.” For example, there is the apparent necessity of undemocratic means for controlling complex technological practices, the deskilling of these practices for greater efficiency, the undesigned and undesired consequences of the use of even seemingly innocent technologies (for example, with antibiotics come super-germs, with IT for everyone come government dossiers on everyone) – all of this “progress” seems to point quite generally to technology’s taking on an unpleasant and unmanageable life of its own. Technological systems behave, say Tiles and Oberdiek, like ecosystems. Try to control any part of the system, and the unexpected happens somewhere else.

Nevertheless, the authors argue that the pessimistic vision, too, is overdrawn, and just as with technological optimism, its tendencies to excess can be traced to its dependence on the inadequate vocabulary of modern philosophy. If one’s basic notion of *freedom* is “autonomy,” then our ability to control events will always seem, wrongly, to be either total or nonexistent. If *rationality* is defined instrumentally, then the default position on appropriate goals will always be the efficient realization of whatever those with the most power/knowledge

want (see, e.g., Foucault, Chapter 54). And if *reality* is understood as whatever can be known and used, then the very distinction between the human and the non-human – and thus the foundational distinction between natural causation and free valuation implied by the dualisms of modern philosophy – becomes difficult to sustain (as Pickering and Latour in this section, and Bostrom, Chapter 43, conclude). Tiles and Oberdiek suggest that what is needed is a philosophical (and non-Cartesian?) “middle ground” that would allow us to avoid the extremes of both technological optimism and pessimism. As other readings in this anthology show, variations of technological optimism or pessimism, as well as perspectives that share the authors’ sense that a third approach is possible – one that puts greater emphasis on what it means for us to start our inquiries already situated “in the midst” of technological culture – are all represented in recent science and technology studies.

Andrew Pickering and Bruno Latour might both be usefully interpreted as taking Tiles and Oberdiek’s critique of modern philosophy seriously. Thus, Pickering approaches both science and technology in an explicitly non-traditional way, urging that we first think of them as practices in which we are materially and intellectually submerged. In this, he sees himself as necessarily offering a new ontology – what he calls a “decentered ontology of becoming.” Traditional philosophers of science (and those philosophies of technology that still model themselves after it – e.g., Franssen, Chapter 18) typically focus on questions about what knowledge is, how it is obtained and justified, and perhaps its ethical use, and then label all other questions “merely” humanistic, historical, political, or social-scientific. Pickering labels this constrictive approach “representational,” meaning that its understanding of science (and technology) constitutes a kind of anthropocentric idealism in which disembodied intellects are depicted as observing what lies factually before them and attempting to represent in theories (and techniques) the objective reality that these facts allegedly disclose. Pickering rejects the realist and objectivist metaphysics of a fully determinate pre-existing world that animates such philosophy. Of course, representation is one thing science does, but this is no justification for forcing all descriptions of technoscientific life into this Cartesian frame. The basic condition of the world, he says, is one of action or “performance,” not knowing; hence, the fundamental categories of philosophy should be temporality, process, and emergence – categories adequate to illuminating the constant interaction of humans and machines,

that endless struggle of accommodation and adjustment which Pickering often calls “the dance of agency.” This is our world in its always thoroughly performative condition – a “mangle of practice” in which our dualistic conception of rational and autonomous human selves vs. knowable and usable material objects is a very late (and exaggerated) construction.

Pickering’s “mangle” – expanded metaphorically from the British word for “wringer” – began as (and certainly to some extent remains) a relatively inchoate notion through which he intends to stress the influence of both the role of material objects and the situatedness of scientists in social interactions, not only within the scientific community itself but also in society more generally. The idea, he says, “conjures up the image of the unpredictable transformations worked upon whatever gets fed into the old-fashioned device ... used to squeeze water out of washing.” Scientists are of course part of the mangle, contending not only with the difficulties and resistances presented by material objects but also with the need to interact with other scientists and social institutions. Pickering sometimes calls the mangle a dialectic process, but one with no overarching trajectory or final goal, either in the sense of a fulfillment of history or the total comprehension of absolute reality. Even the idea of what is possible is forever revised in the ongoing process human–nonhuman intertwining.

Given the evident process-like character of technoscientific life, Pickering also objects to the traditional representative picture of the over-fixity of everything. Of course, motion and material alteration are acknowledged, but only within the parameters of a universe still basically understood in accordance with the static metaphors of nineteenth-century physics, “with its repertoire of enduring causes and constraints.” Hence, a central feature of the mangle idea is its stress on “emergence.” Instead of looking for what can only be thought in “synchronic, non-temporal” terms, philosophies of science and technology should look for processes and transformations; and even the conceptual models we employ to grasp the world and its “brute contingencies” should be treated as something forever reworked in the dance of accommodation and adjustment.

A corollary to Pickering’s new focus on process is his call for us also rethink the rigid traditional distinction between human and nonhuman. He does not go so far as attributing anthropocentrically describable agency directly to non-living objects (as Latour and Callon do). Yet he also does not wish to deny them agency altogether. Here,

he draws on the notion of forces or powers in nature worked out by John Locke in the eighteenth century and again by Rom Harré in the twentieth century. With their help, he conceives of his approach as an alternative to Hume’s heretofore more influential treatment of the material world in terms of separate, presented events. Ironically, in construing the natural powers of inanimate objects as a kind of agency, Pickering consistently employs the anthropomorphic term “agency,” not a more neutral term like Latour’s “actants.” In any case, by adopting a “performative idiom” for philosophy, Pickering sees himself as moving “into a posthumanist space ... in which human actors are still there but now inextricably entangled with the nonhuman, no longer the center of the action and calling the shots.”

Pickering’s approach might usefully be compared with Dewey’s pragmatism – at least in its “experimental” character, if not so obviously with Dewey’s instrumentalism – insofar as his temporalizing of the scientific and technological process leads him to conceive of the interplay between inquiry, material involvement, and feedback as involving a constant tinkering or “tuning.” As Hickman suggests (see Chapter 34), in later works Dewey often uses “technology” as a virtual synonym for “inquiry.” Pickering also claims some kinship with Heidegger, but it is not clear that he understands Heidegger well enough to explain this in any detail. Granted that he thinks of himself as defending an “ontology” of becoming, there is nothing Heideggerian about his regarding this as a political move. Pickering’s overall conception of global technology is not “dystopian”; and the radical changes he thinks might be made in our normative conceptions of material and social life – that is when we begin to think of ourselves more self-consciously as “in the flow of becoming” rather than as on the outside trying to control it – certainly bear no relation to Heidegger’s disastrous political ruminations in the 1930s.

Trevor Pinch and Wiebe Bijker defend a straightforwardly social constructionist view of technology. As the selections from Pickering and Latour show, this outlook has become extremely influential in science and technology studies, even among those who do not fully embrace it. Social constructionism first emerged in post-positivistic studies of science, where the logical empiricists’ formal and purely rational conceptions of scientific procedure (see Part II, Section 1) were recontextualized to show that science is best understood as a human practice – one in which defining and evaluating data, making discoveries, and giving explanations are all

“negotiations” among real persons and social groups. Social constructionists insist on remaining neutral with regard to the truth-status of scientific claims. They evoke a “principle of symmetry” with regard to all competing claims (a move criticized by Winner, Chapter 55), in order to focus on understanding them, rather than judging them as superior or inferior from a privileged external vantage point. However, this symmetry or neutrality has been interpreted in two very different ways. Some interpret it to be a methodological stance of “bracketing,” in which science as a sociocultural practice is simply studied without the need to take a stand on the objectivity of its results or the reality of its subject matter. However, others regard social constructionist neutrality as a substantive position, an ontological and not merely a methodological stance, so that the so-called facts and objects of science must all be construed as *being* nothing more than socially constructed and thus not “real” in the sense of present in an objective world, independently of humans, and hopefully capable of “proper” representation.

Especially this second, substantive construal of neutrality has been strongly contested, both for its apparently anti-realist conception of science and for focusing too exclusively on the production of scientific facts, objects, and claims, and too little on their social impact. In general, the principal objection to social constructivism is that it shares the weaknesses of all pluralistic approaches to social studies of science and technology – a weakness that becomes philosophically dangerous when pluralism is conceived substantively instead of methodologically. If the various groups of inventors, consumers, and persons in government and business are all equally regarded as participants in the negotiations over scientific and technological policy, the inevitable tendency is to ignore the extent to which more powerful groups and interests may call the tune and to neglect what is not “visible” in the negotiations – for example, who and what are effectively excluded, subordinated, or harmed by the process as it is guided in accordance with the dominant orientations and attitudes of the more visible participants. Indeed, from a deliberately adopted value-neutral perspective, normative questions about the problematic sociopolitical character of the modern technoscientific orientation cannot even arise.

Social constructionist accounts of technology now duplicate the pattern of study worked out earlier in connection with social studies of science, again typically drawing special attention to actual processes of invention and interaction. Holistic characterizations of technology

by thinkers like Heidegger, Ellul, Marcuse, and Mumford are all rejected for wrongly inclining us to think of it in extra-empirical, deterministic terms, or to picture it as autonomous or out of control. Instead the focus is turned to examining the fine structure of particular technologies, together with the groups of inventors and consumers involved with these technologies. In this way, one arrives at a picture of both the social negotiations that, say, determine the final form of an artifact and also the social consensus that accepts it as a desired product.

Bruno Latour’s actor-network theory (ANT), also associated with the work of Michael Callon and John Law, has become an especially influential and radicalized form of social constructivism. In this recent defense of the theory (from *Reassembling the Social*, 2005), Latour reiterates his famous denial of the existence of “society,” as we usually understand this notion, but he explains his rejection more clearly and explicitly than in earlier works like *Laboratory Life* (1979, with Steve Woolgar) or *Science in Action* (1987). In traditional social science and common sense, he notes, one typically thinks of social wholes (e.g., religions, political parties, markets, societies) as something human beings act in and belong to, that is, precisely as *some things*, special kinds of real entities, organized according to a plan or implicit logic in terms of which we cognize and use material objects. For Latour, however, there is a glaringly abstract and anthropomorphic cast to this whole pattern of understanding. Even in the simplest tasks and most rudimentary organizations, every entity takes shape by virtue of its relations with everything else; so, too, with complex macro-level phenomena like science, nature, society; and so, too, with the whole process. Everything comes to be what it is (i.e., semiotically speaking, “mean” what it means) in and during the interactions and associations through which a whole is constituted. Conversely, the whole *just is* this continuously constituting process. Hence ANT, unlike what Latour perceives to be the traditional social scientific “default position” – in which social wholes are treated as if they were “separate domains” whose “structures” researchers represent in their theories – conceives these wholes as interactive “networks” – that is, heterogeneous combinations or amalgamations of textual, conceptual, social, material, and technical “actants,” only some of which are human. In this way, Latour extends Bloor’s “principle of symmetry” from neutrality concerning true vs. false claims to neutrality about humans vs. objects, calling them both “volitional actors,” that is, any agent, collective or individual, that can associate with or dissociate from

other agents. Actants enter into networked associations, which in turn define them, name them, and provide them with substance, intention, and subjectivity. Here, we can hear echoes of the older “systems approach” to technology, which followed the engineer’s modeling of power and communication systems (indeed, one older historian from this period, Thomas P. Hughes, now explicitly embraces ANT as systems theory’s replacement). There is also something strikingly Leibnizian in ANT’s use of “monadic” imagery to characterize actants; but for Latour himself (as he has lately come to explain), actants are more like Whitehead’s “actual occasions” – that is, foundationally indeterminate and momentary events/entities, with no a priori substance or essence, and always in the process of acquiring and modifying the natures they receive in their networks’ “movement of re-association and reassembling.” For Latour as for Whitehead, “societies” include all sorts of relational complexes, chemical-molecular, organic, linguistic, economic, and cosmological; moreover, there is no privileged external position from which these complexes are “objectively” understood.

Latour contrasts his own view especially with the French sociologist Émile Durkheim, for whom social facts and social laws are irreducible to the facts of individual behavior and psychological laws about this behavior. (Comte, as Durkheim’s foremost predecessor, even denied that “psychology” would ever achieve scientific status.) Latour turns to the much less influential French social thinker Gabriel Tarde, Durkheim’s contemporary and opponent, who completely rejected Durkheim’s institutionalist and anti-reductionist outlook. Indeed, especially in light of Latour’s influence on Continental philosophy of technology, it is interesting to ponder the similarities between his deconstruction of sociology and the logical positivists’ attack on the holism implicit in Gestalt psychology’s use of the logic of relations. In any case, part of Latour’s aim in focusing on individual actants is to discredit the idea that there are any “hidden social forces” (e.g., unconscious motives or inherited and determinative traditions). He is unsympathetic to the idea that actors are not fully aware of what they are doing. The aim is to treat everything as on the surface and self-evident, and to interpret the complexities of social life entirely in terms of the struggles and resolutions worked out by actants themselves. In this respect his approach resembles the ethnomethodology of Harold Garfinkel (whom Latour cites as displaying similarities to Tarde).

It is not hard to understand why so many have found Latour’s theory attractive, at least initially. What we might call his promotion of a new ontology by fiat seems to promise that one might sidestep with one move all the old epistemic controversies in traditional philosophy of science, blow away the stale air of mainstream structuralism (and structural-functionalism), and force a more careful turn in social science toward detailed research into the actual intricacies of a technoscientific life, where rigid distinctions between human vs. machine, science vs. technology, and authoritative viewpoint vs. mere opinion just seem out of place. ANT has encouraged many philosophers of technology to take the so-called “empirical turn,” in which one rejects the older speculations about Technology *Überhaupt* and emphasizes the careful study of actual “material relations” with our technoscientific surroundings (e.g., Verbeek, Chapter 47, traces his own postphenomenological exploration of the “morality of things” to ANT).

However, ANT has also understandably come to be widely and passionately disputed – so much so that Latour famously quipped that perhaps he should “abandon what was wrong with ANT, that is, ‘actor,’ ‘network,’ ‘theory,’ without forgetting the hyphen.” Of course, he did not do this; yet even with his subsequent clarifications and modifications, deeply problematic ontological, epistemological, and political issues remain. Some of the first two sorts of issues are discussed in the selection from Sismondo. But it is useful to note briefly some political issues as well. As Latour acknowledges, ANT explicitly and deliberately embraces a species of methodological individualism for social science. His theory was born in the 1980s, when the orthodox social scientific emphasis on institutions, large-scale organizations, and social movements faced both internal and external public opposition. From within science came the rise of mathematically modeled micro-research in economics, sociobiology, evolutionary biology, and even history, as well as numerous postpositivist and poststructuralist critiques of the standard accounts of scientific practice. From the wider world came the post-World War II wave of neoliberal, libertarian, individualist, and even anarchist political and economic reactions to collective/institutional social life. Holistic phenomena like “culture,” “society,” and “social structure” thus seemed as problematic to scientific researchers as “social justice,” “class,” and “welfare state” did to entrepreneurs, technocrats, and other “freedom” lovers. In this atmosphere, as Latour himself acknowledges, all the central tenets of his own

scientific orientation – its neutrality regarding human vs. nonhuman, its rejection of external standards of objectivity or value, its “follow the actors” preference for the most visible and dominant actants – echo and articulate the characteristics of a certain political stance as well. It is of course easy to make too much of the fact that Latour’s work is published in a series devoted to corporate management, or that he himself quotes favorably Margaret Thatcher’s crudely unfeeling “There is no such thing as society, only individuals and families,” but it would certainly have been useful if he had explained in what sense(s) he thinks she meant this “very differently.” His silence is often held against him, not because critics are eager to label him a Thatcherite, but because it is difficult to see precisely how his generalized principle of symmetry, which denies the (political as well as epistemic) relevance of theoretical terms describing anything more than entities or processes, could ever encourage anything more than a mere “understanding” of all the networks in our present world which happen to have achieved sufficient stability to be designated “societies” through the “inscription” of the dominant sentiments of the rich and powerful.

In his critical assessment of ANT, Sergio Sismondo follows John Law in characterizing the theory as “relational materialism.” What it means to call it “relational” seems clear. We can trace this approach to reality and to society back to Hegel and Marx, and thus view ANT as part of the twentieth century’s intellectual shift away from the earlier philosophical emphasis on properties or qualities – a movement that stretches all the way from William James’ perception of relations; to the extension of Aristotle’s logic of properties to a logic of relations by Gottlob Frege, Bertrand Russell, Charles S. Peirce, and other mathematical logicians; to relativity theorists’ and logical positivists’ production of a relational theory of space/time; to (most importantly in connection with Latour himself) Alfred North Whitehead’s development of a full-blown metaphysics of relations (who even claimed in conversations that subject–predicate logic was the source of modern immorality!). Whitehead has experienced a surprising revival among science studies postmodernists. In the 1920s and 1930s his influence was confined mainly to philosophical theologians (e.g., Charles Hartshorne), and he otherwise remained without a following until such figures as Latour, Pickering, and Donna Haraway all began to praise Whitehead’s relational panpsychism as an anticipation of their own views.

The sense in which ANT can be called a “materialism,” however, is more problematic – especially given the acknowledged influence of Whitehead. Latour, of course, is no Whiteheadian, insofar as he attributes agency not only to nonhuman organisms but to non-living artifacts such as machines and chemicals. But it is possible that Sismondo and Law are thinking of something more like Marx’s historical materialism or the cultural materialism of neo-Marxists like Raymond Williams, who both opposed the “mechanical materialism” of Enlightenment materialists such as Thomas Hobbes, Baron d’Holbach, and Jules la Mettrie. This suggestion gets some support from the fact that recent postphenomenological philosophers of technology like Don Ihde and Peter-Paul Verbeek (Chapters 46 and 47) often explain their “empirical turn” away from the older speculative and dystopian views of Mumford, Ellul, and Heidegger as amounting to a new emphasis on “materiality” – by which they mean that postphenomenology attends primarily to giving careful accounts of “concrete” personal, interpersonal, and social relations with actual technologies (in the plural).

Sismondo concludes with brief summaries of four problem areas for ANT. First, there is the high price it seems required to pay for generalizing the principle of symmetry. Critics argue that ANT’s treatment of cultures and cultural networks seems especially weak. For example, such phenomena as the “style” of activities in a particular workplace, or the role of trust in a complex practice, seem distinctively “human” all the way down. Indeed, even “strictly rational” choices are actually made and play out in culturally distinctive ways. Unfortunately, says Sismondo, “the world of ANT is culturally flat.” Second, there is ANT’s notorious difficulty with the notion of agency, in apparently both overemphasizing the roles of choice and explicit planning in the functioning of social wholes, and failing to do full justice to the phenomenon of “acting” itself when the actants involved are human. Like the behaviorists’ accounts before them, ANT’s descriptions of what people are and do – developed without making any reference to “subjective” unobservables like intentionality – simply fail to be convincing (and have, moreover, disturbing political lacunae concerning moral responsibility). Third, however epistemologically appealing it may initially seem to sidestep centuries of obscure and probably insoluble problems such as whether there is “really” a world out there, it is difficult to ignore the virtually universal sense among (to name just the two most obvious groups) scientists and engineers

that some of their claims actually, in a strong sense, get things right. Besides, Latour's own insistence on the existence of nonhuman entities seems to commit him to some sort of realism in spite of himself. Hence, Sismondo identifies other thinkers with strong constructivist leanings (e.g., Pickering) who have faced this question more directly, and he rubs Latour's nose in the problem by quoting his disconcertingly offhand admission that "A little bit of constructivism takes you far away from realism; a complete constructivism brings you back to it." Finally, Sismondo identifies a cluster of issues regarding

the "stability" of networks that still await satisfactory treatment by ANT. The problem seems particularly acute in the case of larger wholes like societies, and complex practices like an interdisciplinary scientific research project, where following well-established or even formalized rules seems necessary to the very existence of a relatively stable "network." There appears to be no room in ANT for something like Wittgenstein's account of how "following a rule" is an interpretive process, and Latour's notions of tinkering, observing, and manipulating seem essentially inadequate to the task.

Conflicting Visions of Technology

Mary Tiles and Hans Oberdiek

Throughout this century, and certainly since World War II, technological developments have solved or alleviated problems that long plagued humankind. We rejoice that scientific and technological advances have either eradicated or brought under control many childhood diseases and gratefully take advantage of vastly increased opportunities for speedy travel and long distance communication. Yet it often seems that technology creates more problems, and more intractable problems, than it solves. This is true even in medicine, where dramatic and obviously beneficial advances have been made. Both at the beginning and at the end of life physicians now have the power to keep alive indefinitely people who would have mercifully perished quickly were nature simply allowed to take its course. Even programmes of immunization against childhood diseases such as measles and chicken pox have contributed to overpopulation and hunger in developing nations. Attempts to increase crop yields to avoid starvation have required the introduction of costly fertilizers and pesticides which, in turn, have caused chemical pollution and medical disorders. Population increases and the introduction of intensive farming, or the famine resulting from an inability to increase agricultural production, have brought about traumatic changes in age-old patterns of life. It can seem that the technological 'solution' to one problem leads just to the creation of many, unanticipated new problems.

Out of these ambivalent feelings towards technology have grown two conflicting visions, one optimistic the

other pessimistic, one of technical omnipotence the other of technical impotence, one of control of the environment and human destiny through technology the other of technological systems running out of control. The optimists see technology as fulfilling the biblical injunction to 'fill the earth and subdue it, and have dominion over the fish of the sea and over the birds of the air and over every living thing' (Genesis 1:28). Although dominion can be construed either as stewardship or as domination, the aim inherited from seventeenth century movements that inaugurated 'modern science' has been that of domination. Thus Bacon (1561–1626), regarded by many as the father of modern science and technology, talks of subduing and dominating nature. Bacon was confident that by deploying our intellectual powers it would be possible to gain knowledge of nature's secrets and so acquire the ability to bend the course of nature to our will. He had faith that humans would co-operate to acquire this knowledge and that they would deploy it to improve the lot of humankind. His vision of a scientifically developed and organized society, presented in *New Atlantis* (Bacon, 1627), reflects his optimistic view of human beings, their moral as well as intellectual perfectibility. On this optimistic view, we are firmly in control of the technologies we produce. Technology provides us with instruments which can be used and further developed by us, or not, depending on our purposes. As such, any technology is value neutral: we impose our values in deciding which technology to use and how. Our success

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in controlling certain aspects of nature and in harnessing its secret powers (atomic energy) has exceeded Bacon's wildest dreams. Isn't it therefore reasonable to suppose that the methods which have served us well thus far will enable us to continue to overcome obstacles, to solve problems and to expand our control over nature indefinitely?

On the other hand there are those who have become deeply pessimistic as a result of observing the path of so-called technological 'progress'. As they see it, we are strangely impotent in the face of, indeed are enslaved by, a pervasive technology that, ironically, we ourselves have made. Not only is the goal of dominating nature a mere dream, but our ability to control the effects and course of development of the technology we have unleashed is also illusory; mute structures and blind forces are causally far more potent than human will and intelligence. At best, and if we are lucky, we can give technology a little nudge in this or that direction, perhaps slightly retarding its inexorable course. Technological development may have been initiated by humans, but it has become autonomous, has gone beyond the point where, individually or collectively, we can exercise control over it.

Each of these visions overdramatizes. Each is just a caricature of what any one person actually believes. Curiously most of us find ourselves captivated by first one and then the other, depending on the technology, or features of a technology, under consideration. Word processors are likely to be thought a boon by writers and students. They can now control and manipulate a text with greater ease and speed than ever before. Computers generally provide those who use them with enormous power to manipulate data. But this very power can pose a threat to those on whom data is collected, stored and transmitted. Those who have had their credit privileges removed because of a computer error often find it nearly impossible to have their credit rating restored. Computer booking for air travel, computer holding of medical records, academic records, police files all make it possible for a governmental agency to amass a file on an individual without that individual being aware of the information being collected or having the opportunity to scrutinize or correct it. Each of us is thus likely to have occasion to feel the attraction of both visions of technology, and this suggests that much can be said for each. This seems to offer the depressing prospect of interminable, inconclusive debate between optimists and pessimists. After outlining the positions and showing what can be said for and against them, however, we will suggest that the battle lines should not be drawn here. The tendency to see technology issues in one or

other of these lights is itself a reflection of deeper, culturally more pervasive assumptions which are shared by optimists and pessimists. By making these presumptions explicit it will be possible to shift the terms of debate away from simply having to adopt pro- or anti-technology positions. We can move instead towards providing a framework for thinking through what is at stake in any given controversial technological decision.

Optimism

Optimists hold that technology and its products are value neutral; technologies are passive tools which can be used for good or evil. If technology is sometimes used improperly and causes harm, the fault lies with its human operators and developers, not with the technology. As the proverb goes, 'It is a poor carpenter who blames his tools.' It has thus been labelled an instrumentalist view of technology (Feenburg, 1991). This optimistic vision is a familiar part of capitalist technological cultures and is dominant within them. It finds expression in the advertising designed to sell us the latest 'state of the art' dishwasher, computer, insecticide or toothpaste. For example, in an advert for Sinclair computers we find:

information technology has a long and benign history. The computer, the telephone, the telegraph, the printing press, the invention of writing itself – all of them led to increased prosperity and universal improvements in the standard of living. . . . The more information we have, and the more sophisticated the use we make of it, the more exciting and effective our decisions and actions become. (Sinclair, 1983)

The same optimistic vision was used by President Reagan to sell his Strategic Defense Initiative, or Star Wars, programme – the vision that the problem of providing an impenetrable defence against incoming nuclear missiles can be solved, providing sufficient human resources and money are devoted to it. This was coupled with the message that this would be a benign technology because it was developed purely for defensive purposes. So far from seeing human beings as helpless in the face of inexorable technological progress, optimists tend to see technology as a route to virtually unlimited power over nature as human capabilities are dramatically extended. Optimists, for instance, see the micro-chip as representing a quantum leap in the technology of humankind:

the microcomputer is rapidly assuming huge burdens of drudgery from the human brain and thereby expanding the mind's capacity in ways that man has only begun to grasp. With the chip, amazing feats of memory and execution become possible in everything from automobile engines to universities and hospitals, from farms to banks and corporate offices, from outer space to baby's nursery. (*Time*, 20 February 1978, p. 38)

and:

By massive physical changes deliberately induced [through technology], we can literally pry new alternatives out of nature. . . . We have the power to create new possibilities, and the will to do so. By creating new possibilities, we give ourselves more choices. With more choices, we have more opportunities. With more opportunities, we can have more freedom, and with more freedom we can be more human. (Mesthene, 1983, pp. 110–11)

This vision is persuasive because it has a foundation in our experience of technological development. Our society has changed dramatically since the nineteenth century and even since World War II. Electronic technologies based on the transistor and the micro-chip have brought within the reach of the average person both aspects of culture (music, film, information of all kinds) and complex, easy to operate, tools (computers, calculators, microwave ovens) which were once accessible only to the wealthy. New drugs, vaccines and surgical procedures mean that many medical conditions which were once life threatening or fatal can now be treated or prevented from occurring. Agricultural productivity has increased beyond what was conceivable at the beginning of the century, and consequently the level of nutrition of most in developed countries has been markedly improved. And so one could go on.

We recognize that it is the carpenter's lack of skill which leads him or her to make a rickety chair; and that were he or she to attack someone with his or her hammer, we would blame the carpenter, not the hammer. Although modern technologies are far removed from the simple tools of a carpenter, the principle, we can be readily persuaded, is the same. Disasters involving advanced technologies – nuclear power plant accidents, plane crashes, and oil spills – result from faulty design or control, or from faulty operation, not from anything inherent in the technology itself. In cases such as the use of concealable explosive devices to destroy aircraft,

where advanced technology is used maliciously, the blame for the resulting loss of life lies with those placing the explosives, not with explosive or electronic technology.

Such reasoning lends plausibility to the picture of technology as simply providing us with tools which can be used to good or bad ends. Technology simply augments human abilities so creating new possibilities. Devoid of intrinsic value and lacking both will and intelligence, it plays an entirely passive role in the human exercise of power and control.

Optimists do recognize that technological development carries a price. It inevitably destroys as it creates. Pure running water in every villager's home undermines the communal life focused on the village well. They also recognize that since technology brings increased power over nature, it also carries the risk that this power may fall into the wrong hands, being used for destructive rather than constructive purposes.

Technology spells only possibility, and is in that respect neutral. Its massive power can lead to massive error so efficiently perpetrated as to be well-nigh irreversible. (Mesthene, 1983, p. 111)

But to emphasize this negative possibility shows a lack of resolve, and is to go against the spirit of the age, which is 'witnessing a widespread recovery of nerve' (Mesthene, 1983, p. 114). For the first time since the Greeks, Mesthene argues, we are convinced again that there is nothing in the universe that cannot, in principle, be known. 'The commitment to universal intelligibility entails moral responsibility', and this is hard work, but (if we do not lose our nerve) 'we have the means at hand to make the good life, right here and now' (Mesthene, 1983, p. 115).

By referring to the Ancient Greeks Mesthene points us to the source of the vision of human fulfilment which has been crucial in forming and sustaining the optimistic, instrumentalist view of technology. Already in Plato and Aristotle we find clearly expressed the idea that it is reason which marks humans off from animals. For humans fully to realize their human potential is thus for them to rise above their mere animal nature by cultivating and employing their rational capacities allowing these, rather than animal instincts and appetites, to direct their action. This means that only those who have the time (the leisure) to cultivate their rational faculties, freed from concern with the material necessities of biological life, can live truly fulfilled human lives. Practical work,

whether of the skilled worker or the agricultural labourer, is thus devalued. It is something humans need to be freed from if they are to become fulfilled. Moreover, it is activity whose function and direction should ideally be the product of knowledge, of understanding the nature of the goals to be achieved and the means to achieve them. The bridle maker (weapons manufacturer) needs to receive design specifications from those who will use it (military personnel) and these in turn are directed by generals (military strategists) who determine the role of cavalry (bombs and artillery). Generals in turn look to politicians for their military objectives. In a well-ordered state (Republic) the means–end hierarchy maps onto a social–political hierarchy, an authority structure, in which direction flows from those who are qualified, in virtue of their theoretical and practical wisdom, to deliberate about ends and the best means of achieving them, to the skilled workers and labourers who must bring them about. (See, for example, Plato's *Republic* 601c and Aristotle's *Nichomechean Ethics* 1094a10–15.)

For the Greeks, the freedom of some to lead fulfilled human lives was contingent upon the labour of others (slaves and females) providing for the material necessities of life (production and reproduction). Slaves are explicitly likened to tools (Aristotle's *Politics* Bk.I iv 1253b23) and one might thus say that slave labour and its management formed a 'technology'. It was even argued that slaves would be necessary unless or until technology was developed to take over the labour performed by slaves. Here the instrumental vision both of labour and of technology could not be more clear.

Marx and Engels made only a minor modification in this vision when they dreamed of overcoming the need for the division of labour, the division between those who deliberate about ends and those who carry them out and by their labour provide for the necessities of life. They dreamed that the development of industrial technology could be used to overcome this division. Technology, provided it belongs to and is managed by the whole community for the communal good, was envisioned as replacing slaves, freeing everyone from the necessity of labour and so making available to all the possibility of a fulfilled human life (Marx and Engels, 1970, p. 61). (This dream was already outlined, in somewhat different technological terms, by Bacon when writing his *New Atlantis*.) In other words, both the programme of modern science and Marxist revolutionary politics were founded on an instrumental view of technology and on a vision of science as that which delivers the rational tools for

controlling nature, freeing humans from enslavement to it. It is an instrumental vision founded on a separation of the distinctively human from the natural and hence on the conception that humans can only realize their full potential when freed from the practical demands of the work and labour necessary to ensure their biological well-being.

The fact that this view of technology has transcended the political divide of the Cold War years has lent credibility to the view that technology is value neutral – it seems to be neutral between the very different value frameworks of democratic individualism with free-market capitalism and totalitarianism with state capitalism. On this view, the way to advance technology is to advance science. Technology is applied science. That is, the application, via rational problem solving techniques, of rationally acquired understanding to material situations to achieve freely chosen ends. The assumed independence of both science and material problem situations from social determination gives a double-edged objectivity to technology. It is a product of rationally acquired, universal knowledge of the laws of nature, laws which hold no matter where one is in the universe. This knowledge is applied to material situations and could be similarly applied, with similar results, to such situations wherever they arise. Success or failure is evident: the goal is achieved or it isn't. Technological progress consists in making more possibilities available (being able to do more things) so that more desired ends can be achieved and can be achieved more efficiently.

This scheme is implicit in Western philosophical tradition and is reinforced by its recurrent returns to classical Greek texts, those of Plato and Aristotle in particular. It also underlies the decision making practices of many contemporary national and international institutions. Stamp (1989) illustrates this in the case of development agencies. A vision of development is founded on the belief that lack of development is a result merely of lack of financial resources to get available technology. This is to assume that a machine or process which works in one place will work when transferred to another. Development aid then takes the form of financing for technology transfer. Stamp also illustrates the fallacies of this approach. Most poignantly these are demonstrated in the failures of development policies and their consequent human suffering and social disruption.

It is precisely in the problems of technology transfer that the limitations of viewing technology in purely instrumental terms have become most evident. Technologies, by their very specification, are introduced not

into purely material contexts but into social contexts. They are to be used by human beings, to perform tasks previously done in other ways by other means, possibly by other people, or to do wholly new things. Their introduction is bound to have social effects.

Optimists such as Mesthene would not deny that this is the case, but would argue that the problems that have arisen with transfer are the result of human, moral failings resulting in irresponsible use of technology. Mesthene's appeal to moral responsibility is both an injunction to those who use technologies and an indication of what becomes a key concern for those optimistically pursuing new technologies. The concern is that the technology does not fall into the wrong (morally irresponsible or reprehensible) hands. Control over the development of technology demands control over its dissemination and this can be assured only if control is exercised over (other) people. This was clearly seen by those involved in the decision to develop peaceful uses for nuclear power. Weinberg, curator of the Oak Ridge National Laboratory from 1955 to 1973, suggested that a 'technological priesthood' would be necessary to ensure that nuclear power was managed properly and in perpetuity (Weinberg, 1972, p. 34). Observing that the development of nuclear weapons had already created a military priesthood whose function was to guard against the inadvertent use of nuclear weapons and to prevent them or the expertise and materials for building them from falling into the wrong hands, Weinberg realized that the development of peaceful uses for nuclear energy was going to require the creation of a similar group of trusted people as both possessors and guardians of nuclear expertise.

Thus the vision of domination of nature through technology contains within it the seeds of social paranoia:

Once we have multiplied the power of our body by a machine, then we have lost the self-regulating features of nature. We want that power for our self, but we do not want it to be used on our self. Thus, as we use it we tend to distance ourselves from it. The machine is turned against the Other, whether this be the soil, a bird, a bacterium, or other people. In the process we become grandiose and abstracted from the concrete immediate flow of life. (Kovel, 1983, p. 121)

In this way thinking that one can control technology, and so seeing it as conferring power, leads naturally to thinking also that one can, and must, control other people, namely those who do not share one's goals and values, and who might therefore put technology to uses other than those intended or even turn it against oneself.

If this mind-set is accompanied by the tendency to see every problem of control as a technological problem, one to which a technological solution can be found, then it can lead to the development of technologies not designed to 'better the lot of all humankind', but to control and manage one part of humankind in the interests of another part. In *Brave New Workplace* Howard examines the extent to which computer technology has been perceived and used to increase managerial control over a workforce (Howard, 1985). The performance of a telephone operator, or any other person working at a computer terminal, can easily be continuously monitored for speed, efficiency, errors made, etc. Computers and the numerical control of production line machinery allow for the deskilling of many jobs, making it possible both to pay workers less and to give them even less input into the control of the production process. However, it must be remembered that there is no necessary connection between an optimistic attitude towards the technological domination of nature and the adoption of a technological approach to the management and control of people. Computers can be introduced into the workplace so that workers are empowered, acquiring new skills and having more control over their work. They can allow a person to work from home while keeping an eye on small children and make flexible hours more possible. What we have seen is that the development of ever more powerful technologies does entail great risks that this technology may be put to destructive use. Therefore those justifying its development on the grounds of the benefits it will bring have to envision a scenario in which there are some measures of control over access to the expertise and materials necessary to develop and deploy it. There is an incompatibility between the pursuing power through technology and the ideal of a completely free and open society.

Pessimism

It is for this reason that pessimistic critics of technology talk about technological systems and technical practices (techniques) rather than about devices. They see these systems as embodying values beyond those which are evident in selection of the ends intended to be achieved by technological means. The instrumental criterion 'efficiency' masks the presence of those values. If efficiency is a measure of the ratio of costs to benefits, how costs and benefits are counted becomes crucial; costs to whom, benefits to whom and of what type? The purely

instrumental approach of the optimist, because founded in a bifurcated vision of the world into natural and individual human, tends to overlook the social costs of implementing a technology by not according any reality to the social or the socially constructed. Pessimists, on the other hand, tend to treat technological systems as part of the reality within which people live and work; indeed technological systems constitute this environment by functioning to create and sustain it.

The best and most widely known proponent of a pessimistic view of technology is Ellul. He somberly argues that 'technique' autonomously and irresistibly enslaves everything: art, family life, economics, science and even leisure. Technologies, being ways of doing and making, undeniably shape our moral, social and political lives to a degree unthinkable in earlier periods. The pervasiveness of their impact does tempt us to think of technologies not only as self-governing but also as governing and controlling our lives. Workers in a computerized office must work to the demands of the computer and have tasks shaped and conditioned by the particular communications and reproduction technology surrounding them. In such situations, where the experience is of being dominated by technology, of impotence in the face of an inhuman force, it is easy to feel that technology is beyond our control. It is this kind of manifestation of a technological, managerial mind-set, one which has the maximization of efficiency as its *raison d'être*, rather than a technological system, in and of itself, which would seem to be the real target of Ellul's criticisms, and indeed best fits his definition of technique'. As he defines the term, technique consists in 'the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity' (Ellul, 1964, p. xxv). For him 'the new technical milieu' is distinguished by six salient characteristics:

- (a) It is artificial; (b) It is autonomous with respect to values, ideas, and the state; (c) It is self-determining in a closed circle. Like nature, it is a closed organization which permits it to be self-determinative independently of all human intervention; (d) It grows according to a process which is causal but not directed to ends; (e) It is formed by an accumulation of means which have established primacy over ends; (f) All its parts are mutually implicated to such a degree that it is impossible to separate them or to settle any technical problems in isolation. (Ellul, 1983, p. 86)

If technology is truly self-governing, then it is clearly out of *our* control and therefore easily thought to be

simply 'out of control'. Frankenstein movies express in fiction what has taken place in fact: our inventions have become our masters (Winner, 1977, contains an excellent discussion of this). Ellul's vision, like Mesthene's, captures and brings to the fore ways of thinking about ourselves and our relation to the world which are very deeply rooted in Western culture. For this very reason his pessimistic view of our relation to the technology that moulds our culture seems persuasive. But let us take a closer look at his six salient characteristics.

(a) Undoubtedly technologies and the environments they create are human artefacts and so in that sense they are indisputably artificial. Moreover, as advertisers of everything from popcorn and shampoo to clothing and footwear know and encourage us to continue to believe, 'natural is good, artificial is bad'. In other words, the terms 'natural' and 'artificial' are heavily value-laden terms. Yet 'all natural' shampoo is as much an artefact as a motor car. The ingredients may all be derived from naturally occurring substances, but one could argue that ultimately the materials in a car (steel, rubber, plastic) themselves derive from naturally occurring materials. Once we start to think about it, it is not easy to see how to draw the line between natural and artificial. It may be easy enough to distinguish between imitation pearls and real ones, but how much more difficult to classify domesticated animals (Siamese cats, Jersey cows, Swaledale sheep) or fl-hybrid tomatoes. Advertisers play both on the attitudes which Ellul expresses and on the near impossibility of drawing any firm distinction between natural and artificial. All civilizations surround themselves with artefacts and shape their environment by building houses and cities, engaging in agriculture and so on. In what sense, then, can it be said that the technical milieu is artificial, whereas that of pre-technical cultures was not? [...] For now it is sufficient to note that to employ 'artificial' as a way of expressing alienation from our dislike of technology, though rhetorically effective in contemporary culture, is a move which needs further justification.

(b) and (c) These two characteristics go together. (c) is in effect an elaboration of what is entailed by (b). To say that a person or a system is autonomous is to say that it has the power of self-determination. (c) makes the stronger claim that the technical milieu is actually wholly self-determining; it forms a closed system, one immune from outside interference. Implicitly Ellul sees our world as compartmentalized into at least three independent segments – nature, technology, human affairs. When he

compares the technical milieu to nature he presupposes that nature forms a closed system, one with which humans cannot interfere and whose course cannot be altered by human action. We are thus pictured as caught up in two orders of reality and as powerless in the face of both of them. Instead of mastering nature through technology, humans have created another, equally ungovernable, non-natural world.

Again, this vision has a partial grounding in our experience of the world of technology. Technologies present us with realities which place demands on us independently of what we either individually or even collectively might wish for or think desirable. Use of the automobile and of electricity derived from oil requires the global transportation of millions of gallons of oil. Inevitably there are spillages, destruction of the marine environment and spoiled beaches. In a culture built around the automobile and presupposing its widespread ownership and use, individuals who want to exclude reliance on that technology from their lives will find living almost as much of a challenge as those who try to cultivate naturally dry, but fertile, land and who must constantly irrigate their crops. The hydraulic civilization of ancient Sri Lanka relied on an elaborately organized irrigation technology. This irrigation system required centralized oversight and maintenance for its operation and was thus possible only with the perpetuation of a centralized form of government. We must acknowledge both that no individual can control or direct the development of a way of life extensively shaped by and dependent upon specific technologies and that the existence of such technological systems constrains governmental action. Neither admission, however, establishes that the technical milieu is either autonomous or forms a closed system. It would be difficult to maintain that any technological system is causally closed. Nature is quite capable of unleashing forces which destroy systems made by humans in minutes (think, for example, of the devastating effects of earthquakes, volcanic eruptions, floods, hurricanes, tornadoes). Our technological systems stand in intricate causal relations to natural systems. This we are learning to our cost from the complex debates about global warming, acid rain and the fragile ozone layer. Such issues might indeed provide a test case for Ellul's vision. Is it the case that a growing human concern to reverse adverse effects on the global environment will necessarily be ineffective because the technical milieu is such that it is autonomous, unresponsive to human values and goals? Are technical systems any less responsive

to control than human political systems? Neither individual human beings nor their national governments can control the fate of a nation, yet we would be reluctant to conclude that the actions, goals and ideals of individuals and governments have no impact. Is Ellul perhaps moving too swiftly from lack of total control to total lack of control?

(d), (e) and (f) Here again the appeal of Ellul's vision rests on recognizable features of the way in which technologies have developed. Technologies grow like topsy, with neither rhyme nor reason, with little regard for individual human intentions and purposes. 'The Pill', for instance, was originally developed for a variety of purposes, including that of helping married women increase their chances of conceiving by regulating the menstrual cycle. Its role in ushering in a sexual revolution was neither intended nor anticipated. It is not that technological devices are invented without purpose, but that once created they are picked up by other people who see in them uses and avenues of development other than those for which they were originally designed. We use screwdrivers for opening paint cans, washing up liquid for killing white fly, computers for playing video games.

From the point of view of any one person, it then appears that a technological device, once created, assumes a life of its own, its development and deployment governed by principles that no single individual or group of individuals can control. This is what Ellul means when he stresses that the bits and pieces making up any technology ('the accumulated means') establish primacy over ends. But is this development process wholly internal to and dictated by the technology itself, as Ellul appears to suggest, when he says that means establish primacy over ends? Development directed to a multiplicity of different people's ends may lead to results no one of them desired or foresaw. This is especially true when the use of technologies is so pervasive that they form complex, interdependent networks. The various parts of modern technological culture are so interwoven that no technical problem can be solved in total isolation.

Modern technologies, in short, behave like ecosystems. When we intervene here, unexpected consequences pop up there. We are familiar with the difficulties governments have in trying to regulate their economies. A similar story could be told of attempts to make safe nuclear power plants, develop environmentally benign pesticides, design aircraft or space shuttles: no technical problem can be solved in isolation, so the solution to one problem creates others elsewhere. In this respect existing

technical interconnections do limit the scope for realizing human ends, but it does not follow from this that the network of technological systems is immune to human intervention and develops only according to its own internal laws. Some problems can be solved in relative independence, for though everything may be ultimately interrelated, it is still possible to distinguish and use specific parts for specific purposes as if they were separable. This may get us into trouble as unnoticed interconnections cause unforeseen problems, but this is a more apt description of the human condition than that requiring us to solve all problems at once before being able to solve any. We have not yet stopped trying to communicate using words even though, in the end, the meaning of any word in a language depends on its interconnections with every other word and every use of language has the potential for altering those interconnections in unforeseeable ways. Not to look up a word in a dictionary to determine its (partial) meaning on the grounds that one knows that ultimately all words are interrelated and none can be defined in isolation would be a recipe for illiteracy, not realistic prudence.

Ellul presents a persuasive case for the autonomy of technology and the pessimistic mood it engenders. In stressing the autonomous nature of technology, however, those who follow Ellul come perilously close to espousing a kind of determinism, if not fatalism: once having released the genie – or atom – from the bottle, once having created the technological monster, the forces unleashed must inexorably play themselves out. We have no more choice in how to respond to them than had Canute in the face of a rising tide. We delude ourselves if we think we can harness the tremendous power of technology, bending it to our will: at best we are only along for the ride. Those who regard technology as beyond control, sometimes yearn for earlier, less technological times, when attunement, rather than domination, best described the way we regard our environment. Ellul, however, would regard such longing as delusive wishful thinking.

Although proponents of Ellul's view provide deep insights into the ways technology penetrates and pervades our lives, the claim that technology is autonomous and therefore out of control cannot be sustained. We have granted that technologies and the environments they create are artificial, that technologies present us with realities no individual or institution can fully control, and that technologies grow and develop in ways which may be wholly unintended and unforeseen by

their originators. But after making these concessions we can still dispute the claim that the technical milieu is 'self-determining in a closed circle', independent of all human intervention.

Indeed, the claim (d) that the technical milieu grows according to a process which is causal but not directed to ends would seem to be in direct conflict with Ellul's own definition of the term 'technique' as 'the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity'. 'Efficiency' is a term employed in the assessment of the means used to achieve a given end: it requires a weighing of costs against benefits. As Borgmann incisively notes, efficiency 'is a systematically incomplete concept . . . [for] we need antecedently fixed goals on behalf of which values are minimized or maximized', Borgmann, 1984, p. 9). If technological systems are closed and causal, they cannot also have goals and therefore cannot be said to fulfil them either efficiently or inefficiently. To take a non-technical example, as a paperweight, a rock might work efficiently because it does exactly what one wants with a minimum of fuss; used as a doorstop, however, we might judge it inefficient because it is not heavy enough. Similarly television cannot be beaten for bringing us instant news and the advantages of instant potatoes. That we need either may be disputed, but undoubtedly television efficiently brings us both, as intended by large corporate enterprises. If our only concern is with getting the most out of fossil fuels we will define an efficient power plant to be one which converts a high proportion of the heat energy released by burning a fossil fuel into electrical energy – it produces a maximal amount of electricity per ton of fuel. However, if our aim is to produce electricity from fossil fuels in an environmentally safe way, then a plant giving high energy conversion but at the cost of serious atmospheric pollution might be rated less efficient than one whose energy conversion rate was lower but which caused less pollution.

Unless one endows technology with its own goals and the intelligence to work towards them, its ability to achieve autonomy and power through efficiency remains totally mysterious. In other words, the view that technology is autonomous because it is ruled by the standard of achieving maximal efficiency anthropomorphizes technology, usually by demonizing it. Our attitude to computers illustrates the way in which our attitudes easily oscillate here. When using a personal computer with a

familiar and not terribly sophisticated program one will regard it as just another machine, no more endowed with a will of its own than a mechanical typewriter. But confronted with a large machine running sophisticated software we regard it as an authority: inhuman only in the perfection of its rationality, the ruthlessness of its logic, it assumes the proportions of a superior being.

In this way technology can come to assume a life of its own, apparently undirected yet operating with a ruthless, rational efficiency, sweeping away impediments in its path. Even the creators of technology seem helpless in the face of its inhuman, non-human, or demonic urges. Here again popular culture provides innumerable examples of technological marvels acting as if possessed with minds of their own, from lovable R2D2 to ominous HAL (a.k.a. IBM?).

Pessimists and Optimists

As we have suggested, the experience of those who live in a so-called technological culture can be called on to persuade us of both optimistic and pessimistic views of technology. Most people will oscillate between these attitudes depending on the particular form of technology that they happen to be thinking about and on their relation to it. A home mechanic who repairs and introduces adjustments and improvements to his or her car, or a personal computer enthusiast who understands its software, adapting it to his or her own use, will have decidedly optimistic attitudes towards these technologies, being eager to know about new products coming onto the market, wanting to have, or at least have an opinion on, the latest developments. These same people might, however, be deeply pessimistic about nuclear or medical technology. We are often powerless to resist the trends of development in specific technologies, in part because of the economic and political powers these represent. Technology itself may not be autonomous and out of control, but industries which have accumulated political and economic power through the development, marketing and use of technology are out of the control of individuals and their governments. This does indeed present us with a real problem. Yet in many respects it is an old problem, and perhaps we can derive some comfort from that. It is the problem of the many under the domination of a few.

Both optimism and pessimism, though initially tempting, provide us with distorting visions. Although clearly

the optimistic picture is too optimistic and needs to be critically scrutinized, the swing to a wholesale pessimistic rejection of technology is neither feasible for most of us, nor, in the light of the above considerations, would it seem to be justified. Do we have only these two options? We shall suggest that this is not the case; that our tendency to oscillate between these two extremes indicates that neither adequately reflects the character of our relation to technologies and technological systems; and that both are founded in suppositions which are deeply embedded in our way of thinking about ourselves in relation to the rest of the world. What we thus need to explore is the possibility of finding a middle ground, a conceptual base that does not, in advance, commit us to either a global pro- or anti-technology stance. One way in which such apparently exclusive choices can be finessed is to look for the framing assumptions, underlying both, which limit our options. These need to be made explicit if we are to begin to make sense of the technological culture in which we live and of our relation to it rather than oscillating between contradictory feelings of impotence and omnipotence. Our aim should not be to take up a certain stance towards technology, but to see various technologies for what they are, in their varied contexts and without the mystifications of supposing them to be either fully under our control or wholly out of control.

The pessimistic/optimistic, impotence/omnipotence visions of technology are founded on a pair of closely interconnected dichotomies: values versus facts and humans versus nature. These oppositions shape the way one sees the problems posed by technology. Technology itself must be located either in the realm of values or in the realm of facts, either as an extension of human beings or as an extension of nature. Both optimists and pessimists assign technology the same location; it lies within the realm of the factual as an extension of nature. Both think that knowledge of nature is the factual knowledge delivered by the natural sciences. Such knowledge is objective, gained by rational methods employed in the disinterested pursuit of truth. Technology, they believe, is the product of the rational application of that knowledge. Its development is a rational result of advances made in science. The development of technology is then perceived as also a rational, objective process – it acquires the characteristics attributed to the scientific knowledge seen to generate it. The divergence between the two visions rests on whether

it is thought that humans gain their autonomy by exercise of reason in the service of a free will so that they can come to dominate nature by directing technological development to serve human ends. Or whether it is thought that science and technology, governed solely by the standards of rationality and objectivity, fail to embody any distinctively human ideals and to this extent form an extension of the domain of reality determined by laws which place it beyond human control. For the latter, to be dominated by the standard of rationality is to lose one's autonomy and to be caught up in an inhuman, deterministic framework. To this extent the opposition is a replaying, in a new context, of the opposition between free will and determinism. If humans are part of nature, they must be bound and determined by its laws and therefore cannot be free. If, on the other hand, they are free because not a part of nature, then how can they act in the natural world and so demonstrate their freedom?

This way of viewing the relation between humans and nature is problematic because it makes the issue of freedom an all or nothing affair. Either humans are a part of nature, or they are not; therefore either they must be wholly determined by natural laws or they must be wholly free. There is no space for a middle ground. Similarly it seems either we must be totally in control of technology or technology must be wholly out of our control.

These distinctions, between fact and value and between humans and nature, are integral to the instrumental conception of technology which is quite explicitly endorsed by optimists. Instruments, belonging to the factual realm, are value neutral; they are the mere means to ends which are set in the light of values held by human beings. Technology as a whole is envisioned as instrumental in enabling humans to free themselves from the necessities of nature; so conceived its role depends on the assumption that what is essential to human fulfilment lies beyond the confines of nature. But pessimists with their emphasis on technology as inhuman and the claim that the dominance of technology is the dominance of means over ends, are also taking an instrumental view of technology. The difference between the visions is a difference of values, a difference grounded in differing visions of what constitutes human fulfilment. Pessimists are pessimistic

precisely because they do not accept that technology can be a vehicle for human progress since human fulfilment does not consist merely in the exercise of reason to secure material satisfaction, security and comfort. Instead they tend to emphasize artistic creativity, intellectual culture, development of interpersonal relations, or religion as being the realms in which human freedom finds expression and in which human fulfilment is to be found. The values inherent in these visions of human fulfilment are seen as over-ridden by the implementation of technical systems as ways of life needed to sustain them are destroyed. In this sense technology cannot be regarded as value neutral since its introduction elevates one set of values at the expense of others, not merely at the level of ideological preference but at the real level of making choices of alternative values unavailable. In this sense values are destroyed and technology, far from creating human possibilities, destroys them. Technological systems turn human beings into mere natural objects by leaving them no alternative to be anything else.

The enlightenment spirit which fostered the growth of natural science as a route to technological achievement placed its faith in reason as a route to freedom via a knowledge of the laws of nature. Knowledge of laws confers power over and lifts one out of the natural order, frees one from domination by natural forces, enabling the manipulation of these forces to human ends. The optimistic vision of technology rests on this same faith. The pessimistic vision echoes humanist themes critical of and sceptical about the possible achievements of science, critical of the conception of reason as that which makes us human. The image of Faustus selling his soul (his humanity) to gain the knowledge which yields power captures this – to be governed by pure reason is to cease to be human. The difficulty of resolving the conflict between these attitudes towards reason as the highest human power or as essentially inhuman emerges in our ambivalent attitudes to computers. They are valuable to us precisely because they lack certain human characteristics – they do not get angry, impatient, resentful . . . They are perfectly rational. But does that mean that they are superior beings to which we should defer, or are they just tools for our use? Are they artificial intelligences? There are no easy answers to these questions.

References

- Bacon, Francis, 1627. *New Atlantis*. London. Modern Edition *The Advancement of Learning and the New Atlantis*. Oxford: Oxford University Press, 1906.
- Borgmann, Albert, 1984. *Technology and the Character of Modern Life*. Chicago: University of Chicago Press.
- Ellul, Jacques, 1964. *The Technological Society*, trans. John Wilkinson. New York: Knopf.
- Ellul, Jacques, 1983 [1963], "The Technological Order," in *The Technological Order*, ed. Carl F. Stover. Detroit: Wayne State University Press. Reprinted in and quoted from Mitcham and Mackey, *Philosophy and Technology*, 1983.
- Feenberg, Andrew, 1991. *Critical Theory of Technology*. Oxford: Oxford University Press.
- Howard, Robert, 1985. *Brave New Workplace*. New York: Viking Press.
- Kovel, Joel, 1983. *Against the State of Nuclear Terror*. London: Free Association Books.
- Marx, Karl, and Engels, Friedrich, 1970. *The German Ideology*, ed. C. J. Arthur. London: Lawrence and Wishart.
- Mesthene, Emmanuel, 1983 [1967]. *Technology and Social Change*. Indianapolis: Bobb-Merrill. Selection reprinted in Mitcham and Mackey, *Philosophy and Technology*.
- Mitcham, Carl and Mackey, Robert, eds., 1983. *Philosophy and Technology: Readings in Philosophical Problems of Technology*. New York: Free Press., ed. 2001.
- Sinclair, Sir Clive, 1983. Advertisement in *Observer*, 22 May, quoted in Kevin Robins and Frank Webster, 1988, "Athens without Slaves ... or Slaves without Athens," in *Science as Culture* 3: 7–53.
- Stamp, Patricia, 1989. *Technology, Gender, and Power in Africa*. Ottawa: International Development Research Centre.
- Weinberg, Alvin M., 1972. "Social Institutions and Nuclear Energy," *Science* 177, July: 34.
- Winner, Langdon, 1977. *Autonomous Technology: Technics-out-of-control as a Theme in Political Thought*. Cambridge, MA: MIT Press.

The Mangle of Practice

Andrew Pickering

The natural sciences are commonly accepted as the source of the most reliable knowledge available to us, the font of objectivity. The origins of this putative objectivity have never been consensually identified, however, despite protracted philosophical attempts to clarify them, and indeed, these attempts have themselves been under continuous attack at least since the early 1960s (Hanson 1958, Kuhn 1970, Feyerabend 1975). In recent years, the challenge to objectivist philosophy of science has been put most sharply by sociologists of science, who have argued for the social relativity of scientific knowledge, claiming to discern its constitutive connection to particular communities of producers and users. My aim is to continue the attack, and to suggest that scientific knowledge is not just relative to some community but, worse, that it is truly historical in a sense that I seek to specify as this essay goes on. Then, having buried both objectivism and relativism, I will praise them. Within my historicist account of science it is possible to articulate displaced conceptions of both the relativity and the objectivity of scientific knowledge that are more readily defended than the traditional conceptions criticized below.

The everyday connotations of “objectivity” are straightforward. They reflect the conviction that some body of knowledge is not the product of the whims or artifices of individuals or groups. To affirm the objectivity of scientific knowledge is to affirm that it is not, for example, a projection of human fantasy. Instead, the

production of scientific knowledge is disciplined by its subject matter, the material world, and this is what gives it its objective quality, its otherness from us. I think that there is something right about this conception of objectivity, but that there is also something quite misleading about the ways in which it has been spelled out and contested in philosophical and sociological discourse. So let me now discuss two limiting articulations of objectivism and relativism in order to characterize a whole spectrum of possibilities that I want to reject.

Within the mainstream Anglo-American philosophical tradition, the objectivity of science is understood as the product of some special scientific rationality, usually conceived in terms of normative standards supposed to be operative in theory-choice (see, for example, Popper 1959, Lakatos 1978). Scientists are free to invent and entertain whatever outlandish theories they wish, but candidate theories must eventually be stringently tested against these standards. The standards thus limit the play of scientists’ imagination and make it possible to speak of the objectivity of whatever theories succeed in satisfying them. The standards, as it were, distance knowledge from its producers by tying their hands behind their backs in the evaluation of theory. Of course, philosophers of science have failed to agree on just what the appropriate standards are, and thus this route to the articulation of the objectivity of science remains problematic, but that is not a point I need to dwell upon. Instead, I turn to

Andrew Pickering, “The Mangle of Practice,” from *Rethinking Objectivity: Contemporary Interventions*, ed. Allan Megill (Durham, NC: Duke University Press, 1994), pp. 109–125.

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the position often taken as the inverse of objectivism: relativism. The relativist understanding of science has been best developed within the “sociology of scientific knowledge” tradition. Here the variability of scientific belief is emphasized, and is traced back to some distinctly social variable, often “social interest.” The claim, backed up by detailed historical studies, is that particular bodies of scientific knowledge are sustained and developed by particular communities of consumers and users in the light of their particular interests (Barnes 1974, 1982, 1994, Bloor 1976, Collins 1985, Shapin 1982). Relativists thus deny that science has the kind of objectivity that the philosophical tradition has sought to ascribe to it. Scientists are here revealed as genuine agents, by no means operating with their hands tied behind their backs. And scientific knowledge is consequently chained to particular communities: it is knowledge relative to them, with this relativity typically spelled out in terms of interests; it does not “float free” of its conditions of production and use as the objectivist hopes.

In the debate between objectivists and relativists so described, my sympathies are with the latter (for a sustained playing out of positions within this debate, see Hollis and Lukes 1982). But it is important to appreciate the sense in which objectivist and relativist appreciations of science are isomorphous with one another. In order to cash in their notion that scientific knowledge is either objective or socially relative, each assumes that to understand the extension of the technical culture of science one has to refer to some special, non-technical realm of regulatory or guiding principles – standards or interests – that endure through particular acts of knowledge production and evaluation. And this is true not only of the limiting positions that I have sketched out, but of an entire spectrum of more sophisticated versions, variants, and hybrids.¹ This is not surprising, of course. Traditional thought in philosophy and the social sciences on human action and cognition in general begins from just this assumption. Nevertheless, the historicist view that I advocate begins from a different point. I want to suggest that one can understand scientific knowledge production in detail *without any appeal* to special and enduring principles of scientific culture. Of course, to suggest that science can, and indeed does, function in the absence of these sounds like a recipe for complete subjectivism in science, for the total denial of any form of objectivity. But that is not my destination, as I shall explain, first briefly, then at greater length through discussion of an example.

The historicist account of scientific knowledge has emerged largely through detailed studies of scientific practice carried out in the last decade (Latour and Woolgar 1979, Latour 1987, Knorr-Cetina 1981, Lynch 1985, Pickering 1992). It goes like this. First, scientific practice is understood as a process of *modelling*, of the creative extension of existing cultural achievements. Second, modelling is an open-ended process: there are an indefinite number of ways in which a given achievement might be creatively extended (Barnes 1982). This is where the fear of subjectivism arises, and is repressed in their different ways by objectivists and relativists. Objectivists appeal to standards or whatever to cut down the space of possible cultural extension and impose conformity upon the scientific community, to account for “closure,” as I will say, in cultural extension. Relativists likewise appeal, say, to socially sustained interests.² But this is the step that the historicist account refuses to take, looking instead for some other account of closure, of how particular directions of cultural extension are singled out from the indefinite range of possibilities. From within traditional perspectives on science – and within philosophy and the social sciences in general – this is a puzzling move. Surely one has to appeal to some enduring regulatory principle to understand closure? There is, though, an alternative possibility.

Studies of scientific practice point to the conclusion that acts of modelling do not take place in isolation. Instead, practice aims at producing novel *associations* of cultural elements, creatively transformed. Here, with the concept of association, we arrive at the trickiest point of this essay. The problem is that, as far as I can make out, the concept is an irreducible one (Latour 1988, Part Two). I exemplify it below, but perhaps the best way to introduce it is via a machine metaphor. Association, let me say for now, is the condition that obtains between the parts of a complex machine or instrument *when it is working*, and this is where the irreducibility of the concept resides. I can, for instance, describe what association means as far as the components of a computer are concerned, or a car – its engine, transmission, brakes, etc., and their internal arrangements and integration with one another – or a telescope or a bubble chamber, but all of these explanations refer to the specifics of the artifact and I can think of no articulation of association that fits them all. Still, I hope that I have said enough to convey a preliminary idea of association, which will do until we reach the example.

It now remains to observe that the achievement of association in the creative extension of cultural elements

is problematic; that one should expect such extensions to *fail* to produce the desired associations, at least at the first pass and quite possibly indefinitely – the radio that I tried to build as a schoolboy never brought in the BBC Home Service. And this phenomenon, which seems to be constitutive of scientific practice, I want to label as the manifestation of *resistance*. Resistance is the emergence of obstacles on the path to some goal. And the response to resistance is the search for *accommodation*: the revision of open-ended modelling sequences, the exploration of new directions for cultural extension, with, as one possible upshot, closure, meaning the successful achievement of the desired association of transformed cultural elements – a machine that works or, as in the example below, a new instrument, a new interpretation of that instrument, and a fact, a new piece of knowledge. This dialectic of resistance and accommodation is *the mangle of practice* – my name for a genuinely emergent process that gives structure to the extension of scientific culture in the actual process of scientific research. And, to return to the theme of historicity, to speak of the mangle as genuinely emergent is at once to assert the historicity of its products. The particular resistances and accommodations that give content to *this* new instrument, fact or theory arise unpredictably in the real-time of scientific practice and cannot be explained by reference to any catalog of enduring regulatory principles. What emerges from the mangle has therefore a truly historical character, and this is what I mean by describing the appreciation of knowledge outlined here as a historicist one.

The mangle is, I think, the single most important discovery made in the study of scientific practice, and the consequences of its existence are dramatic and far reaching. It mangles just about everything in sight. I now want to present my historical example of the mangle in action, and then to discuss the displaced articulations of the relativity and objectivity of scientific knowledge that emerge from an enquiry into its workings.

[...]

Objectivity, Relativity and Historicity

The mangle of practice is, I believe, a fully general and constitutive feature of scientific research, and one that can account for closure in cultural extension and knowledge production without the invocation of any special regulatory or guiding attributes of culture. The question now is: where does this image of practice leave us on the

objectivist – relativist spectrum? The answer is surely nowhere, at least on the conceptions of objectivity and relativity that I laid out earlier. If objective knowledge is knowledge produced in adherence to enduring standards, then scientific knowledge is not objective on my account. Neither is it socially relative, if such relativity is articulated in terms of preexisting goals or interests. Instead, one has to acknowledge a constitutive role for contingency in the particular closures that emerge from the mangle; all of those cases of “it just happened” matter in understanding why the facts, instruments and interpretations generated took the precise form that they did. Which means that if one wants to speak of the relativity of scientific knowledge, one has to speak of its relativity to chance rather than to enduring features of “the social.” Better, it seems to me, to speak, as here, of the full blown historicity of science, in recognition of the genuinely historical character of the extension of scientific culture.

But historicism is not subjectivism, and it is important now to take the trip back through relativism to objectivism, displacing these positions as we go. First, note that in my historical example I stressed the situatedness of resistance and accommodation as well as their contingency. There is structure to practice, as well as chance. And this structure, which is caught up in the conception of modelling and in the *telos* of association, suffices to chain new knowledges back to the conditions of their production. [...] So the historicity of knowledge emerging from the mangle is a culturally situated historicity, and knowledge is, in this sense, relative to culture. But this relativity cannot be summed up in any enduring social principle like interest that specifies the link between present and future. The meshing of contingency and structure in the mangle points, then, to a kind of hyper-relativism.

If historicism is hyper-relativism, one might suppose that it is as far from an objectivist understanding as one can get. The odd thing is, though, that within this historicist appreciation it is easy enough to recapture an appreciation of the objectivity of science, albeit a displaced one that would not be acceptable to the traditional objectivist. To return to everyday usage, to speak of the objectivity of knowledge is to deny that knowledge is a “mere construction,” a projection of human fantasy onto the world, and to affirm that knowledge is somehow disciplined by the otherness with which it engages.³ A philosophical discourse of standards is one way to explicate this everyday denial and affirmation; my analysis of the mangle of practice is another and, I think, better way. [...] To put the point

most sharply, I can imagine no more stringent test, no tougher requirement, to place on knowledge claims affecting objectivity than that they should have passed through the mangle. To successfully negotiate an indefinite sequence of emergent resistances in the interplay of material, conceptual and social practices is a far more impressive and admirable achievement than simply to conform to a list of standards given in advance. It seems to me entirely reasonable, therefore, to see scientific knowledge as objective, though the articulation of the everyday conception of objectivity has to be displaced away from philosophical explications in terms of standards and of knowledge *per se*, and towards an understanding of the mangle and of knowledge as engaged in practice. And, of course, one has to remember that this displaced sense of objectivity points, at the same time, to a culturally situated historicity. The traditional oppositions between objectivity, relativity, and historicity are false ones, the distinctions mangled by the mangle.

One last point needs attention. One can imagine a world in which closure in cultural extension is structured solely by the mangle of practice. But, it might be said, that world is not ours. Our world is shot through, as it happens, with standards, interests, and whatever. And, by virtue of this fact, traditional discussions of objectivity and relativity retain their force. In closing, I want to sketch out a reply to this point. It is, I think, often useful broadly to characterize given cultures and communities in terms of such variables as standards and interests. Illuminating studies in, for example, the sociology of scientific knowledge point to just this conclusion (Shapin 1982 is a persuasive review of the literature). But I can think of several objections of increasing severity to treating this perspective as general and foundational. First, even in those instances where one can confidently identify standards or interests, the mangle is still in action. Even if, for example, some enduring interest can be said to run through some passage of scientific practice, I cannot see how one can get at the *specifics* of the knowledge produced without reference to the dialectic of resistance and accommodation. This dialectic, not the interest itself, determines how the interest plays itself out in practice.⁴

Further, it seems to me that often, though not always or necessarily, the mangle mangles variables like standards or interests. To see how this can go, consider Steven Shapin's (1988, 543–46) argument that perhaps the best way to think of “interest” in science studies is via a translation to “expertise”: scientists have an interest in maximizing the

perceived utility of whatever skills and competences they possess. On the one hand, there is something obviously right about this idea; on the other, expertise is the variable *par excellence* that gets mangled. [. . .] The mangle, then, confronts us with the fact that the traditional variables used to explain or adjudicate cultural extension themselves are subject to change in practice.⁵

Actually, analysis of the mangle of practice undermines traditional positions in the objectivity/relativity debate more profoundly than I have yet made clear. Those traditional positions are disciplinary ones, grounded in well-entrenched disciplinary concepts and fortified by impressive disciplinary boundaries. The objectivist position finds its home in philosophy of science, and articulates itself around a notion of individualized reason; the relativist camp is at home in the sociology of scientific knowledge, and begins from a conception of “the social” seen as a distinct realm having its own properties and characterization.⁶ But none of these disciplinary conceptualizations or boundaries is safe from the mangle. One way to see this is to note that even if one accepts Shapin's identification of expertise and interest then, still, one can see that the mangling of the pure social variable “interest” is accomplished in a process that is not itself purely social and that cannot be caught up in the concepts of a pure discipline of sociology. [. . .] [E]xperimental expertise [is] ground out in material practice – in building, tinkering with, and observing a material apparatus – in a domain, that is, where any discourse centered in a pure realm of “the social” is incompetent to speak.⁷

My conclusion is, therefore, that while it is from time to time useful to think of practice in terms of pure disciplinary variables like interest, it is important to recognize that these variables, whatever they are, are transformed in practice in a process that cannot be caught up in pure disciplinary concepts. In a fundamental sense there is, for example, no pure realm of “the social” in which to imagine a pure social-relativism. Nor is there a pure realm of reason in which to imagine a pure objectivity. Disciplinary purity – with its opposed understandings of objectivity, relativity, and whatever – can only be had by ignoring the mangle of practice.⁸ But practice is there, and the more we reflect on it, the more traditional disciplinary conceptualizations and boundaries are going to crumble. And the further this process goes, the clearer it will become that there is no contradiction in asserting the simultaneous objectivity, relativity, and historicity of scientific knowledge.

Notes

The arguments of this paper owe much to conversations with David Bloor in the summer of 1990. I thank Allan Megill for constructive comments.

- 1 Many contemporary discussions of objectivity and relativism are couched in a language of “constraint.” Often the attempt is to reach some kind of eclectic compromise, in which epistemological standards are said to constrain but not determine the play of interests. More interestingly, various authors have suggested that the technical culture of science itself, rather than any special realm of standards, constrains the play of interests. I am more sympathetic to this view, but, still, it relies upon a notion of some regulative aspect of culture that is already there – now the “rigidity” of culture – to articulate a softened appreciation of the objectivity of science. I argue against it in Pickering (forthcoming).
- 2 For example, Shapin (1979) discusses the controversy between the phrenologists and their opponents in early nineteenth-century Edinburgh, and traces back deep differences in anatomical representations of the brain to the differing social interests of the parties involved.
- 3 On the “mere construction” reading of the sociology of scientific knowledge, see Pickering (1990).
- 4 Here and below I focus more on “interests” than “standards” because I find that the former concept, though problematic, speaks more directly to the nature of scientific practice than the latter.
- 5 For a brief discussion of the mangling of standards, see the concluding section of Pickering and Stephanides (1992). The problem created for traditional explanatory schemas by the mangling of their favoured explanatory variables is clear.
- 6 On the centrality of a pure concept of “the social” to classical sociology of scientific knowledge, see Bloor (1992) and Collins and Yearley (1992).
- 7 In fact, the peculiarity of Shapin’s translation of interest to expertise is that it moves from a pure social variable to one that is, at most, impurely social.
- 8 I should stress that this suggestion is not a plea for the eclecticism of pure disciplinary approaches mentioned in note 1. Such tackings together of disciplinary accounts can no more encompass the mangle of practice than can disciplinary accounts taken in isolation.

References

- Barnes, B. (1974) *Scientific Knowledge and Sociological Theory* (London: Routledge and Kegan Paul).
- Barnes, B. (1982) *T.S. Kuhn and Social Science* (London: Macmillan).
- Barnes, B. (1994) “How Not to Do the Sociology of Knowledge.” in Allan Megill (ed.), *Rethinking Objectivity: Contemporary Inter-ventions* (Durham, NC: Duke University Press, 1994), 109–125.
- Bloor, D. (1976) *Knowledge and Social Imagery* (London: Routledge and Kegan Paul).
- Bloor, D. (1992) “Left and Right Wittgensteinians,” in 266–82 Pickering (1992).
- Collins, H. M. (1985) *Changing Order: Replication and Induction in Scientific Practice* (Beverly Hills: Sage Publications).
- Collins, H. M. and S. Yearley (1992) “Epistemological Chicken,” in 301–26 Pickering (1992).
- Feyerabend, P. K. (1975) *Against Method* (London: New Left Books).
- Hanson, N. R. (1958) *Patterns of Discovery: An Inquiry into the Conceptual Foundations of Knowledge* (Cambridge: Cambridge University Press).
- Hollis, M. and S. Lukes (eds.) (1982) *Rationality and Relativism* (Cambridge: MIT Press).
- Knorr-Cetina, K. (1981) *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science* (Oxford: Pergamon).
- Kuhn, T. S. (1970) *The Structure of Scientific Revolutions*, 2nd ed. enlarged (Chicago: University of Chicago Press; orig. 1962).
- Lakatos, I. (1978) *The Methodology of Scientific Research Programmes. Philosophical Papers Volume 1* (Cambridge, England: Cambridge University Press).
- Latour, B. (1987) *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge: Harvard University Press).
- Latour, B. (1988) *The Pasteurization of France* (Cambridge: Harvard University Press).
- Latour, B. and S. Woolgar (1979) *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills: Sage). 2nd ed. (Princeton, Princeton University Press, 1986).
- Lynch, M. (1985) *Art and Artifact in Laboratory Science: A Study of Shop Work and Shop Talk in a Research Laboratory* (London: Routledge and Kegan Paul).
- Pickering, A. (1990) “Knowledge, Practice and Mere Construction,” *Social Studies of Science* 20, 682–729.
- Pickering, A. (ed.) (1992) *Science as Practice and Culture* (Chicago and London: University of Chicago Press).
- Pickering, A. (1995) “Beyond Constraint: The Temporality of Practice and the Historicity of Knowledge,” in J. Z. Buchwald (ed.), *Scientific Practice: Theories and Stories of Doing Physics* (Chicago: University of Chicago Press).

- Pickering, A. and A. Stephanides (1992) "Constructing Quaternions: On the Analysis of Conceptual Practice," in Pickering (1992), 139–67.
- Popper, K. (1959) *The Logic of Scientific Discovery* (New York: Harper and Row).
- Shapin, S. (1979) "The Politics of Observation: Cerebral Anatomy and Social Interests in the Edinburgh Phrenology Disputes," in R. Wallis (ed.), *On the Margins of Science: The Social Construction of Rejected Knowledge*. Sociological Review Monograph 27 (University of Keele), 139–78.
- Shapin, S. (1982) "History of Science and Its Sociological Reconstructions," *History of Science* 20, 157–211.
- Shapin, S. (1988) "Following Scientwists Around," *Social Studies of Science* 18, 533–50.
- Smith, B. H. (1988) *Contingencies of Value* (Cambridge: Harvard University Press).

The Social Construction of Facts and Artifacts

Trevor J. Pinch and Wiebe E. Bijker

One of the most striking features of the growth of “science studies” in recent years has been the separation of science from technology. Sociological studies of new knowledge in science abound, as do studies of technological innovation, but thus far there has been little attempt to bring such bodies of work together.¹ It may well be the case that science and technology are essentially different and that different approaches to their study are warranted. However, until the attempt to treat them within the same analytical endeavor has been undertaken, we cannot be sure of this.

It is the contention of this chapter that the study of science and the study of technology should, and indeed can, benefit from each other. In particular we argue that the social constructivist view that is prevalent within the sociology of science and also emerging within the sociology of technology provides a useful starting point. We set out the constitutive questions that such a unified social constructivist approach must address analytically and empirically.

This chapter falls into three main sections. In the first part we outline various strands of argumentation and review bodies of literature that we consider to be relevant to our goals. We then discuss the two specific approaches from which our integrated viewpoint has developed: the “Empirical Programme of Relativism”

(Collins 1981c) and a social constructivist approach to the study of technology (Bijker et al. 1984). In the third part we bring these two approaches together and give some empirical examples. We conclude by summarizing our provisional findings and by indicating the directions in which we believe the program can most usefully be pursued.

Some Relevant Literature

In this section we draw attention to three bodies of literature in science and technology studies. The three areas discussed are the sociology of science, the science-technology relationship, and technology studies. We take each in turn.

Sociology of Science

It is not our intention to review in any depth developments in this field as a whole.² We are concerned here with only the recent emergence of the sociology of scientific *knowledge*.³ Studies in this area take the actual content of scientific ideas, theories, and experiments as the subject of analysis. This contrasts with earlier work in

Trevor Pinch and Wiebe Bijker, “The Social Construction of Facts and Artifacts,” from *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: Massachusetts Institute of Technology, 1987), pp. 17–22, 24–28, 46–50. © 1987 Massachusetts Institute of Technology, reproduced by permission of the MIT Press.

the sociology of science, which was concerned with science as an institution and the study of scientists' norms, career patterns, and reward structures.⁴ One major – if not *the* major – development in the field in the last decade has been the extension of the sociology of knowledge into the arena of the “hard sciences.” The need for such a “strong programme” has been outlined by Bloor: Its central tenets are that, in investigating the causes of beliefs, sociologists should be impartial to the truth or falsity of the beliefs, and that such beliefs should be explained symmetrically (Bloor 1973). In other words, differing explanations should not be sought for what is taken to be a scientific “truth” (for example, the existence of x-rays) and a scientific “falsehood” (for example, the existence of n-rays). Within such a program all knowledge and all knowledge claims are to be treated as being socially constructed; that is, explanations for the genesis, acceptance, and rejection of knowledge claims are sought in the domain of the social world rather than in the natural world.⁵

This approach has generated a vigorous program of empirical research, and it is now possible to understand the processes of the construction of scientific knowledge in a variety of locations and contexts. For instance, one group of researchers has concentrated their attention on the study of the laboratory bench.⁶ Another has chosen the scientific controversy as the location for their research and have thereby focused on the social construction of scientific knowledge among a wider community of scientists.⁷ As well as in hard sciences, such as physics and biology, the approach has been shown to be fruitful in the study of fringe science⁸ and in the study of public-science debates, such as lead pollution.⁹

Although there are the usual differences of opinion among researchers as to the best place to locate such research (for instance, the laboratory, the controversy, or the scientific paper) and although there are differences as to the most appropriate methodological strategy to pursue,¹⁰ there is widespread agreement that scientific knowledge can be, and indeed has been, shown to be thoroughly socially constituted. These approaches, which we refer to as “social constructivist,” mark an important new development in the sociology of science. The treatment of scientific knowledge as a social construction implies that there is nothing epistemologically special about the nature of scientific knowledge: It is merely one in a whole series of knowledge cultures (including, for instance, the knowledge systems pertaining to “primitive” tribes) (Barnes 1974; Collins

and Pinch 1982). Of course, the successes and failures of certain knowledge cultures still need to be explained, but this is to be seen as a sociological task, not an epistemological one.

The sociology of scientific knowledge promises much for other areas of “science studies.” For example, it has been argued that the new work has relevance for the history of science (Shapin 1982), philosophy of science (Nickles 1982), and science policy (Healey 1982; Collins 1983b). The social constructivist view not only seems to be gaining ground as an important body of work in its own right but also shows every potential of wider application. It is this body of work that forms one of the pillars of our own approach to the study of science and technology.

Science-Technology Relationship

The literature on the relationship between science and technology, unlike that already referred to, is rather heterogeneous and includes contributions from a variety of disciplinary perspectives. We do not claim to present anything other than a partial review, reflecting our own particular interests.

One theme that has been pursued by philosophers is the attempt to separate technology from science on analytical grounds. In doing so, philosophers tend to posit overidealized distinctions, such as that science is about the discovery of truth whereas technology is about the application of truth. Indeed, the literature on the philosophy of technology is rather disappointing (Johnston 1984). We prefer to suspend judgment on it until philosophers propose more realistic models of both science and technology.

Another line of investigation into the nature of the science-technology relationship has been carried out by innovation researchers. They have attempted to investigate empirically the degree to which technological innovation incorporates, or originates from, basic science. A corollary of this approach has been the work of some scholars who have looked for relationships in the other direction; that is, they have argued that pure science is indebted to developments in technology.¹¹ The results of the empirical investigations of the dependence of technology on science have been rather frustrating. It has been difficult to specify the interdependence. For example, Project Hindsight, funded by the US Defense Department, found that most technological growth

came from mission-oriented projects and engineering R&D, rather than from pure science (Sherwin and Isenson 1966, 1967). These results were to some extent supported by a later British study (Langrish et al. 1972). On the other hand, Project TRACES, funded by the NSF in response to Project Hindsight, found that most technological development stemmed from basic research (Illinois Institute of Technology, 1968). All these studies have been criticized for lack of methodological rigor, and one must be cautious in drawing any firm conclusions from such work (Kreilkamp 1971; Mowery and Rosenberg 1979). Most researchers today seem willing to agree that technological innovation takes place in a wide range of circumstances and historical epochs and that the import that can be attached to basic science therefore probably varies considerably.¹² Certainly the view prevalent in the “bad old days” (Barnes 1982a) – that science discovers and technology applies – will no longer suffice. Simplistic models and generalizations have been abandoned. As Layton remarked in a recent review:

Science and technology have become intermixed. Modern technology involves scientists who “do” technology and technologists who function as scientists The old view that basic sciences generate all the knowledge which technologists then apply will simply not help in understanding contemporary technology. (Layton 1977, p. 210)

Researchers concerned with measuring the exact interdependence of science and technology seem to have asked the wrong question because they have assumed that science and technology are well-defined monolithic structures. In short, they have not grasped that science and technology are themselves socially produced in a variety of social circumstances (Mayr 1976). It does seem, however, that there is now a move toward a more sociological conception of the science–technology relationship. For instance, Layton writes:

The divisions between science and technology are not between the abstract functions of knowing and doing. Rather they are social. (Layton 1977, p. 209)

Barnes has recently described this change of thinking:

I start with the major reorientation in our thinking about the science–technology relationship which has occurred in recent years We recognize science and technology to be on a par with each other. Both sets of practitioners creatively

extend and develop their existing culture; but both also take up and exploit some part of the culture of the other They are in fact enmeshed in a symbiotic relationship. (Barnes 1982a, p. 166)

Although Barnes may be overly optimistic in claiming that a “major reorientation” has occurred, it can be seen that a social constructivist view of science and technology fits well with his conception of the science–technology relationship. Scientists and technologists can be regarded as constructing their respective bodies of knowledge and techniques with each drawing on the resources of the other when and where such resources can profitably be exploited. In other words, both science and technology are socially constructed cultures and bring to bear whatever cultural resources are appropriate for the purposes at hand. In his view the boundary between science and technology is, in particular instances, a matter for social negotiation and represents no underlying distinction. It then makes little sense to treat the science–technology relationship in a general unidirectional way. Although we do not pursue this issue further in this chapter, the social construction of the science–technology relationship is clearly a matter deserving further empirical investigation.

Technology Studies

Our discussion of technology studies work is even more schematic. There is a large amount of writing that falls under the rubric of “technology studies.” It is convenient to divide the literature into three parts: innovation studies, history of technology, and sociology of technology. We discuss each in turn.

Most innovation studies have been carried out by economists looking for the conditions for success in innovation. Factors researched include various aspects of the innovating firm (for example, size of R&D effort, management strength, and marketing capability) along with macroeconomic factors pertaining to the economy as a whole.¹³ This literature is in some ways reminiscent of the early days in the sociology of science, when scientific knowledge was treated like a “black box” (Whitley 1972) and, for the purpose of such studies, scientists might as well have produced meat pies. Similarly, in the economic analysis of technological innovation everything is included that might be expected to influence

innovation, except any discussion of the technology itself. As Layton notes:

What is needed is an understanding of technology from inside, both as a body of knowledge and as a social system. Instead, technology is often treated as a “black box” whose contents and behaviour may be assumed to be common knowledge. (Layton 1977, p. 198)

Only recently have economists started to look into this black box.¹⁴

The failure to take into account the content of technological innovations results in the widespread use of simple linear models to describe the process of innovation. The number of developmental steps assumed in these models seems to be rather arbitrary . . .¹⁵ Although such studies have undoubtedly contributed much to our understanding of the conditions for economic success in technological innovation, because they ignore the technological content they cannot be used as the basis for a social constructivist view of technology.¹⁶

This criticism cannot be leveled at the history of technology, where there are many finely crafted studies of the development of particular technologies. However, for the purposes of a sociology of technology, this work presents two kinds of problem. The first is that descriptive historiography is endemic in this field. Few scholars (but there are some notable exceptions) seem concerned with generalizing beyond historical instances, and it is difficult to discern any overall patterns on which to build a theory of technology (Staudenmaier 1983, 1985). This is not to say that such studies might not be useful building blocks for a social constructivist view of technology – merely that these historians have not yet demonstrated that they are doing sociology of knowledge in a different guise.¹⁷

The second problem concerns the asymmetric focus of the analysis. For example, it has been claimed that in twenty-five volumes of *Technology and Culture* only nine articles were devoted to the study of failed technological innovations (Staudenmaier 1985). This contributes to the implicit adoption of a linear structure of technological development, which suggests that

the whole history of technological development had followed an orderly or rational path, as though today’s world was the precise goal toward which all decisions, made since the beginning of history, were consciously directed. (Ferguson 1974, p. 19)

This preference for successful innovations seems to lead scholars to assume that the success of an artifact is an explanation of its subsequent development. Historians of technology often seem content to rely on the manifest success of the artifact as evidence that there is no further explanatory work to be done. For example, many histories of synthetic plastics start by describing the “technically sweet” characteristics of Bakelite; these features are then used implicitly to position Bakelite at the starting point of the glorious development of the field:

God said: “let Baekeland be” and all was plastics! (Kaufman 1963, p. 61)

However, a more detailed study of the developments of plastic and varnish chemistry, following the publication of the Bakelite process in 1909 (Baekeland 1909a, 1909b), shows that Bakelite was at first hardly recognized as the marvelous synthetic resin that it later proved to be.¹⁸ And this situation did not change much for some ten years. During the First World War the market prospects for synthetic plastics actually grew worse. However, the dumping of war supplies of phenol (used in the manufacture of Bakelite) in 1918 changed all this (Haynes 1954, pp. 137–138) and made it possible to keep the price sufficiently low to compete with (semi-) natural resins, such as celluloid.¹⁹ One can speculate over whether Bakelite would have acquired its prominence if it had not profited from that phenol dumping. In any case it is clear that a historical account founded on the retrospective success of the artifact leaves much untold.

Given our intention of building a sociology of technology that treats technological knowledge in the same symmetric, impartial manner that scientific facts are treated within the sociology of scientific knowledge, it would seem that much of the historical material does not go far enough. The success of an artifact is precisely what needs to be explained. For a sociological theory of technology it should be the *explanandum*, not the *explanans*.

Our account would not be complete, however, without mentioning some recent developments, especially in the American history of technology. These show the emergence of a growing number of theoretical themes on which research is focused (Staudenmaier 1985; Hughes 1979). For example, the systems approach to technology,²⁰ consideration of the effect of labor relations on technological development,²¹ and detailed studies of some not-so-successful inventions²² seem to herald departures from the “old” history of technology. Such

work promises to be valuable for a sociological analysis of technology, and we return to some of it later.

The final body of work we wish to discuss is what might be described as “sociology of technology.”²³ There have been some limited attempts in recent years to launch such a sociology, using ideas developed in the history and sociology of science – studies by, for example, Johnston (1972) and Dosi (1982), who advocate the description of technological knowledge in terms of Kuhnian paradigms.²⁴ Such approaches certainly appear to be more promising than standard descriptive historiography, but it is not clear whether or not these authors share our understanding of technological artifacts as social constructs. For example, neither Johnston nor Dosi considers explicitly the need for a symmetric sociological explanation that treats successful and failed artifacts in an equivalent way. Indeed, by locating their discussion at the level of technological paradigms, we are not sure how the artifacts themselves are to be approached. As neither author has yet produced an empirical study using Kuhnian ideas, it is difficult to evaluate how the Kuhnian terms may be utilized.²⁵ Certainly this has been a pressing problem in the sociology of science, where it has not always been possible to give Kuhn’s terms a clear empirical reference.

The possibilities of a more radical social constructivist view of technology have been touched on by Mulkey (1979a). He argues that the success and efficacy of technology could pose a special problem for the social constructivist view of *scientific knowledge*. The argument Mulkey wishes to counter is that the practical effectiveness of technology somehow demonstrates the privileged epistemology of science and thereby exempts it from sociological explanation. Mulkey opposes this view, rightly in our opinion, by pointing out the problem of the “science discovers, technology applies” notion implicit in such claims. In a second argument against this position, Mulkey notes (following Mario Bunge (1966)) that it is possible for a false or partly false theory to be used as the basis for successful practical application: The success of the technology would not then have anything to say about the “truth” of the scientific knowledge on which it was based. We find this second point not entirely satisfactory. We would rather stress that the truth or falsity of scientific knowledge is irrelevant to sociological analysis of belief: To retreat to the argument that science may be wrong but good technology can still be based on it is missing this point. Furthermore, the success of technology is still left unexplained within such an argument. The only effective way to deal with these difficulties is to adopt a perspective

that attempts to show that technology, as well as science, can be understood as a social construct.

Mulkey seems to be reluctant to take this step because, as he points out, “there are very few studies ... which consider how the technical meaning of hard technology is socially constructed” (Mulkey 1979a, p. 77). This situation however, is starting to change: A number of such studies have recently emerged. For example, Michel Gallon, in a pioneering study, has shown the effectiveness of focusing on technological controversies. He draws on an extensive case study of the electric vehicle in France (1960–75) to demonstrate that almost everything is negotiable: what is certain and what is not; who is a scientist and who is a technologist; what is technological and what is social; and who can participate in the controversy (Gallon 1980a, b, 1981, and Bijker et al. 1985). David Noble’s study of the introduction of numerically controlled machine tools can also be regarded as an important contribution to a social constructivist view of technology (Noble 1984). Noble’s explanatory goals come from a rather different (Marxist) tradition,²⁶ and his study has much to recommend it: He considers the development of both a successful and a failed technology and gives a symmetric account of both developments. Another intriguing study in this tradition is Lazonick’s account (1979) of the introduction of the self-acting mule: He shows that aspects of this technical development can be understood in terms of the relations of production rather than any inner logic of technological development. The work undertaken by Bijker, Bönig, and Van Oost is another attempt to show how the socially constructed character of the content of some technological artifacts might be approached empirically: Six case studies were carried out, using historical sources.²⁷

In summary, then, we can say that the predominant traditions in technology studies – innovation studies and the history of technology – do not yet provide much encouragement for our program. There are exceptions, however, and some recent studies in the sociology of technology present promising starts on which a unified approach could be built. We now give a more extensive account of how these ideas may be synthesized.

EPOR and SCOT

In this part we outline in more detail the concepts and methods that we wish to employ. We start by describing the “Empirical Programme of Relativism” as it was

developed in the sociology of scientific knowledge. We then go on to discuss in more detail the approach taken by Bijker and his collaborators in the sociology of technology.

The Empirical Programme of Relativism (EPOR)

The EPOR is an approach that has produced several studies demonstrating the social construction of scientific knowledge in the “hard” sciences. This tradition of research has emerged from recent sociology of scientific knowledge. Its main characteristics, which distinguish it from other approaches in the same area, are the focus on the empirical study of contemporary scientific developments and the study, in particular, of scientific controversies.²⁸

Three stages in the explanatory aims of the EPOR can be identified. In the *first stage* the interpretative flexibility of scientific findings is displayed; in other words, it is shown that scientific findings are open to more than one interpretation. This shifts the focus for the explanation of scientific developments from the natural world to the social world. Although this interpretative flexibility can be recovered in certain circumstances, it remains the case that such flexibility soon disappears in science; that is, a scientific consensus as to what the “truth” is in any particular instance usually emerges. Social mechanisms that limit interpretative flexibility and thus allow scientific controversies to be terminated are described in the *second stage*. A *third stage*, which has not yet been carried through in any study of contemporary science, is to relate such “closure mechanisms” to the wider social-cultural milieu. If all three stages were to be addressed in a single study, as Collins writes, “the impact of society on knowledge ‘produced’ at the laboratory bench would then have been followed through in the hardest possible case” (Collins 1981c, p. 7).

The EPOR represents a continuing effort by sociologists to understand the content of the natural sciences in terms of social construction. Various parts of the program are better researched than others. The third stage of the program has not yet even been addressed, but there are many excellent studies exploring the first stage. Most current research is aimed at elucidating the closure mechanisms whereby consensus emerges (the second stage). Many studies within the EPOR have been most fruitfully located in the area of scientific controversy. Controversies offer a methodological advantage in the comparative ease with which they reveal the interpretative

flexibility of scientific results. Interviews conducted with scientists engaged in a controversy usually reveal strong and differing opinions over scientific findings. As such flexibility soon vanishes from science, it is difficult to recover from the textual sources with which historians usually work. Collins has highlighted the importance of the “controversy group” in science by his use of the term “core set” (Collins 1981b). These are the scientists most intimately involved in a controversial research topic. Because the core set is defined in relation to knowledge production in science (the core set constructs scientific knowledge), some of the empirical problems encountered in the identification of groups in science by purely sociometric means can be overcome. And studying the core set has another methodological advantage, in that the resulting consensus can be monitored. In other words, the group of scientists who experiment and theorize at the research frontiers and who become embroiled in scientific controversy will also reflect the growing consensus as to the outcome of that controversy. The same group of core set scientists can then be studied in both the first and second stages of the EPOR. For the purposes of the third stage, the notion of a core set may be too limited.

The Social Construction of Technology (SCOT)

Before outlining some of the concepts found to be fruitful by Bijker and his collaborators in their studies in the sociology of technology, we should point out an imbalance between the two approaches (EPOR and SCOT) we are considering. The EPOR is part of a flourishing tradition in the sociology of scientific knowledge: It is a well-established program supported by much empirical research. In contrast, the sociology of technology is an embryonic field with no well-established traditions of research, and the approach we draw on specifically (SCOT) is only in its early empirical stages, although clearly gaining momentum.²⁹

In SCOT the developmental process of a technological artifact is described as an alternation of variation and selection.³⁰ This results in a “multidirectional” model, in contrast with the linear models used explicitly in many innovation studies and implicitly in much history of technology. Such a multidirectional view is essential to any social constructivist account of technology. Of course, with historical hindsight, it is possible to collapse the multidirectional model on to a simpler linear model;

but this misses the thrust of our argument that the “successful” stages in the development are not the only possible ones.
[...]

The wider context

Finally, we come to the third stage of our research program. The task here in the area of technology would seem to be the same as for science – to relate the content of a technological artifact to the wider sociopolitical milieu. This aspect has not yet been demonstrated for the science case,³¹ at least not in contemporaneous sociological studies.³² However, the SCOT method of describing technological artifacts by focusing on the meanings given to them by relevant social groups seems to suggest a way forward. Obviously, the sociocultural and political situation of a social group shapes its norms and values, which in turn influence the meaning given to an artifact. Because we have shown how different meanings can constitute different lines of development, SCOT’s descriptive model seems to offer an operationalization of the relationship between the wider milieu and the actual content of technology. To follow this line of analysis, see Bijker 1985.

Conclusion

In this chapter we have been concerned with outlining an integrated social constructivist approach to the empirical study of science and technology. We reviewed several relevant bodies of literature and strands of argument. We indicated that the social constructivist approach is a flourishing tradition within the sociology of science and that it shows every promise of wider application. We reviewed the literature on the science–technology relationship and showed that here, too, the social constructivist approach is starting to bear fruit. And we reviewed some of the main traditions in technology studies. We argued that innovation studies and much of the history of technology are

unsuitable for our sociological purposes. We discussed some recent work in the sociology of technology and noted encouraging signs that a new wave of social constructivist case studies is beginning to emerge.

We then outlined in more detail the two approaches – one in the sociology of scientific knowledge (EPOR) and one in the field of sociology of technology (SCOT) – on which we base our integrated perspective. Finally, we indicated the similarity of the explanatory goals of the two approaches and illustrated these goals with some examples drawn from technology. In particular, we have seen that the concepts of interpretative flexibility and closure mechanism and the notion of social group can be given empirical reference in the social study of technology.

As we have noted throughout this chapter, the sociology of technology is still underdeveloped, in comparison with the sociology of scientific knowledge. It would be a shame if the advances made in the latter field could not be used to throw light on the study of technology. On the other hand, in our studies of technology it appeared to be fruitful to include several social groups in the analysis, and there are some indications that this method may also bear fruit in studies of science. Thus our integrated approach to the social study of science and technology indicates how the sociology of science and the sociology of technology might benefit each other.

But there is another reason, and perhaps an even more important one, to argue for such an integrated approach. And this brings us to a question that some readers might have expected to be dealt with in the first paragraph of this chapter, namely, the question of how to distinguish science from technology. We think that it is rather unfruitful to make such an a priori distinction. Instead, it seems worthwhile to start with commonsense notions of science and technology and to study them in an integrated way, as we have proposed. Whatever interesting differences may exist will gain contrast within such a program. This would constitute another concrete result of the integrated study of the social construction of facts and artifacts.

Notes

This chapter is a shortened and updated version of Pinch and Bijker (1984).

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- 1 The science technology divorce seems to have resulted not so much from the lack of overall analytical goals within "science studies" but more from the contingent demands of carrying out empirical work in these areas. To give an example, the new sociology of scientific knowledge, which attempts to take into account the actual content of scientific knowledge, can best be carried out by researchers who have some training in the science they study, or at least by those who are familiar with an extensive body of technical literature (indeed, many researchers are ex-natural scientists). Having gained such expertise, the researchers tend to stay within the domain where that expertise can best be deployed. Similarly, R&D studies and innovation studies, in which the analysis centers on the firm and the marketplace, have tended to demand the specialized competence of economists. Such disparate bodies of work do not easily lead to a more integrated conception of science and technology. One notable exception is Ravetz (1971). This is one of the few works of recent science studies in which both science and technology and their differences are explored within a common framework.
- 2 A comprehensive review can be found in Mulkey and Milič (1980).
- 3 For a recent review of the sociology of scientific knowledge, see Collins (1983c).
- 4 For a discussion of the earlier work (largely associated with Robert Merton and his students), see Whitley (1972).
- 5 For more discussion, see Barnes (1974), Mulkey (1979b), Collins (1983c), and Barnes and Edge (1982). The origins of this approach can be found in Fleck (1935).
- 6 See, for example, Latour and Woolgar (1979), Knorr-Cetina (1981), Lynch (1985), and Woolgar (1982).
- 7 See, for example, Collins (1975), Wynne (1976), Pinch (1977, 1986), Pickering (1984), and the studies by Pickering, Harvey, Collins, Travis, and Pinch in Collins (1981a).
- 8 Collins and Pinch (1979, 1982).
- 9 Robbins and Johnston (1976). For a similar analysis of public science controversies, see Gillespie et al. (1979) and McCrea and Markle (1984).
- 10 Some of the most recent debates can be found in Knorr-Cetina and Mulkey (1983).
- 11 The *locus classicus* is the study by Hessen (1931).
- 12 See, for example, de Solla Price (1969), Jevons (1976), and Mayr (1976).
- 13 See, for example, Schumpeter (1928, 1942), Schmookler (1966, 1972), Freeman (1974, 1977), and Scholz (1977).
- 14 See, for example, Rosenberg (1982), Nelson and Winter (1977, 1982), and Dosi (1982, 1984). A study that preceded these is Rosenberg and Vincenti (1978).
- 15 Adapted from Uhlmann (1978), p. 45.
- 16 For another critique of these linear models, see Kline (1985).
- 17 Shapin writes that "a proper perspective of the uses of science might reveal that sociology of knowledge and history of technology have more in common than is usually thought" (1980, p. 132). Although we are sympathetic to Shapin's argument, we think the time is now ripe for asking more searching questions of historical studies.
- 18 Manuals describing resinous materials do mention Bakelite but not with the amount of attention that, retrospectively, we would think to be justified. Professor Max Bottler, for example, devotes only one page to Bakelite in his 228-page book on resins and the resin industry (Bottler 1924). Even when Bottler concentrates in another book on the *synthetic* resinous materials, Bakelite does not receive an indisputable "first place." Only half of the book is devoted to phenol/formaldehyde condensation products, and roughly half of that part is devoted to Bakelite (Bottler 1919). See also Matthis (1920).
- 19 For an account of other aspects of Bakelite's success, see Bijker et al. (1985).
- 20 See, for example, Constant (1980), Hughes (1983), and Hanijski (1973).
- 21 See, for example, Noble (1979), Smith (1977), and Lazonick (1979).
- 22 See, for example, Vincenti (1986).
- 23 There is an American tradition in the sociology of technology. See, for example, Gilfillan (1935), Ogburn (1945), Ogburn and Meyers Nimkoff (1955), and Westrum (1983). A fairly comprehensive view of the present state of the art in German sociology of technology can be obtained from Jokisch (1982). Several studies in the sociology of technology that attempt to break with the traditional approach can be found in Krohn et al. (1978).
- 24 Dosi uses the concept of technological trajectory, developed by Nelson and Winter (1977); see also Van den Belt and Rip (Bijker et al. 1985). Other approaches to technology based on Kuhn's idea of the community structure of science are mentioned by Bijker et al. (1985). See also Constant (Bijker et al. 1985) and the collection edited by Laudan (1984).
- 25 One is reminded of the first blush of Kuhnian studies in the sociology of science. It was hoped that Kuhn's "paradigm" concept might be straightforwardly employed by sociologists in their studies of science. Indeed there were a number of studies in which attempts were made to identify phases in science, such as preparadigmatic, normal, and revolutionary. It soon became apparent, however, that Kuhn's terms were loosely formulated, could be subject to a variety of interpretations, and did not lend themselves to operationalization in any straightforward manner. See, for example, the inconclusive discussion over whether a Kuhnian analysis applies to psychology in Palermo (1973). A notable exception is Barnes's contribution to the discussion of Kuhn's work (Barnes 1982b).

- 26 For a valuable review of Marxist work in this area, see MacKenzie (1984).
- 27 For a provisional report of this study, see Bijker et al. (1984). The five artifacts that are studied are Bakelite, fluorescent lighting, the safety bicycle, the Sulzer loom, and the transistor. See also Bijker et al. (1985).
- 28 Work that might be classified as falling within the EPOR has been carried out primarily by Collins, Pinch, and Travis at the Science Studies Centre, University of Bath, and by Harvey and Pickering at the Science Studies Unit, University of Edinburgh. See, for example, the references in note 7.
- 29 See, for example, Bijker and Pinch (1983), Bijker (1984), and Bijker et al. (1985). Studies by Van den Belt (1985), Schot (1985, 1986), Jelsma and Smit (1986), and Elzen (1985, 1986) are also based on SCOT.
- 30 Constant (1980) used a similar evolutionary approach. Both Constant's model and our model seem to arise out of the work in evolutionary epistemology, see, for example, Toulmin (1972) and Campbell (1974). Elster (1983) gives a review of evolutionary models of technical change. See also Van den Belt and Rip (Bijker et al. 1985).
- 31 A model of such a "stage 3" explanation is offered by Collins (1983a).
- 32 Historical studies that address the third stage may be a useful guide here. See, for example, MacKenzie (1978), Shapin (1979, 1984), and Shapin and Schaffer (1985).

References

- Baekeland, L. H. 1909a. "On soluble, fusible, resinous condensation products of phenols and formaldehyde." *Journal of Industrial and Engineering Chemistry* 1:345-349.
- Baekeland, L. H. 1909b. "The synthesis, constitution, and use of Bakelite." *Journal of Industrial and Engineering Chemistry* 1:149-161.
- Barnes, B. 1974. *Scientific Knowledge and Sociological Theory*. London: Routledge and Kegan Paul.
- Barnes, B. 1982a. "The science-technology relationship: A model and a query." *Social Studies of Science* 12:166-172.
- Barnes, B. 1982b. *T. S. Kuhn and Social Science*. London: Macmillan.
- Barnes, B., and Edge, D., eds. 1982. *Science in Context*. Milton Keynes: Open University Press.
- Bijker, W. E. 1984. "Collectifs technologiques et styles technologiques: Eléments pour un modèle explicatif de la construction sociale des artefacts techniques," in *Travailleur collectif et relations science-production*, J. H. Jacot, ed. Paris: Editions du CNRS, 113-120.
- Bijker, W. E., and Pinch, T. J. 1983. "La construction sociale de faits et d'artefacts: Impératifs stratégiques et méthodologiques pour une approche unifiée de l'étude des sciences et de la technique." Paper presented to L'atelier de recherche (III) sur les problèmes stratégiques et méthodologiques en milieu scientifique et technique. Paris, March.
- Bijker, W. E., Bonig, J., and van Oost, E. C. J. 1984. "The social construction of technological artefacts." Paper presented to the EASST Conference. A shorter version of this paper is published in *Zeitschrift für Wissenschaftsforschung*, special issue 2, 3:39-52 (1984).
- Bijker, W. E., Hughes, T. P., and Pinch, T. J., eds. 1985. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, Mass.: MIT Press.
- Bloor, D. 1973. "Wittgenstein and Manheim on the sociology of mathematics." *Studies in the History and Philosophy of Science* 4:173-191.
- Bottler, M. 1924. *Harze und Harzindustrie*. Leipzig: Max Jänecke.
- Bunge, M. 1966. "Technology as applied science." *Technology and Culture* 7:329-347.
- Gallon, M. 1980a. "The state and technical innovation: A case study of the electrical vehicle in France." *Research Policy* 9:358-376.
- Gallon, M. 1980b. "Struggles and negotiations to define what is problematic and what is not: The sociology of translation," in *The Social Process of Scientific Investigation*, K. Knorr, R. Krohn, and R. Whitley, eds. Dordrecht and Boston: Reidel, vol. 4, 197-219.
- Gallon, M. 1981. "Pour une sociologie des controverses; technologiques." *Fundamenta Scientiae* 2:381-399.
- Campbell, U. T. 1974. "Evolutionary epistemology," in *The Philosophy of Karl Popper, The Library of Living Philosophers*, P. A. Schlipp, ed. La Salle, Ill.: Open Court, vol. 14-1, 413-463.
- Collins, H. M. 1975. "The seven sexes: A study in the sociology of a phenomenon, or the replication of experiments in physics." *Sociology* 9:205-224.
- Collins, H. M., ed. 1981a. "Knowledge and controversy." *Social Studies of Science* 11:3-158.
- Collins, H. M. 1981b. "The place of the core-set in modern science: Social contingency with methodological propriety in science." *History of Science* 19:6-19.
- Collins, H. M. 1981c. "Stages in the empirical programme of relativism." *Social Studies of Science* 11:3-10.
- Collins, H. M. 1983a. "An empirical relativist programme in the sociology of scientific knowledge," in *Science Observed: Perspectives on the Social Study of Science*, K. D. Knorr-Cetina and M. J. Mulkay, eds. Beverly Hills: Sage, 85-113.
- Collins, H. M. 1983b. "Scientific knowledge and science policy: Some foreseeable implications." *EASST Newsletter*, November, 2:5-8.
- Collins, H. M. 1983c. "The sociology of scientific knowledge: Studies of contemporary science." *Annual Review of Sociology* 9:265-285.

- Collins, H. M., and Pinch, T. J. 1979. "The construction of the paranormal: Nothing unscientific is happening," in *On the Margins of Science: The Social Construction of Rejected Knowledge*, R. Wallis, ed. Keele: University of Keele, 237–270.
- Collins, H. M., and Pinch, T. J. 1982. *Frames of Meaning: The Social Construction of Extraordinary Science*. London: Routledge and Kegan Paul.
- Constant, E. W., II. 1980. *The Origins of the Turbojet Revolution*. Baltimore: Johns Hopkins University Press.
- de Solla Price, D. J. 1969. "The structure of publication in science and technology," in *Factors in the Transfer of Technology*, W. H. Gruber and D. G. Marquis, eds. Cambridge, Mass.: MIT Press, 91–104.
- Dosi, G. 1982. "Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change." *Research Policy* 11: 147–162.
- Dosi, G. 1984. *Technical Change and Industrial Transformation*. London: Macmillan.
- Elster, J. 1983. *Explaining Technical Change*. Cambridge: Cambridge University Press.
- Elzen, B. 1985. "De ultracentrifuge: op zoek naar patronen in technologische ontwikkeling door een ver-gelijkin van twee case-studies." *Jaarboek voor de Geschiedenis van Bedrijven Techniek* 2:250–278.
- Elzen, B. 1986. "Two ultracentrifuges: A comparative study of the social construction of artefacts." *Social Studies of Science* 16:621–662.
- Ferguson, E. 1974. "Toward a discipline of the history of technology." *Technology and Culture* 15:13–30.
- Fleck, L. 1935. *Entstehung und Entwicklung einer wis-senschaftlichen Tatsache: Einführung in die Lehre vom Denkstil und Denkkollektiv*. Basel: Benno Selinver. Reprinted by Suhrkamp, Frankfurt am Main, 1980. English translation: *The Genesis and Development of a Scientific Fact*, Chicago: The University of Chicago Press, 1979.
- Freeman, C. 1974. *The Economics of Industrial Innovation*. Harmondsworth: Penguin. Reprinted by Frances Pinter, London, 1982.
- Freeman, C. 1977. "Economics of research and development," in *Science, Technology and Society: A Cross-Disciplinary Perspective*, I. Spiegel-Rösing and D. de Solla Price, eds. London and Beverly Hills: Sage, 223–275.
- Gilfillan, S. G. 1935. *The Sociology of Invention*. Cambridge, Mass.: MIT Press.
- Gillespie, B., Eva, D., and Johnston, R. 1979. "Carcinogenic risk assessment in the United States and Great Britain: The case of aldrin/dieldrin." *Social Studies of Science* 9: 265–301.
- Hanieski, J. F. 1973. "The airplane as an economic variable: Aspects of technological change in aeronautics, 1903–1955." *Technology and Culture* 14:535–552.
- Haynes, W. 1954. *American Chemical Industry*, Vol. 2. New York: Van Nostrand.
- Healey, P. 1982. "The research funding organization as a focus for science studies." Paper presented to the Science Studies Conference, Oxford, September.
- Hessen, B. 1931. "The social and economic roots of Newton's *Principia*," in *Science at the Crossroads*, by N. I. Bukharin, A. F. Joffe, M. Rubinstein, B. Zavadovsky, E. Colman, N. I. Vavilov, W. Th. Mitkewich, and B. Hessen. London: Frank Cass, 147–212.
- Hughes, T. P. 1979. "Emerging themes in the history of technology." *Technology and Culture* 20:697–711.
- Hughes, T. P. 1983. *Networks of Power: Electrification in Western Society. 1880–1930*. Baltimore: Johns Hopkins University Press.
- Illinois Institute of Technology. 1968. *Technology in Retrospect and Critical Events in Science. (TRACES)*. Chicago: ITT Research Institute.
- Jelsma, J., and Smit, W. A. 1986. "Risks of recombinant DNA research: From uncertainty to certainty," in *Impact Assessment Today*, H. A. Becker and A. L. Porter, eds. Van Arkel: Utrecht, 715–741.
- Jevons, F. R. 1976. "The interaction of science and technology today, or, is science the mother of invention?" *Technology and Culture* 17:729–742.
- Johnston, R. 1972. "The internal structure of technology," in *The Sociology of Science*, P. Halmos, ed. Keele: University of Keele, 117–130.
- Johnston, R. 1984. "Controlling technology: An issue for the social studies of science." *Social Studies of Science*, 14:97–112.
- Jokisch, R., ed. 1982. *Techniksoziologie*. Frankfurt am Main: Suhrkamp.
- Kaufman, M. 1963. *The First Century of Plastics: Celluloid and Its Sequel*, London: The Plastics Institute.
- Kline, S. 1985. "Research, invention, innovation, and production: Models and reality." *Research Management* 28(4):36–45.
- Knorr-Cetina, K. D. 1981. *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science*. Oxford: Pergamon.
- Knorr-Cetina, K. D., and Mulkay, M. J., eds. 1983. *Science Observed: Perspectives on the Social Study of Science*. London and Beverly Hills: Sage.
- Kreilkamp, K. 1971. "Hindsight and the real world of science policy." *Science Studies* 1:43–66.
- Krohn, W., Layton, E. T., and Weingart, P., eds. 1978. *The Dynamics of Science and Technology, Sociology of the Sciences Yearbook*, vol. 2. Dordrecht: Reidel.
- Langrish, J., Gibbons, M., Evans, W. G., and Jevons, F. R. 1972. *Wealth from Knowledge*. London: Macmillan.
- Latour, B. and Woolgar, S. 1979. *Laboratory Life. The Social Construction of Scientific Facts*. London and Beverly Hills: Sage; second edition published as *Laboratory Life. The Construction of Scientific Facts*, Princeton, N.J.: Princeton University Press, 1986.

- Laudan, R., ed. 1984. *The Nature of Technological Knowledge: Are Models of Scientific Change Relevant?* Dordrecht: Reidel.
- Layton, E. 1977. "Conditions of technological development," in *Science, Technology and Society: A Cross-Disciplinary Perspective*, I. Spiegel-Rösing and D. de Solla Price, eds. London and Beverly Hills: Sage, 197–222.
- Lazonick, W. 1979. "Industrial relations and technical change: The case of the self-acting mule." *Cambridge Journal of Economics* 3:231–262.
- Lynch, M. 1985. *Art and Artefact in Laboratory Science: A Study of Shop Work and Shop Talk in a Research Laboratory*. London: Routledge and Kegan Paul.
- MacKenzie, D. 1978. "Statistical theory and social interest: A case study." *Social Studies of Science* 8:35–83.
- MacKenzie, D. 1984. "Marx and the machine." *Technology and Culture* 25:473–502.
- Matthis, A. R. c. 1920. *Insulating Varnishes in Electrotechnics*. London: John Heywood.
- Mayr, O. 1976. "The science-technology relationship as a historiographic problem." *Technology and Culture* 17:663–673.
- McCrea, F. B., and Markle, G. E. 1984. "The estrogen replacement controversy in the USA and UK: Different answers to the same question?" *Social Studies of Science* 14:1–26.
- Mowery, D. C., and Rosenberg, N. 1979. "The influence of market demand upon innovation: A critical review of some recent: empirical studies." *Research Policy* 8:103–153.
- Mulkay, M. J. 1979a. "Knowledge and utility: Implications for the sociology of knowledge." *Social Studies of Science* 9:63–80.
- Mulkay, M. J. 1979b. *Science and the Sociology of Knowledge*. London: Allen and Unwin.
- Mulkay, M. J., and Milič, V. 1980. "The sociology of science in East and West." *Current Sociology*, Winter, 28:1–342.
- Nelson, R. R., and Winter, S. G. 1977. "In search of a useful theory of innovation." *Research Policy* 6:36–76.
- Nelson, R. R., and Winter, S. G. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, Mass.: The Belknap Press of Harvard University Press.
- Nickles, T. 1982. "How discovery is important to cognitive studies of science." Paper presented to the Philosophy of Science Association Meeting, Philadelphia, October.
- Noble, D. F. 1979. "Social choice in machine design: The case of automatically controlled machine tools," in *Case Studies on the Labour Process*, A. Zimbalist, ed. New York: Monthly Review Press, 18–50.
- Noble, D. F. 1984. *Forces of Production: A Social History of Industrial Automation*. New York: Knopf.
- Ogburn, W. F. 1945. *The Social Effects of Aviation*. Boston: Houghton Mifflin.
- Ogburn, W. F., and Meyers Nimkoff, F. 1955. *Technology and the Changing Family*. Boston: Houghton Mifflin.
- Palermo, D. S. 1973. "Is a scientific revolution taking place in psychology?" *Science Studies* 3:211–244.
- Pickering, A. 1984. *Constructing Quarks – A Sociological History of Particle Physics*. Chicago and Edinburgh: University of Chicago Press and Edinburgh University Press.
- Pinch, T. J. 1977. "What does a proof do if it does not prove? A study of the social conditions and metaphysical divisions leading to David Bohm and John von Neumann failing to communicate in quantum physics," in *The Social Production of Scientific Knowledge*, E. Mendelsohn, P. Weingart, and R. Whitley, eds. Dordrecht: Reidel, 171–215.
- Pinch, T. J. 1986. *Confronting Nature: The Sociology of Solar-Neutrino Detection*. Dordrecht: Reidel.
- Pinch, T. J., and Bijker, W. E. 1984. "The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other." *Social Studies of Science* 14:399–441. Also published in Serbo-Croatian as "Društveno Proizvođenje Činjenica I Tvorivina: O Cjelovitom Pristupu Izučavanju Znanosti I Tehnologije," *Gledišta, časopis za društvenu kritiku i teoriju*, March–April, 25: 21–57 (1984).
- Ravetz, J. R. 1971. *Scientific Knowledge and Its Social Problems*. Oxford: Oxford University Press.
- Robbins, D., and Johnston, R. 1976. "The role of cognitive and occupational differentiation in scientific controversies." *Social Studies of Science* 6:349–368.
- Rosenberg, N. 1982. *Inside the Black Box: Technology and Economics*. Cambridge: Cambridge University Press.
- Rosenberg, N., and Vincenti, W. G. 1978. *The Britannia Bridge: The Generation and Diffusion of Knowledge*. Cambridge, Mass.: MIT Press.
- Schmookler, J. 1966. *Invention and Economic Growth*. Cambridge, Mass.: Harvard University Press.
- Schmookler, J. 1972. *Patents, Invention and Economic Change, Data and Selected Essays*. Z. Griliches and L. Hurwicz, eds. Cambridge, Mass.: Harvard University Press.
- Scholz, L. with a contribution by G. von L. Uhlmann, 1977. *Technik-Indikatoren, Ansätze zur Messung des Standes der Technik in der industriellen Produktion*. Berlin and München: Duncker & Humblot.
- Schot, J. 1985. "De ontwikkeling van de techniek als een variatie selectieproces. De meekrapteelt en-bereiding in het licht van een alternatieve techniekopvatting." Master's thesis, Erasmus University of Rotterdam, unpublished.
- Schot, J. 1986. "De meekrapnijverheid: de ontwikkeling van de techniek als een proces van variatie en selectie," in *Jaarboek voor de Geschiedenis van Bedrijf en Techniek*, E. S. A. Bloemen, W. E. Bijker, W. van den Broeke, et al., eds. Utrecht: Stichting, vol. 3, 43–62.
- Schumpeter, J. 1971 [1928], "The instability of capitalism," in *The Economics of Technological Change*, N. Rosenberg, ed. Harmondsworth: Penguin, 13–42.
- Schumpeter, J. 1942. *Capitalism, Socialism and Democracy*. New York: Harper & Row. Reprinted 1974 by Unwin University Books, London.

- Shapin, S. 1979. "The politics of observation: Cerebral anatomy and social interests in the Edinburgh phrenology disputes," in *On the Margins of Science: The Social Construction of Rejected Knowledge*, R. Wallis, ed. Keele: University of Keele, 139–178.
- Shapin, S. 1980. "Social uses of science," in *The Ferment, of Knowledge*, G. S. Rousseau and R. Porter, eds. Cambridge: Cambridge University Press, 93–139.
- Shapin, S. 1982. "History of science and its sociological reconstructions." *History of Science* 20:157–211.
- Shapin, S. 1984. "Pump and circumstance: Robert Boyle's literary technology." *Social Studies of Science* 14: 481–520.
- Shapin, S., and Schaffer, S. 1985. *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life*. Princeton: Princeton University Press.
- Sherwin, C. S., and Isenson, R. S. 1966. *First Interim Report on Project Hindsight: Summary*. Washington, D.C.: Office of the Director of Defense Research and Engineering.
- Sherwin, C. S., and Isenson, R. S. 1967. "Project hindsight: A Defense Department study of the utility of research." *Science* 156: 1571–1577.
- Smith, M. Roe. 1977. *Harpers Ferry Armory and the New Technology: The Challenge of Change*. Ithaca, N.Y.: Cornell University Press.
- Staudenmaier, J. M., SJ. 1983. "What SHOT hath wrought and what SHOT hath not: Reflections on 25 years of the history of technology." Paper presented to the Twenty-fifth Annual Meeting of SHOT.
- Staudenmaier, J. M., SJ. 1985. *Technology's Storytellers: Reweaving the Human Fabric*. Cambridge, Mass.: MIT Press.
- Toulmin, S. 1972. *Human Understanding*, vol. 1. Oxford: Oxford University Press.
- Uhlmann, L. 1978. *Der Innovationsprozess in westeur-päisichen Industrieländern. Band 2: Den Ablauf industriellen Innovationprozesses*. Berlin and München: Duncker and Humblot.
- van den Belt, H. 1985. "A. W. Hofman en de Franse Octrooioprocesen rond anilincrood: demarcatie als sociale constructie." *Jaarboek voor de Geschiedenis van Bedrijven Techniek* 2:64–86.
- Vincenti, W. G. 1986. "The Davis wing and the problem of airfoil design: Uncertainty and growth in engineering knowledge." *Technology and Culture* 26.
- Westrum, R. 1983. "What happened to the old sociology of technology?" Paper presented to the Eighth Annual Meeting of the Society for Social Studies of Science, Blacksburg, Virginia, November.
- Whitley, R. D. 1972. "Black boxism and the sociology of science: A discussion of the major developments in the field," in *The Sociology of Science*, P. Halmos, ed. Keele: University of Keele, 62–92.
- Woolgar, S. 1982. "Laboratory studies: A comment on the state of the art." *Social Studies of Science* 12:481–498.
- Wynne, B. 1976. "C. G. Barkla and the J phenomenon: A case study of the treatment of deviance in physics." *Social Studies of Science* 6:307–347.

Actor–Network Theory (ANT)

Bruno Latour

How to Resume the Task of Tracing Associations

The argument of this book can be stated very simply: when social scientists add the adjective ‘social’ to some phenomenon, they designate a stabilized state of affairs, a bundle of ties that, later, may be mobilized to account for some other phenomenon. There is nothing wrong with this use of the word as long as it designates what is *already* assembled together, without making any superfluous assumption about the *nature* of what is assembled. Problems arise, however, when ‘social’ begins to mean a type of material, as if the adjective was roughly comparable to other terms like ‘wooden’, ‘steely’, ‘biological’, ‘economical’, ‘mental’, ‘organizational’, or ‘linguistic’. At that point, the meaning of the word breaks down since it now designates two entirely different things: first, a movement during a process of assembling; and second, a specific type of ingredient that is supposed to differ from other materials.

What I want to do in the present work is to show why the social cannot be construed as a kind of material or domain and to dispute the project of providing a ‘social explanation’ of some other state of affairs. Although this earlier project has been productive and probably necessary in the past, it has largely stopped being so thanks in part to the success of the social sciences. At the

present stage of their development, it’s no longer possible to inspect the precise ingredients that are entering into the composition of the social domain. What I want to do is to redefine the notion of social by going back to its original meaning and making it able to trace connections again. Then it will be possible to resume the traditional goal of the social sciences but with tools better adjusted to the task. After having done extensive work on the ‘assemblages’ of nature, I believe it’s necessary to scrutinize more thoroughly the exact content of what is ‘assembled’ under the umbrella of a society. This seems to me the only way to be faithful to the old duties of sociology, this ‘science of the living together’.¹

[. . .]

What is a society? What does the word ‘social’ mean? Why are some activities said to have a ‘social dimension’? How can one demonstrate the presence of ‘social factors’ at work? When is a study of society, or other social aggregates, a good study? How can the path of a society be altered? To answer these questions, two widely different approaches have been taken. Only one of them has become common sense – the other is the object of the present work.

The first solution has been to posit the existence of a specific sort of phenomenon variously called ‘society’, ‘social order’, ‘social practice’, ‘social dimension’, or ‘social structure’. For the last century during which social theories have been elaborated, it has been

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important to distinguish this domain of reality from other domains such as economics, geography, biology, psychology, law, science, and politics. A given trait was said to be 'social' or to 'pertain to society' when it could be defined as possessing specific properties, some negative – it must not be 'purely' biological, linguistic, economical, natural – and some positive – it must achieve, reinforce, express, maintain, reproduce, or subvert the social order. Once this domain had been defined, no matter how vaguely, it could then be used to shed some light on specifically social phenomena – the social could explain the social – and to provide a certain type of explanation for what the other domains could not account for – an appeal to 'social factors' could explain the 'social aspects' of non-social phenomena.

For instance, although it is recognized that law has its own strength, some aspects of it would be better understood if a 'social dimension' were added to it; although economic forces unfold under their own logic, there also exists social elements which could explain the somewhat erratic behavior of calculative agents; although psychology develops according to its own inner drives, some of its more puzzling aspects can be said to pertain to 'social influence'; although science possesses its own impetus, some features of its quest are necessarily 'bound' by the 'social limitations' of scientists who are 'embedded in the social context of their time'; although art is largely 'autonomous', it is also 'influenced' by social and political 'considerations' which could account for some aspects of its most famous masterpieces; and although the science of management obeys its own rules, it might be advisable to also consider 'social, cultural, and political aspects' that could explain why some sound organizational principles are never applied in practice.

Many other examples can easily be found since this version of social theory has become the default position of our mental software that takes into consideration the following: there exists a social 'context' in which non-social activities take place; it is a specific domain of reality; it can be used as a specific type of causality to account for the residual aspects that other domains (psychology, law, economics, etc.) cannot completely deal with; it is studied by specialized scholars called sociologists or socio-(x) – 'x' being the placeholder for the various disciplines; since ordinary agents are always 'inside' a social world that encompasses them, they can at best be 'informants' about this world and, at worst, be blinded to its existence, whose full effect is only visible to the social scientist's more disciplined eyes; no matter how difficult it is to carry on

those studies, it is possible for them to roughly imitate the successes of the natural sciences by being as objective as other scientists thanks to the use of quantitative tools; if this is impossible, then alternative methods should be devised that take into account the 'human', 'intentional', or 'hermeneutic' aspects of those domains without abandoning the ethos of science; and when social scientists are asked to give expert advice on social engineering or to accompany social change, some sort of political relevance might ensue from these studies, but only after sufficient knowledge has been accumulated.

This default position has become common sense not only for social scientists, but also for ordinary actors via newspapers, college education, party politics, bar conversations, love stories, fashion magazines, etc.² The social sciences have disseminated their definition of society as effectively as utility companies deliver electricity and telephone services. Offering comments about the inevitable 'social dimension' of what we and others are doing 'in society' has become as familiar to us as using a mobile phone, ordering a beer, or invoking the Oedipus complex – at least in the developed world.

The other approach does not take for granted the basic tenet of the first. It claims that there is nothing specific to social order; that there is no social dimension of any sort, no 'social context', no distinct domain of reality to which the label 'social' or 'society' could be attributed; that no 'social force' is available to 'explain' the residual features other domains cannot account for; that members know very well what they are doing even if they don't articulate it to the satisfaction of the observers; that actors are never embedded in a social context and so are always much more than 'mere informants'; that there is thus no meaning in adding some 'social factors' to other scientific specialties; that political relevance obtained through a 'science of society' is not necessarily desirable; and that 'society', far from being the context 'in which' everything is framed, should rather be construed as one of the many connecting elements circulating inside tiny conduits. With some provocation, this second school of thought could use as its slogan what Mrs Thatcher famously exclaimed (but for very different reasons!): 'There is no such a thing as a society.'

If they are so different, how could they both claim to be a science of the social and aspire to use the same label of 'sociology'? On the face of it, they should be simply incommensurable, since the second position takes as the major puzzle to be solved what the first takes as its solution, namely the existence of specific social ties

revealing the hidden presence of some specific social forces. In the alternative view, 'social' is not some glue that could fix everything including what the other glues cannot fix; it is *what* is glued together by many *other* types of connectors. Whereas sociologists (or socio-economists, socio-linguists, social psychologists, etc.) take social aggregates as the given that could shed some light on residual aspects of economics, linguistics, psychology, management, and so on, these other scholars, on the contrary, consider social aggregates as what should be explained by the specific *associations* provided by economics, linguistics, psychology, law, management, etc.³

The resemblance between the two approaches appears much greater, however, provided one bears in mind the etymology of the word 'social'. Even though most social scientists would prefer to call 'social' a homogeneous thing, it's perfectly acceptable to designate by the same word a trail of *associations* between heterogeneous elements. Since in both cases the word retains the same origin – from the Latin root *socius* – it is possible to remain faithful to the original intuitions of the social sciences by redefining sociology not as the 'science of the social', but as the *tracing of associations*. In this meaning of the adjective, social does not designate a thing among other things, like a black sheep among other white sheep, but a *type of connection* between things that are not themselves social.

At first, this definition seems absurd since it risks diluting sociology to mean any type of aggregate from chemical bonds to legal ties, from atomic forces to corporate bodies, from physiological to political assemblies. But this is precisely the point that this alternative branch of social theory wishes to make as all those heterogeneous elements *might be* assembled anew in some given state of affairs. Far from being a mind-boggling hypothesis, this is on the contrary the most common experience we have in encountering the puzzling face of the social. A new vaccine is being marketed, a new job description is offered, a new political movement is being created, a new planetary system is discovered, a new law is voted, a new catastrophe occurs. In each instance, we have to reshuffle our conceptions of what was associated together because the previous definition has been made somewhat irrelevant. We are no longer sure about what 'we' means; we seem to be bound by 'ties' that don't look like regular social ties.

[...]

Thus, the overall project of what we are supposed to do together is thrown into doubt. The sense of belonging

has entered a crisis. But to register this feeling of crisis and to follow these new connections, another notion of social has to be devised. It has to be *much wider* than what is usually called by that name, yet *strictly limited* to the tracing of new associations and to the designing of their assemblages. This is the reason why I am going to define the social not as a special domain, a specific realm, or a particular sort of thing, but only as a very peculiar movement of re-association and reassembling.

In such a view, law, for instance, should not be seen as what should be explained by 'social structure' in addition to its inner logic; on the contrary, its inner logic may explain some features of what makes an association last longer and extend wider. Without the ability of legal precedents to draw connections between a case and a general rule, what would we know about putting some matter 'into a larger context'?⁴ Science does not have to be replaced by its 'social framework', which is 'shaped by social forces' as well as its own objectivity, because its objects are themselves dislocating any given context through the foreign elements research laboratories are associating together in unpredictable ways. Those quarantined because of the SARS virus painfully learned that they could no longer 'associate' with parents and partners in the same way because of the mutation of this little bug whose existence has been revealed by the vast institution of epidemiology and virology. Religion does not have to be 'accounted for' by social forces because in its very definition – indeed, in its very name – it links together entities which are not part of the social order. Since the days of Antigone, everyone knows what it means to be put into motion by orders from gods that are irreducible to politicians like Creon. Organizations do not have to be placed into a 'wider social frame' since they themselves give a very practical meaning to what it means to be nested into a 'wider' set of affairs. After all, which air traveler would know the gate to go to without looking anxiously and repeatedly at the number printed on her boarding pass and circled in red by an airline attendant? It might be vacuous to reveal behind the superficial chats of politicians the 'dark hidden forces of society' at work, since without those very speeches a large part of what we understand to be part of a group will be lost. Without the contradictory spiels of the warring parties in Iraq, who in the 'occupied' or 'liberated' Baghdad will know how to recognize friend and foe?

And the same is true for all other domains. Whereas, in the first approach, every activity – law, science, technology, religion, organization, politics, management,

etc. – could be related to and explained by the same social aggregates *behind* all of them, in the second version of sociology there exists *nothing* behind those activities even though they might be linked in a way that does produce a society – *or doesn't* produce one. Such is the crucial point of departure between the two versions. To be social is no longer a safe and unproblematic property, it is a movement that may fail to trace any new connection and may fail to redesign any *well-formed* assemblage. As we are going to learn throughout this book, after having rendered many useful services in an earlier period, what is called 'social explanation' has become a counter-productive way to *interrupt* the movement of associations instead of resuming it.

According to the second approach, adherents of the first have simply confused what they should explain with the explanation. They begin with society or other social aggregates, whereas one should end with them. They believed the social to be made essentially of social ties, whereas associations are made of ties which are themselves non-social. They imagined that sociology is limited to a specific domain, whereas sociologists should travel wherever new heterogeneous associations are made. They believed the social to be always already there at their disposal, whereas the social is not a type of thing either visible or to be postulated. It is visible only by the *traces* it leaves (under trials) when a *new* association is being produced between elements which themselves are in no way 'social'. They insisted that we were already held by the force of some society when our political future resides in the task of deciding what binds us all together. In brief, the second school claims to *resume* the work of connection and collection that was abruptly interrupted by the first. It is to help the interested enquirers in *reassembling* the social that this book has been written.

In the course of the book we will learn to distinguish the standard sociology of the social from a more radical subfamily which I will call *critical sociology*.⁵ This last branch will be defined by the following three traits: it doesn't only *limit* itself to the social but *replaces* the object to be studied by another matter made *of* social relations; it claims that this substitution is unbearable for the social actors who *need* to live under the illusion that there is something 'other' than social there; and it considers that the actors' objections to their social explanations offer the best *proof* that those explanations are right.

To clarify, I will call the first approach 'sociology of the social' and the second 'sociology of associations'

(I wish I could use 'associology'). I know this is very unfair to the many nuances of the social sciences I have thus lumped together, but this is acceptable for an introduction which has to be very precise on the unfamiliar arguments it chooses to describe as it sketches the well-known terrain. I may be forgiven for this roughness because there exist many excellent introductions for the sociology of the social but none, to my knowledge, for this small subfield of social theory⁶ that has been called – by the way, what is it to be called? Alas, the historical name is 'actor-network-theory', a name that is so awkward, so confusing, so meaningless that it deserves to be kept. If the author, for instance, of a travel guide is free to propose new comments on the land he has chosen to present, he is certainly not free to change its most common name since the easiest signpost is the best – after all, the origin of the word 'America' is even more awkward. I was ready to drop this label for more elaborate ones like 'sociology of translation', 'actant-rhizome ontology', 'sociology of innovation', and so on, until someone pointed out to me that the acronym A.N.T. was perfectly fit for a blind, myopic, workaholic, trail-sniffing, and collective traveler. An ant writing for other ants, this fits my project very well!⁷ Ideally, the word *sociology* should work best, but it cannot be used before its two components – what is social and what is a science – have been somewhat revamped. As this book unfolds, I will use it more and more often though, reserving the expression 'sociology of the social' to designate the repertoire to which other social scientists, in my view, limit themselves too readily.

It's true that in most situations resorting to the sociology of the social is not only reasonable but also indispensable, since it offers convenient shorthand to designate all the ingredients already *accepted* in the collective realm. It would be silly as well as pedantic to abstain from using notions like 'IBM', 'France', 'Maori culture', 'upward mobility', 'totalitarianism', 'socialization', 'lower-middle class', 'political context', 'social capital', 'downsizing', 'social construction', 'individual agent', 'unconscious drives', 'peer pressure', etc. But in situations where innovations proliferate, where group boundaries are uncertain, when the range of entities to be taken into account fluctuates, the sociology of the social is no longer able to trace actors' new associations. At this point, the last thing to do would be to limit in advance the shape, size, heterogeneity, and combination of associations. To the convenient shorthand of the social, one has to substitute the painful and costly longhand of its associations. The

How to find one's way in the literature under the heading Actor-Network-Theory

Most of the relevant bibliography can be found on the excellent website 'the Actor Network Resource' maintained by John Law.⁸ The origin of this approach can be found in the need for a new social theory adjusted to science and technology studies (Callon and Latour 1981). But it started in earnest with three documents (Latour 1988b; Callon 1986; Law 1986b). It was at this point that non-humans – microbes, scallops, rocks, and ships – presented themselves to social theory in a new way. It was the first time for me that the objects of science and technology had become, so to speak, social-compatible. The philosophical foundation of this argument was presented in the second part of (Latour 1988a) although in a form that made it difficult to grasp.

Since then it has moved in many directions, being reviewed and criticized by many papers listed on Law's website. Although there is no clear litmus test for ANT membership, some ad hoc and makeshift ones may be devised. Needless to say, this interpretation of ANT represents only my view. This book does not aim at a more collective presentation, only at a more systematic one. Here are some of the tests that I have found most useful.

One of them is the precise role granted to non-humans. They have to be *actors* and not simply the hapless bearers of symbolic projection. But this activity should not be the type of agency associated up to now with matters of fact or natural objects. So if an account employs either a symbolic or a naturalist type of causality, there is no reason to include it in the ANT corpus even though it might claim to be. Conversely, any study that gives non-humans a type of agency that is more open than the traditional natural causality – but more efficient than the symbolic one – can be part of our corpus, even though some of the authors would not wish to be associated in any way with this approach. For instance, a biological book (Kupiec and Sonigo

2000) could pertain to ANT because of the new active role given to the gene.

Another test is to check which direction the explanation is going in. Is the list of what is social in the end the same limited repertoire that has been used to explain (away) most of the elements? If the social remains stable and is used to explain a state of affairs, it's not ANT. For instance, no matter how enlightening it has been for all of us, the *Social Shaping of Technology* (Bijker 1995) would not be part of the corpus since the social is kept stable all along and accounts for the shape of technological change. But McNeill (1976), although he is in no way an ANT author, would qualify for inclusion, since what is to be associated is being modified by the inclusion of rats, viruses, and microbes into the definition of what is to be 'collected' in an empire. In this way, a book like Cronon's (1991) is certainly a masterpiece of ANT because no hidden social force is added to explain the progressive composition of the metropolis itself. The same would be true of the work done in distributed cognition (Hutchins 1995). This is also what has made much of the history of science and technology important for our program, and why sociology of art has been a continuous companion, especially through the influence of Hennion (1993).

A third and more difficult test would be to check whether a study aims at reassembling the social or still insists on dispersion and deconstruction. ANT has been confused with a postmodern emphasis on the critique of the 'Great narratives' and 'Eurocentric' or 'hegemonic' standpoint. This is, however, a very misleading view. Dispersion, destruction, and deconstruction are not the goals to be achieved but what needs to be overcome. It's much more important to check what are the new institutions, procedures, and concepts able to collect and to reconnect the social (Callon et al. 2001; Latour 2004b).

duties of the social scientist mutate accordingly: it is no longer enough to limit actors to the role of informers offering cases of some well-known types. You have to grant them back the ability to make up their own theories of what the social is made of. Your task is no longer to impose some order, to limit the range of acceptable entities, to teach actors what they are, or to add some

reflexivity to their blind practice. Using a slogan from ANT, you have 'to follow the actors themselves', that is try to catch up with their often wild innovations in order to learn from them what the collective existence has become in their hands, which methods they have elaborated to make it fit together, which accounts could best define the new associations that they have been

forced to establish. If the sociology of the social works fine with what has been already *assembled*, it does not work so well to collect anew the participants in what is not – *not yet* – a sort of social realm.

A more extreme way of relating the two schools is to borrow a somewhat tricky parallel from the history of physics and to say that the sociology of the social remains ‘pre-relativist’, while our sociology has to be fully ‘relativist’. In most ordinary cases, for instance situations that change slowly, the pre-relativist framework is perfectly fine and any fixed frame of reference can register action without too much deformation. But as soon as things accelerate, innovations proliferate, and entities are multiplied, one then has an absolutist framework generating data that becomes hopelessly messed up. This is when a relativistic solution has to be devised in order to remain able to move between frames of reference and to regain some sort of commensurability between traces coming from frames traveling at very different speeds and acceleration. Since relativity theory is a well-known example of a major shift in our mental apparatus triggered by very basic questions, it can be used as a nice parallel for the ways in which the sociology of associations reverses and generalizes the sociology of the social.

In what follows I am not interested in refutation – proving that the other social theories are wrong – but in proposition. How far can one go by suspending the common sense hypothesis that the existence of a social realm offers a legitimate frame of reference for the social sciences? If physicists at the beginning of the previous century were able to do away with the common sense solution of an absolutely rigid and indefinitely plastic ether, can sociologists discover new traveling possibilities by abandoning the notion of a social substance as a ‘superfluous hypothesis’? This position is so marginal, its chance of success so slim, that I see no reason to be fair and thorough with the perfectly reasonable alternatives that could, at any point, smash it into pieces. So, I will be opinionated and often partial in order to demonstrate clearly the contrast between the two viewpoints. In exchange for this breach of fairness, I will try to be as coherent as possible in drawing the most extreme conclusions from the position I have chosen to experiment with. My test will be to see how many new questions can be brought to light by sticking firmly, even blindly, to all the obligations that this new departure point is forcing us to obey. The final test will be to check, at the end of this book, if the sociology of associations has been able

to take up the relay of the sociology of the social by following different types of new and more active connections, and if it has been able to inherit all that was legitimate in the ambition of a science of the social. As usual, the result of whether this has been successful or not will be up to the reader.

For those who like to trace a discipline to some venerable ancestor, it is worth noting that this distinction between two contrasted ways of understanding the duties of social science is nothing new. It was already in place at the very beginning of the discipline (at least in France) in the early dispute between the elder Gabriel Tarde and Emile Durkheim, the winner.⁹ Tarde always complained that Durkheim had abandoned the task of explaining society by confusing cause and effect, replacing the understanding of the social link with a political project aimed at social engineering. Against his younger challenger, he vigorously maintained that the social was not a special domain of reality but a principle of connections; that there was no reason to separate ‘the social’ from other associations like biological organisms or even atoms; that no break with philosophy, and especially metaphysics, was necessary in order to become a social science; that sociology was in effect a kind of interpsychology;¹⁰ that the study of innovation, and especially science and technology, was the growth area of social theory; and that economics had to be remade from top to bottom instead of being used as a vague metaphor to describe the calculation of interests. Above all, he considered the social as a circulating fluid that should be followed by new methods and not a specific type of organism. We don’t need to accept all of Tarde’s idiosyncrasies – and there are many – but in the gallery of portraits of eminent predecessors he is one of the very few, along with Harold Garfinkel, who believed sociology could be a science accounting for how society is held together, instead of using society to explain something else or to help solve one of the political questions of the time. That Tarde was utterly defeated by sociologists of the social to the point of being squeezed into a ghostly existence for a century does not prove that he was wrong. On the contrary, it simply makes this book even more necessary. I am convinced that if sociology had inherited more from Tarde (not to mention Comte, Spencer, Durkheim, and Weber), it could have been an even more relevant discipline. It still has the resources to become so as we will see at the end of this book. The two traditions can easily be reconciled, the second being

simply the resumption of the task that the first believed was too quickly achieved. The factors gathered in the past under the label of a ‘social domain’ are simply some of the elements to be assembled in the future in what I will call not a society but a *collective*.

[...]

This book on how to use ANT for reassembling social connections is organized in three parts corresponding to the three duties that the sociology of the social has conflated for reasons that are no longer justified:

How to *deploy* the many controversies about associations without restricting in advance the social to a specific domain?

How to render fully traceable the means allowing actors to *stabilize* those controversies?

Through which *procedures* is it possible to reassemble the social not in a society but in a collective?

In the first part, I will show why we should not limit in advance the sort of beings populating the social world. Social sciences have become much too timid in deploying the sheer complexity of the associations they have encountered.¹¹ I will argue that it’s possible to feed, so to speak, off controversies and learn how to become good relativists – surely an indispensable preparation before venturing into new territory. In the second part, I will show how it’s possible to render social connections traceable by following the work done to stabilize the controversies followed in the first part. Borrowing a metaphor from cartography, I could say that ANT has tried to render the social world as *flat* as possible in order to ensure that the establishment of any new link is clearly visible. Finally, I will conclude by showing why the task of assembling the collective is worth pursuing, but only after the shortcut of society and ‘social explanation’ has been abandoned. If it’s true that the views of society offered by the sociologists of the social were mainly a way of insuring civil peace when modernism was under way,¹² what sort of collective life and what sort of knowledge is to be gathered by sociologists of associations once modernizing has been thrown into doubt while the task of finding the ways to cohabit remains more important than ever?

[...]

Learning to Feed off Controversies

Like all sciences, sociology begins in wonder. The commotion might be registered in many different ways but it’s always the paradoxical presence of something at once

invisible yet tangible, taken for granted yet surprising, mundane but of baffling subtlety that triggers a passionate attempt to tame the wild beast of the social. ‘We live in groups that seem firmly entrenched, and yet how is it that they transform so rapidly?’ ‘We are made to do things by other agencies over which we have no control and that seem plain and mundane enough.’ ‘There is something invisible that weighs on all of us that is more solid than steel and yet so incredibly labile.’ ‘There exist forces that are strangely similar to those studied by natural scientists and yet distinctively different.’ ‘This puzzling mixture of obdurate resistance and perverse complexity seems wide opened to inquiry, and yet it defies all inquiries.’ It would be hard to find a social scientist not shaken by one or more of these bewildering statements. Are not these conundrums the source of our *libido sciendi*? What pushes us to devote so much energy into unraveling them?

There is, however, an increasing distance between what triggers those successive shocks and the solutions that have been devised to explain them. I am going to argue in Part I that although the insights of sociology are correct, the solutions suggested by a shrinking definition of the social has in many ways adulterated what was productive and scientific in them. This is why I want to reexamine each of those successive questions and dissect them so that we can renew our definition of what is an association.

Faithful to relativist principles, instead of dividing the social domain as most textbooks of sociology usually do into a list of actors, methods, and domains *already* taken as members of the social realm, I have organized the first part of this work by types of controversies about *what* this universe is made of. I think it is possible to build upon the major intuitions of the social sciences by examining five major uncertainties:¹³

- the nature of groups: there exist many contradictory ways for actors to be given an identity;
- the nature of actions: in each course of action a great variety of agents seem to barge in and displace the original goals;
- the nature of objects: the type of agencies participating in interaction seems to remain wide open;
- the nature of facts: the links of natural sciences with the rest of society seems to be the source of continuous disputes;
- and, finally, about the type of studies done under the label of a science of the social as it is never clear in which precise sense social sciences can be said to be empirical.

What has made ANT so implausible is that before going anywhere those five uncertainties have to be piled on top of one another, with each new one making the former even more puzzling until some common sense is regained – but only at the end. Most users of ANT have so far had little patience to wait and I can't blame them.

The reader will discover here a set of complicated instructions to make displacement more costly and more painful. The reason for this is that I want to break the habit of linking the notions of 'society', 'social factor', and 'social explanation' with a sudden *acceleration* in the description. When sociologists of the social pronounce the words 'society', 'power', 'structure', and 'context', they often jump straight ahead to connect vast arrays of life and history, to mobilize gigantic forces, to detect dramatic patterns emerging out of confusing interactions, to see everywhere in the cases at hand yet more examples of well-known types, to reveal behind the scenes some dark powers pulling the strings. Not that they are wrong since it's perfectly true that older social relations have been packaged in such a way as to seem to provide a ready explanation for many puzzling subjects. But the time has come to have a much closer look at the type of aggregates thus assembled and at the ways they are connected to one another.

When you wish to discover the new unexpected actors that have more recently popped up and which are not yet *bona fide* members of 'society', you have to travel somewhere else and with very different kinds of gear. As we are going to see, there is as much difference in the two uses of the word 'social' as there is between learning how to drive on an already existing freeway and exploring for the first time the bumpy territory in which a road has been planned against the wishes of many local communities.¹⁴ There's no question that ANT prefers to travel slowly, on small roads, on foot, and by paying the full cost of any displacement out of its own pocket.

The reason for this change of tempo is that, instead of taking a reasonable position and imposing some order beforehand, ANT claims to be able to find order much better *after* having let the actors deploy the full range of controversies in which they are immersed. It is as if we were saying to the actors: 'We won't try to discipline you, to make you fit into our categories; we will let you deploy your own worlds, and only later will we ask you to explain how you came about settling them.' The task of defining and ordering the social should be left to the actors themselves, not taken up by the analyst. This is

why, to regain some sense of order, the best solution is to trace connections *between* the controversies themselves rather than try to decide how to settle any given controversy.¹⁵ The search for order, rigor, and pattern is by no means abandoned. It is simply relocated one step further into abstraction so that actors are allowed to unfold their own differing cosmos, no matter how counter-intuitive they appear.

It is this increased level of abstraction in social theory which makes ANT hard to grasp at first. And yet this shift is comparable to what a cartographer does in trying to record the shape of a foreign coast on a piece of paper. She might exert herself to fit the various reports sent by explorers into some existing geometrical format – bays have to be circles, capes triangles, continents squares. But after noticing the hopeless mess created by those records, none of which exactly fall into pre-determined shapes, she will eagerly accept any proposition to displace the quest for geometrical rigor with a totally abstract Cartesian grid. Then she will use this empty grid to patiently record the coastline itself, allowing it to be drawn in as tortuous a way as geological history made it to be. Although it may appear stupid to record every reported point simply by longitude and latitude, it would be even more stupid to insist that only data that fits a preordained geometrical shape be kept. Similarly, ANT claims that it is possible to trace more sturdy relations and discover more revealing patterns by finding a way to register the links between unstable and shifting frames of reference rather than by trying to keep one frame stable. Society is no more 'roughly' made of 'individuals', of 'cultures', of 'nation states' than Africa is 'roughly' a circle, France a hexagon or Cornwall a triangle. There is nothing surprising in this since every scientific discipline is a slow training in devising the right sort of relativism that can be adapted to the data at hand. Why would sociology alone be forbidden to invent its own path and be requested to stick to the obvious? Now that geologists have accepted the notion of cold and rigid continental plates floating freely over the hot, molten seabed that seeps out of deep oceanic rifts, are they not, so to speak, on 'firmer ground'? Similarly, ANT claims that we will find a much more scientific way of building the social world if we abstain from interrupting the flood of controversies. We, too, should find our firm ground: on shifting sands. Contrary to what is so often said, relativism is a way to float on data, not drown in them.

Metaphors borrowed from cartography or from physics break down very fast, however, once the range of

uncertainties to be swallowed by sociologists of association begins to be deployed. In some extreme situations, actors seem to have an uncanny ability to disagree with everything sociologists supposedly take for granted in order to begin their work. Abandoning the fixed frame of reference offered by ether, as physicists did, appears in retrospect a rather simple affair when compared with what we will have to let go of if we want to leave the actors free to deploy the full incommensurability of their own world-making activities.¹⁶ Be prepared to cast off agency, structure, psyche, time, and space along with every other philosophical and anthropological category, no matter how deeply rooted in common sense they may appear to be.

Using the example of our cartographer, it is as if she had to deal not only with multiple reports coming from many travelers but also with multiple projection grids, where each point is requesting its own ad hoc coordinates. Faced with this confusion, one may decide to restrain the range of controversies or to unleash all of them. The first pre-relativist solution works fine but risks limiting sociology to routine, cold, and quiet situations. The second relativist solution tackles active, warm, and extreme situations, but then one has to let controversies unfold all the way. Striking some compromise between the two positions would be most absurd since controversies are not simply a nuisance to be kept at bay, but what allows the social to be established and the various social sciences to contribute in its building. Many of the

difficulties in developing those disciplines have come from a refusal to be theoretical enough and from a misplaced attempt at clinging to common sense mixed with an ill-timed craving for political relevance. Such is the extreme position I wish to try and sustain for as long as possible. The drawback is that throughout their travels readers have to support themselves on a strange diet: they have to feed off controversies about what the social is made out of.

Traveling with ANT, I am afraid to say, will turn out to be agonizingly slow. Movements will be constantly interrupted, interfered with, disrupted, and dislocated by the five types of uncertainties. In the world ANT is trying to travel through, no displacement seems possible without costly and painful translations. Sociologists of the social seem to glide like angels, transporting power and connections almost immaterially, while the ANT-scholar has to trudge like an ant, carrying the heavy gear in order to generate even the tiniest connection. At the end of this book, we will attempt to summarize what differentiates a good ANT account from a bad one – a crucial quality test – by asking three questions: have all the difficulties of traveling been recognized? Has the complete cost of the travel from one connection to the next been fully paid? Has the traveler not cheated by surreptitiously getting a ride from an already existing ‘social order’? In the meantime, my advice is to pack as little as possible, don’t forget to pay your ticket, and prepare for delays.

Notes

A shortened reference format is used in the notes. This somewhat austere book can be read in parallel with the much lighter Bruno Latour and Emilie Hermant (1998), *Paris ville invisible*, which tries to cover much of the same ground through a succession of photographic essays. It’s available online in English (*Paris the Invisible City*) at <http://bruno.latour.name>.

- 1 This expression is explained in Laurent Thévenot (2004), ‘A science of life together in the world’. This logical order – the assemblies of society after those of nature – is the exact opposite of how I came to think about it. The twin books – Bruno Latour (1999), *Pandora’s Hope: Essays on the reality of science studies* and Bruno Latour (2004), *Politics of Nature: How to Bring the Sciences into Democracy* – were written; long after my colleagues and I had developed an alternative social theory to deal with the new puzzles uncovered after carrying out our fieldwork in science and technology.
- 2 The diffusion of the word ‘actor’ itself being one of the many markers of this influence.
- 3 I will use the expression ‘society or other social aggregates’ to cover the range of solutions given to what I call below the ‘first source of uncertainty’ and that deals with the nature of social groups. I am not aiming especially here at the ‘holist’ definitions, since, as we shall see, the ‘individualist’ or the ‘biological’ definitions are just as valid.
- 4 Patricia Ewick and Susan S. Silbey (1998), *The Common Place of Law* and Silbey’s contribution to Bruno Latour and Peter Weibel (2005), *Making Things Public: Atmospheres of Democracy*.
- 5 For the distinction between critical sociology and sociology of critique, see Luc Boltanski and Laurent Thévenot (forthcoming) *On Justification*; Luc Boltanski and Laurent Thévenot (1999), ‘The Sociology of Critical Capacity’; and especially Luc Boltanski (1990), *L’amour et la justice comme compétences*.

- 6 A recent guide is presented in John Law (2004) *After Method: Mess in Social Science Research*. Andrew Barry (2001), *Political Machines. Governing a Technological Society* and Anne-Marie Mol (2003), *The Body Multiple: Ontology in Medical Practice (Science and Cultural Theory)* may also be taken as a good introduction along with Bruno Latour (1996), *Aramis or the Love of Technology*.
- 7 I have to apologize for taking the exact opposite position here as the one taken in Bruno Latour (1999c), 'On Recalling ANT'. Whereas at the time I criticized all the elements of his horrendous expression, including the hyphen, I will now defend all of them, *including* the hyphen!
- 8 See <http://www.lancs.ac.uk/FSS/sociology/css/antres/antres.htm>.
- 9 The only extensive introduction to Tarde in English is Gabriel Tarde and Terry C. Clark (1969), *On Communication and Social Influence*. For a more recent view see Bruno Latour (2002), 'Gabriel Tarde and the End of the Social'. An older translation is available online of Gabriel Tarde (1899/2000), *Social Laws: An Outline of Sociology*.
- 10 By opposition to *intra*-psychology on which he was almost completely silent, see Gabriel Tarde (1895/1999), *Monadologie et sociologie*.
- 11 I have left aside in this book the question of quantitative sociology not because I believe more in qualitative data, but because the very definition of which *quantum* to tally is at stake in the different definitions of the social vector I am going to follow here.
- 12 The first instance of the words 'sociology' and 'social sciences' are found in the famous pamphlet *Qu'est-ce que le Tiers-Etat?* by Emmanuel Joseph Sieyès (1748–1836) to designate a fusion of all the 'cameral sciences' in an art of government, see Frédéric Audren (forthcoming), 'Les juristes et les sociologues'.
- 13 I have chosen 'uncertainties' – in a weak allusion to the 'uncertainty principle' – because it remains impossible to decide whether it resides in the observer or in the phenomenon observed. As we will see, it's never the case that the analyst knows what the actirs ignore, nor is it the case that the actors know what the observer ignores. This is the reason why the social needs to be reassembled.
- 14 A reader, asking in what sense our theory of the social could be reconciled with 'conventional' sociology, offered as an objection the way AIDS patients mobilized as a group. Looking at traditional 'social movements', it was obvious to her that patients' organizations corresponded to 'conventional' definitions of the social because she had entirely forgotten how deeply innovative it was for patients to make politics out of retroviruses. For us on the other hand, AIDS activism, and more generally patient-based organizations, is just the type of innovation that requires completely new definitions of the social. See Steven Epstein (1996), *Impure Science. Aids, Activism and the Politics of Knowledge*; Michel Callon and Vololona Rabeharisoa (1999), *Le pouvoir des malades*; and Nicolas Dodier (2003), *Leçons politiques de l'épidémie de sida*. These prove how fast people forget the new associations and include them in their 'conventional' definition of what is a society.
- 15 A striking example of the richness of this approach has been provided in Boltanski and Thévenot, *On Justification*. In this major work, the authors have shown that it was possible to find a much more solid order once it was accepted that ordinary French persons, when engaged in polemics where they had to justify their positions, could rely not on one but six complete principles of justification (les *Cités* or Orders of Worth: Market, Industrial, Civic, Domestic, Inspired, Opinion) to which the authors later added a possible Green justification. See Claudette Lafaye and Laurent Thévenot (1993), 'Une justification écologique? Conflits dans l'aménagement de la nature'. Although those principles were incommensurable, the sociologists, by moving one step further into abstraction, could nonetheless render them comparable. It's this magnificent example of the power of relativity that I am trying to emulate here.
- 16 'World-making' would be a fine word, see Nelson Goodman (1988), *Ways of World Making*, were it not for the conception of 'making' that goes with it and the definition of the 'one world'.

References

- Audren, F. (forthcoming). 'Les juristes et les sociologues', Ph.D. thesis, Paris: Paris Sorbonne.
- Barry, A. (2001). *Political Machines: Governing a Technological Society*. London: Athlone Press.
- Bijker, W. (1995). *Of Bicycles, Bakelites, and Bulbs: Towards a Theory of Sociotechnical Change*. Cambridge, MA: MIT Press.
- Boltanski, L. (1990). *L'amour et la justice comme compétences*. Paris: A.-M. Métailié.
- Boltanski, L. and Thévenot, L. (2006). *On Justification* (trans. Catherine Porter). Princeton: Princeton University Press
- Callon, M. (1986). 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieux Bay', in *Power, Action and Belief. A New Sociology of Knowledge?* (ed. Law, J.), 196–229.
- Callon, M. and Latour, B. (1981). 'Unscrewing the Big Leviathans: How Do Actors Macrostructure Reality', in

- Advances in Social Theory and Methodology: Toward an Integration of Micro and Macro Sociologies*, (eds. Knorr, K. and Cicourel, A.) London: Routledge, 277–303.
- Callon, M., Lascoumes, P. and Barthe, Y. (2001). *Agir dans un monde incertain: Essai sur la démocratie technique*. Paris: Le Seuil.
- Callon, M. and Rabeharisoa, V. (1999). *Le pouvoir des malades*. Paris: Presses de l'École nationale des mines de Paris.
- Cronon, W. (1991). *Nature's Metropolis: Chicago and the Great West*. New York: Norton.
- Dodier, N. (2003). *Leçons politiques de l'épidémie de sida*. Paris: Presses de la Maison des Sciences de l'Homme.
- Epstein, S. (1996). *Impure Science: Aids, Activism and the Politics of Knowledge*. Berkeley: University of California Press.
- Ewick, P. and Silbey, S. S. (1998). *The Common Place of Law*. Chicago: University of Chicago Press.
- Goodman, N. (1988). *Ways of Worldmaking*. New York: Hackett Publishing Company.
- Hennion, A. (1993). *La passion musicale: Une sociologie de la médiation*. Paris: A.-M. Métailié.
- Hutchins, E. (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press.
- Kupiec, J.-J. and Sonigo, P. (2000). *Ni Dieu ni génie*. Paris: Le Seuil-Collection Science ouverte.
- Lafaye, C. and Thévenot, L. (1993). 'Une justification écologique? Conflits dans l'aménagement de la nature', *Revue Française de Sociologie*, 34/4: 495–524.
- Latour, B. (1988a). 'Irreductions' [to] Part II of *The Pasteurization of France*. Cambridge, MA: Harvard University Press.
- Latour, B. (1988b). *The Pasteurization of France*. Cambridge, MA: Harvard University Press.
- Latour, B. (1996). *Anamnis or the Love of Technology*. Cambridge, MA: Harvard University Press.
- Latour, B. (1999c). 'On Recalling ANT', in *Actor Network and After*, (eds. Law, J. and Hassard, J.) Oxford: Blackwell, 15–25.
- Latour, B. (1999b). *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA: Harvard University Press.
- Latour, B. (2002). 'Gabriel Tarde and the End of the Social', in *The Social in Question: New Bearings in the History and the Social Sciences*, (ed. Joyce, P.) London: Routledge, 117–132.
- Latour, B. (2004b). *Politics of Nature: How to Bring the Sciences into Democracy* (trans. Catherine Porter). Cambridge, MA: Harvard University Press.
- Latour, B. and Hermant, E. (1998). *Paris ville invisible*. Paris: La Découverte-Les Empêcheurs de penser en rond.
- Latour, B. and Weibel, P. (eds.) (2005). *Making Things Public: Atmospheres of Democracy*. Cambridge, MA: MIT Press.
- Law, J. (1986). 'On the Methods of Long-Distance Control: Vessels, Navigation and the Portuguese Route to India', in *Power, Action and Belief. A New Sociology of Knowledge?* (ed. Law, J.) Keele: Sociological Review Monograph, 234–263.
- Law, J. (2004). *After Method: Mess in Social Science Research*. London: Routledge.
- McNeill, W. (1976). *Plagues and Peoples*. New York: Anchor Press.
- Mol, A. (2003). *The Body Multiple: Ontology in Medical Practice (Science and Cultural Theory)*. Duke University Press.
- Tarde, G. (1895/1999). *Monadologie et sociologie*. Paris: Les empêcheurs de penser en rond.
- Tarde, G. (1899/2000). *Social Laws: An Outline of Sociology* (trans. Howard C. Warren). Kitchener, Ont.: Batoche Books.
- Tarde, G. (1969). *On Communication and Social Influence. Selected Papers*. Edited by Terry N. Clark. Chicago: University of Chicago Press.

Actor–Network Theory: Critical Considerations

Sergio Sismondo

Actor–Network Theory: Relational Materialism

Actor–network theory (ANT) is the name given to a framework originally developed by Michel Callon (e.g. 1986), Bruno Latour (e.g. 1987), and John Law (e.g. 1987). ANT has its origins in an attempt to understand science and technology, or rather *technoscience*, since on this account science and technology involve importantly similar processes (Latour 1987). ANT is, though, a general social theory centered on technoscience, rather than just a theory of technoscience.

ANT represents technoscience as the creation of larger and stronger networks. Just as a political actor assembles alliances that allow him or her to maintain power, so do scientists and engineers. However, the actors of ANT are heterogeneous in that they include both human and non-human entities, with no methodologically significant distinction between them. Both humans and non-humans form *associations*, linking with other actors to form networks. Both humans and non-humans have *interests* that cause them to act, that need to be accommodated, and that can be managed and used. Electrons, elections, and everything in between contribute to the building of networks.

Michel Callon (1987), for example, describes the effort of a group of engineers at Electricité de France (EDF) to

introduce an electric car in France. EDF’s engineers acted as “engineer–sociologists” in the sense that they articulated a vision simultaneously of fuel cells for these new cars, of French society into which electric cars would later fit, and of much between the two – engineering is never complete if it stops at the obvious boundaries of engineered artifacts. The EDF actors were not alone, though; their opponents at Renault, who were committed to internal combustion engines, criticized both the technical details and the social feasibility of EDF’s plans, and so were also doing engineering–sociology. The engineering and the sociology are inseparable. Neither the technical vision nor the social vision will come into being without the other, though with enough concerted effort both may be brought into being together.

ANT’s sociology, and the implicit sociology of the scientists and engineers being studied, deals with concrete actors rather than macro-level forces. Latour describes the efforts of the engineer Rudolf Diesel to build an earlier (than EDF’s) new type of engine: “At the start, Diesel ties the fate of his engine to that of *any* fuel, thinking that they would all ignite at a very high pressure. . . . But then, nothing happened. Not every fuel ignited. This ally, which he had expected to be unproblematic and faithful, betrayed him. Only kerosene ignited, and then only erratically. . . . So what is happening? Diesel has to *shift his system of alliances*” (Latour 1987: 123). Diesel’s alliances include

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entities as diverse as kerosene, pumps, other scientists and engineers, financiers and entrepreneurs, and consumers. The technoscientist needs to remain constantly aware of a shifting array of dramatically different actors in order to succeed. A stable network, and a successful piece of technoscience, is the result of managing all of these actors and their associations so that they contribute toward a goal.

Actors build networks. These networks might make machines function, when their components are made to act together to achieve a consistent effect. Or, they might turn beliefs into taken-for-granted facts, when their components are made to act as if they are in agreement. So working machines and accepted facts are the products of networks. The activity of technoscience, then, is the work of understanding the interests of a variety of actors, and *translating* those interests so that the actors work in agreement (Callon 1986; Callon and Law 1989). That is, in order to form part of a network, an actor must be brought to bear on other actors, so they must be brought together. Moreover, they must be brought together so as to work together, which may mean changing the ways in which they act. By being moved and changed, interests are translated in both place and form. In this way, actors are made to act; as originally defined, the actors of ANT are *actants*, things *made to act*.

ANT is a materialist theory. It reduces even the “social” to the material, both inside and outside of science (Latour 2005). Science and technology work by translating material actions and forces from one form into another. Scientific representations are the result of material manipulations, and are solid precisely to the extent that they are mechanized. The rigidity of translations is key here. Data, for example, is valued as a form of representation because it is supposed to be the direct result of interactions with the natural world. Visiting an ecological field site in Brazil, Latour (1999) observes researchers creating data on the colors of soil samples. So that the color of the sample can be translated into a uniform code, Munsell color charts are held against the samples (just as a painter will hold a color chart against a paint sample). As Latour jokes, the gap between representation and the world, a standard philosophical problem that gives rise to questions about realism, is reduced by scientists to a few millimeters. Data-level representations are themselves juxtaposed to form new relationships that are summarized and otherwise manipulated to form higher-level representations, representations that are more general and further from their objects. Again, the translation metaphor is apt, because these operations can be seen as translations of representations into new forms, in which they will be more generally applicable.

Ideally, there should be no leaps between data and theory – and between theory and application – but only a series of minute steps. There is no action at a distance, though through the many translations or linkages there may be long-distance control (see Star 1989).

Again, science and technology must work by translating material actions and forces from one form into another. The working of abstract theories and other general knowledge appears a miracle unless it can systematically be derived from or traced to local interactions, via hands-on manipulation and working machines, via extractions from original settings, via data, and via techniques for summarizing, grouping, and otherwise exploiting information. This is the methodological value of materialism. Universal scientific knowledge is the product of the manipulation of local accounts, a product that can supposedly be transported through time and space to a wide variety of new local circumstances. But such universal knowledge is only applicable through a new set of manipulations that adapt it once again to those local circumstances (or adapt those local circumstances to it). Sciences have to solve the problem of action at a distance, but in so doing they work toward a kind of universality of knowledge.

Seen in these terms, laboratories give scientists and engineers power that other people do not have, for “it is in the laboratories that most new sources of power are generated” (Latour 1983: 160). The laboratory contains tools, like microscopes and telescopes, that change the effective sizes of things. Such tools make objects human in scale, and hence easier to observe and manipulate. The laboratory also contains a seemingly endless variety of tools for separating parts of objects, for controlling them, and for subjecting them to tests: objects are tested to find out what they can and cannot do. This process can also be thought of as a series of tests of actors, to find out which alliances can and cannot be built. Simple tools like centrifuges, vacuum pumps, furnaces, and scales have populated laboratories for hundreds of years; these and their modern descendants tease apart, stabilize, and then quantify objects, enabling a kind of *engine science* (Carroll 2006). *Inscription devices*, or machines that “transform pieces of matter into written documents” (Latour and Woolgar 1986: 51), allow researchers to deal with nature on pieces of paper. Like the representations produced by telescopes and microscopes these are also medium-sized, but perhaps more importantly they are durable, transportable, and relatively easy to compare to each other. Such *immutable mobiles* can be circulated and manipulated independently of the contexts from which they derive. Nature brought to a human scale, teased into components, made stable in

Box 1 The Pasteurization of France

Louis Pasteur's anthrax vaccine is the subject of an early statement of actor-network theory (Latour 1983), and Pasteur's broader campaign on the microbial theory of disease is the subject of a short book (Latour 1988).

How could Pasteur be seen as the central cause of a revolution in medicine and public health, even though he, as a single actor, could do almost nothing by himself? The laboratory was probably the most important starting point. Here is Pasteur, describing the power of the laboratory:

As soon as the physicist and chemist leave their laboratories ... they become incapable of the slightest discovery. The boldest conceptions, the most legitimate speculations, take on body and soul only when they are consecrated by observation and experience. Laboratory and discovery are correlative terms. Eliminate the laboratories and the physical sciences will become the image of sterility and death ... Outside the laboratories, the physicists and chemists are unarmed soldiers in the battlefield. (in Latour 1988: 73)

Pasteur used the strengths of the laboratory to get microbes to do what he wanted. Whereas in nature microbes hide, being invisible components of messy constellations, in the laboratory they could be isolated and nurtured, allowing Pasteur and his assistants to deal with visible colonies. These could be tested, or subjected to *trials of strength*, to find their properties. In the case of microbes, Pasteur was particularly interested in finding weak versions that could serve as vaccines.

Out of the complex set of symptoms and circumstances that make a disease, Pasteur *defined* a microbe in the laboratory; his manipulations and records specified its boundaries and properties. He then was able to argue, to the wider scientific and medical community, that his microbe was responsible for the disease. This was in part done via public demonstrations that repeat laboratory experiments. Breakthroughs like the successful vaccination of sheep against anthrax were performed in carefully staged demonstrations, in which the field was turned into a laboratory, and the public was invited to witness the outcomes of already-performed experiments. Public demonstrations helped convince people of two important things: that microbes are key to their goals, whether those goals are health, the strength of armies, or public order; and that Pasteur had control over those microbes.

Microbes were not merely entities that Pasteur studied, but agents with whom Pasteur built an alliance. The alliance was ultimately very successful. It created enormous interest in Pasteur's methods of inquiry, reshaped public health measures, and brought prestige and power to Pasteur. We might see Pasteur's work as having introduced a new element into society, an element of which other people have to take account if they are to achieve their goals.

When doctors, hygienists, regulators, and others put in place measures oriented around Pasteur's purified microbe, it became a taken-for-granted truth that the microbe was the real cause of the disease, and that Pasteur was the cause of a revolution in medicine and public health.

the laboratory, and turned into marks on paper or in a computer, is manipulable, and manipulable at leisure in *centers of calculation* (Latour 1987) where inscriptions can be combined and analyzed to produce abstract and general representations. When they become accepted, those representations are often taken to be Nature, rather than products of or interpretations of nature.

We can see that, while ANT is a general theory, it is one that explains the centrality of science and technology to the idea of modernity (Latour 1993). Technologies reshape the field of agency, because people delegate agency to them. Science and technology explicitly engage in crossing back and forth between objects and representations, creating more situations in which humans and non-humans affect each other. Science and technology are responsible for the contemporary world, because more than any other activities they have mixed humans and

non-humans together, allowing a dramatic expansion of the social world. Science and technology have brought non-humans into the human world, to shape, replace, and enlarge social organizations, and have brought human meanings and organizations to the non-human world, to create new alignments of forces (Latour 1994).

But although the material processes by which facts and machines are produced may be very complex, science and engineering's networks often stabilize and become part of the background or invisible. Configurations become *black boxes*, objects that are taken for granted as completed projects, not as messy constellations. The accumulation of black boxes is crucial for what is considered progress in science and engineering. As philosopher Alfred North Whitehead (1992 [1911]) wrote, "Civilization advances by extending the number of important operations which we can perform without thinking about them."

While actor-network theory is thoroughly materialist, it is also built on a relational ontology; it is based on a *relational materiality* (Law 1999). Objects are defined by their places in networks, and their properties appear in the context of tests, not in isolation. Perhaps most prominently, not only technological objects but also social groups are products of network-building. Social interests are not fixed and internal to actors, but are changeable external objects. The French military of 1880 was interested in recruiting better soldiers, but Louis Pasteur translated that interest, via rhetorical work, into support for his program of research. After Pasteur's work, the military had a new interest in basic research on microbes. Translation in ANT's sense is not neutral.

Box 2 Ecological thinking

Science and technology are done in rich contexts that include material circumstances, social ties, established practices, and bodies of knowledge. Scientific and technological work is performed in complex ecological circumstances; to be successful, that work must fit into or reshape its environment.

An ecological approach to the study of science and technology emphasizes that multiple and varying elements contribute to the success of an idea or artifact – and any element in an idea or artifact's environment may be responsible for failure. An idea does not by itself solve a problem, but needs to be combined with time to develop it, skilled work to provide evidence for it, rhetorical work to make it plausible to others, and the support to put all of those in place. If some of the evidential work is empirical, then it will also demand materials, and the tinkering to make the materials behave properly. Solutions to problems, therefore, need nurturing to succeed.

There is no *a priori* ordering of such elements. That is, no one of them is crucial in advance. With enough effort, and with enough willingness to make changes elsewhere in the environment, anything can be changed, moved, or made irrelevant. As a result, there is no *a priori* definition of good and bad ideas or good and bad technologies. Success stories are built out of many distinct elements. They are typically the result of many different innovations, some of which might normally be considered technical, some economic, some social, and some political. The “niche” of a technological artifact or a scientific fact is a multi-dimensional development.

Whereas the strong programme was “symmetric” in its analysis of truth and falsity and in its application of the same social explanation for, say, both true and false beliefs, ANT is “supersymmetric,” treating both the social and material worlds as the products of networks (Callon and Latour 1992; Callon and Law 1995). Representing both human and non-human actors, and treating them in the same relational terms, is one way of prompting full analyses, analyses that do not discriminate against any part of the ecologies of scientific facts and technological objects. It does not privilege any particular set of variables, because every variable depends upon others. Networks confront each other as wholes, and to understand their successes and failures STS has to study the wholes (and the parts) of those networks.

Some Objections to Actor-Network Theory

Actor-network theory, especially in the form articulated by Bruno Latour in his widely read book *Science in Action* (1987), has become a constant touchstone in STS, and is increasingly being exported into other domains. The theory is easy to apply to, and can offer insights on, an apparently limitless number of cases. Its focus on the materiality of relations creates research problems that can be solved, through analyses of the components and linkages of any given network. Yet its broad application of materialism, and the fact that its materialism is relational, means that its applications are often counter-intuitive. This success does not, though, mean that STS has uncritically accepted ANT. The remainder of this chapter is devoted to criticisms of the theory. This discussion of problems that ANT faces is not supposed to indicate the theory's failure, but instead should contribute to further explaining the theory and demonstrating its scope.

1 Practices and cultures

Actor-network theory, and for that matter almost every other approach in STS, portrays science and engineering as rational in a means–end sense: technoscientists use the resources that are available – rhetorical resources, established power, facts, and machines – to achieve their goals. Of course, rational choices are not

made in a vacuum, or even only in a field of simple material and conceptual resources. They are made in the context of existing technoscientific cultures and practices. Practices can be thought of as the accepted patterns of action and styles of work; cultures define the scope of available resources (Pickering 1992). Opportunistic work, even work that transforms cultures and practices, is an attempt to appropriately combine and recombine cultural resources to achieve particular goals. Practices and cultures provide the context and structure for technoscientific opportunism. But because ANT treats humans and non-humans on the same footing, and because it adopts an externalized view of actors, it does not pay attention to such distinctively human and apparently subjective factors as cultures and practices.

Cultures and cultural networks do not fit neatly into the network framework offered by ANT. For example, mathematical physicists at Cambridge University developed a particular style of work and theorizing (Warwick 2003; see Box 3). The result was a generalized culture of physics that shaped and was shaped by pedagogy, skills, and networks. To take another example, trust is an essential feature of scientific and technological work, in that researchers rely upon findings and arguments made by people they have never met, and about whom they may know almost nothing. But trust is often established through faith in a common culture. The structure of trust in science was laid down by being transferred from the structure of gentlemanly trust in the seventeenth century; gentlemen could trust each other, and could not easily challenge each other's truthfulness (Shapin 1994). Similarly, trust in technical judgment often resides in cultural affiliations. Engineers educated in the *École Polytechnique* in nineteenth-century France trusted each other's judgments (Porter 1995), just as did engineers educated at the Massachusetts Institute of Technology in the twentieth century (e.g. MacKenzie 1990).

To account for even rational choices we need to invoke practices and cultures. Yet the world of ANT is culturally flat. Within the terms of the theory practices and cultures need be understood in terms of arrangements of actors that produce them. Macro-level features of the social world have to be reducible to micro-level ones, without action at a distance. While that is possibly very attractive, the reduction represents a large promise-sorry note.

Box 3 The Mathematical Tripos and the Cambridge culture of mathematical physics

For much of the nineteenth century, placing highly on Cambridge University's Mathematical Tripos exam was a mark of the successful Cambridge undergraduate, even among those not intending to go on in mathematized fields. The pressure to perform well spawned systems of private tutoring, intense study, and athletic activity, in which students mastered problems, techniques, heuristics, and bodily discipline – university athletics as a whole arose in part because of the exam (Warwick 2003). Students hoping to score among the top group had little choice but to hire the top tutors and submit to their highly regimented plans of study; those tutors, some of them brilliant at both mathematical physics and pedagogy, taught many of the most important physicists of the century. The increasing ability of the undergraduates, and competition in the relatively closed world of those setting the exam, led to the Tripos's increasing difficulty, and also fame: lists of those in the order of merit, with special attention on those placed as "Wranglers" at the top, were printed in the *Times* of London from 1825 to 1909.

All of this activity created a distinctive culture of mathematical physics at Cambridge, one centered on a particular array of skills and examination-sized problems. Even James Clerk Maxwell's 1873 *Treatise on Electricity and Magnetism*, one of the key works of physics of the nineteenth century, was partly written as a textbook for Cambridge undergraduates, and featured case-by-case solutions to problems. That difficult work, in turn, became important to pedagogy, through its consistent and careful interpretation by other physicists, at Cambridge and elsewhere in Britain. The result was a distinctive style of classical physics in Britain, that was, for example, practically incommensurable with the new styles of physics that arose in Germany in the twentieth century, because its core mathematical practices were different (Warwick 2003).

2 Problems of agency

Actor-network theory has been criticized for its distribution of agency. On the one hand, it may encourage analyses centered on key figures, and perhaps as a result

many of the most prominent examples are of heroic scientists and engineers, or of failed heroes. The resulting stories miss work done by other actors, miss structures that prevent others from participating, and miss non-central perspectives. Marginal, and particularly marginalized, perspectives may provide dramatically different insights; for example, women who are sidelined from scientific or technical work may see the activities of science and technology quite differently (e.g. Star 1991). With ANT's focus on agency, positions from which it is difficult to act make for less interesting positions from which to tell stories. So ANT may encourage the following of heroes and would-be heroes.

On the other hand, actor-network analyses can be centered on any perspective, or on multiple perspectives. Michel Callon even famously uses the perspective of the scallops of St. Brieuc Bay for a portion of one important statement of ANT (Callon 1986). This positing of non-human agents is one of the more controversial features of the theory, attracting a great deal of criticism (see, e.g., Collins and Yearley 1992).

In principle, ANT is entirely symmetrical around the human/non-human divide. Non-humans can appear to act in exactly the same way as do humans – they can have interests, they can enroll others. (Because ANT's actors are *actants*, things made to act, agency is an effect of networks, not prior to them. This is a difficult distinction to sustain, and the ends of ANT's analyses seem to rest on the agency of non-humans.) Critics, though, argue that humans and non-humans are crucially different. Humans have, and most non-humans do not have, intentionality, which is necessary for action on traditional accounts of agency. To treat humans and non-humans symmetrically, ANT has to deny that intentionality is necessary for action, and thus deny that the differences between humans and non-humans are important for the theory overall,

In practice, though, actor-network analyses tend to downplay any agency that non-humans might have (e.g. Miettinen 1998). Humans appear to have richer repertoires of strategies and interests than do non-humans, and so tend to make more fruitful subjects of study. The subtitle of Latour's popular *Science in Action* is *How to Follow Scientists and Engineers through Society*, suggesting that however symmetric ANT is, of particular interest are the actions of scientists and engineers.

3 Problems of realism

Running parallel to problems of agency are problems of realism. On the one hand, ANT's relationalism would seem to turn everything into an outcome of network-building. Before their definition and public circulation through laboratory and rhetorical work, natural objects cannot be said to have any real scientific properties. Before their public circulation and use, artifacts cannot be said to have any real technical properties, to do anything. For this reason, ANT is often seen, despite protests by actor-network theorists, as a blunt version of constructivism: what is, is constructed by networks of actors. This constructivism flies in the face of strong intuitions that scientists discover, rather than help create, the properties of natural things. It flies in the face of strong intuitions that technological ideas have or lack force of their own accord, whether or not they turn out to be successful. And this constructivism runs against the arguments of realists that (at least some) things have real and intrinsic properties, no matter where in any network they sit.

On the other hand, positing non-human agents appears to commit ANT to realism. Even if ANT assumes that scientists in some sense define or construct the properties of the so-called natural world, it takes their interests seriously. That is, even if an object's interests can be manipulated, they resist that manipulation, and hence push back against the network. This type of picture assumes a reality that is prior to the work of scientists, engineers, and any other actors. Latour says, "A little bit of constructivism takes you far away from realism; a complete constructivism brings you back to it" (Latour 1990: 71).

Theorists working outside the ANT tradition are faced with similar problems. For example, Karen Barad (2007) articulates a position she calls *agential realism*: human encounters with the world take the form of *phenomena*, which are ontologically basic. Material-discursive practices create intra-actions within these phenomena. These parcel out features of the world and define them as natural or human. Similarly, Andrew Pickering's pragmatic realism (1995) describes a *mangle of practice* in which humans encounter *resistances* to which they respond. Technologies and facts about nature result from a dialectic of resistance and accommodation. Barad's and Pickering's frameworks, which share features with ANT and with each other, are designed to bridge constructivist and realist views.

The implicit realism of ANT has been both criticized, as a step backwards from the successes of methodological relativism (e.g. Collins and Yearley 1992), and praised as a way of integrating the social and natural world into STS (Sismondo 1996). For the purposes of this book, whether ANT makes realist assumptions, and whether they might move the field forwards or backwards are left as open questions, much as they have been in STS itself.

4 Problems of the stability of objects and actions

A further problem facing ANT will be made more salient in later chapters. According to the theory, the power of science and technology rests in the arrangement of actors so that they form literal and metaphorical machines, combining and multiplying their powers. That machining is made possible by the power of laboratories and laboratory-like settings (such, as field sites) that are made to mimic labs (Latour 1999). As noted above, the power of laboratories depends upon material observations and manipulations that we presume to be repeatable and stable. Once an object has been defined and characterized, it can be trusted to behave similarly in all similar situations, and actions can be delegated to that object.

Science and technology gain power from the translation of forces from context to context, translations that can only be consistently achieved by formal rules. However, rules have to be interpreted, and Wittgenstein's problem of rule following shows that no statement of a rule can determine its interpretations. STS has shown

how tinkering is crucial to science and technology, how the work of making observations and manipulations is difficult, how much routine science and engineering involves expert judgment, and how that judgment is not reducible to formulas. ANT, while it recognizes the provisional and challengeable nature of laboratory work, glides over these issues. It presents science and technology as powerful because of the rigidity of their translations, or the objectivity – in the sense that they capture objects – of their procedures. Yet rigidity of translation may be a fiction, hiding many layers of expert judgment.

Conclusions

Especially since the publication of Latour's *Science in Action* (1987), ANT has dominated theoretical discussions in STS, and has served as a framework for an enormous number of studies. Its successes, as a theory of science, technology, and everything else, have been mostly bound up in its relational materialism. As a materialist theory it explains intuitively the successes and failures of facts and artifacts: they are the effects of the successful translation of actions, forces, and interests. As a relationalist theory it suggests novel results and promotes ecological analyses: humans and non-humans are bound up with each other, and features on neither side of that apparent divide can be understood without reference to features on the other. Whether actor-network theorists can answer all the questions people have of it remains to be seen, but it stands as the best known of STS's theoretical achievements so far.

References

- Barad, Karen (2007) *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham, NC: Duke University Press.
- Callon, Michel (1986) "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay." In J. Law, ed., *Power, Action and Belief*. London: Routledge & Kegan Paul, 196–233.
- Callon, Michel (1987) "Society in the Making: The Study of Technology as a Tool for Sociological Analysis." In W. E. Bijker, T. P. Hughes, and T. J. Pinch, eds, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press, 83–103.
- Callon, Michel and Bruno Latour (1992) "Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley." In A. Pickering, ed., *Science as Practice and Culture*. Chicago: University of Chicago Press, 343–68.
- Callon, Michel and John Law (1989) "On the Construction of Sociotechnical Networks: Content and Context Revisited." In R. A. Jones, L. Hargens, and A. Pickering, eds, *Knowledge and Society, Vol. 8: Studies in the Sociology of Science Past and Present*. Greenwich, CT: JAI Press, 57–83.
- Callon, Michel and John Law (1995) "Agency and the Hybrid Collectif." *South Atlantic Quarterly* 94: 481–507.
- Carroll, Patrick (2006) *Science, Culture, and Modern State Formation*. Berkeley: University of California Press.
- Collins, H. M. and S. Yearley (1992) "Epistemological Chicken." In A. Pickering, ed., *Science as Practice and Culture*. Chicago: University of Chicago Press, 301–26.

- Latour, Bruno (1983) "Give Me a Laboratory and I Will Raise the World." In K. D. Knorr Cetina and M. Mulkay, eds, *Science Observed: Perspectives on the Social Study of Science*. London: Sage, 141–70.
- Latour, Bruno (1987) *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.
- Latour, Bruno (1988) *The Pasteurization of France*. Tr. A. Sheridan and J. Law. Cambridge, MA: Harvard University Press.
- Latour, Bruno (1990) "The Force and the Reason of Experiment." In H. E. L. Grand, *Experimental Inquiries*. Dordrecht: Kluwer, 49–80.
- Latour, Bruno (1993) *We Have Never Been Modern*. Tr. C. Porter. New York: Harvester Wheatsheaf.
- Latour, Bruno (1994) "Pragmatogonies: A Mythical Account of How Humans and Nonhumans Swap Properties." *American Behavioral Scientist* 37: 791–808.
- Latour, Bruno (1999) *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA: Harvard University Press.
- Latour, Bruno (2005) *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.
- Latour, Bruno and Steve Woolgar (1986) *Laboratory Life: The Construction of Scientific Facts*, 2nd edn. Princeton: Princeton University Press.
- Law, John (1987) "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion." In W. E. Bijker, T. P. Hughes, and T. J. Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press, 111–34.
- Law, John (1999) "After ANT: Complexity, Naming and Topology." In J. Law and J. Hassard, eds, *Actor Network Theory and After*. Oxford: Blackwell, 1–14.
- MacKenzie, Donald (1990) *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance*. Cambridge, MA: MIT Press.
- Miettinen, Reijo (1998) "Object Construction and Networks in Research Work: The Case of Research on Cellulose-Degrading Enzymes." *Social Studies of Science* 28: 423–64.
- Pickering, Andrew (1992) "From Science as Knowledge to Science as Practice." In A. Pickering, ed., *Science as Practice and Culture*. Chicago: University of Chicago Press, 1–26.
- Pickering, Andrew (1995) *The Mangle of Practice: Time, Agency, and Science*. Chicago: University of Chicago Press.
- Porter, Theodore M. (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton: Princeton University Press.
- Shapin, Steven (1994) *A Social History of Truth: Civility and Science in Seventeenth-Century England*. Chicago: University of Chicago Press.
- Sismondo, Sergio (1996) *Science without Myth: On Constructions, Reality, and Social Knowledge*. Albany, NY: SUNY Press.
- Star, Susan Leigh (1991) "Power, Technologies and the Phenomenology of Conventions: On Being Allergic to Onions." In J. Law, ed., *A Sociology of Monsters: Essays on Power, Technology and Domination*. London: Routledge, 26–56.
- Warwick, Andrew (2003) *Masters of Theory: Cambridge and the Rise of Mathematical Physics*. Chicago: University of Chicago Press.
- Whitehead, Alfred North (1992) *An Introduction to Mathematics* (1st edn 1911). Oxford: Oxford University Press.

Part IV

Heidegger on Technology

Introduction

Most philosophers of technology would probably agree that, for good or (at least as often) for ill, Martin Heidegger's interpretation of technology, its meaning in Western history, and its role in contemporary human affairs is still the single most influential position in the field. The selections in this part, first from Heidegger himself and then from a sampling of his readers, introduce some lines of his influence that also anticipate discussions in subsequent sections.

Heidegger's consideration of technology spans some 40 years, but his core position is found in the article reprinted here. It treats technology (and its association with science) in a way that opens up what Heidegger initially called his "question of the meaning of Being." In his view, the scientifically informed technology that increasingly dominates our world is not something fundamentally new or even modern. Rather, it fulfills Western philosophy's oldest desire for knowledge of what is real as that is expressed in the pre-Socratics, Plato, and Aristotle. For all the specific satisfactions this fulfillment obviously brings, however, Heidegger questions whether it can ever make us feel genuinely "at home." From the start, he was convinced that a science-driven, technologically informed "understanding of Being" – in other words, our primary, operative sense of what it means for something to be "real" – is increasingly experienced as more constraining than satisfactorily illuminating of our encounters with each other and with our surroundings. In *Being and Time*, he proposes to raise the Being-question "again," in hopes of opening up our thinking

to a less hegemonic and more pluralistic conception of the ways that things can "be."

After *Being and Time*, however, Heidegger grew increasingly dissatisfied with several features of his initial way of posing his question. He came to believe that – quite aside from what he himself may have learned in the process – it was misleading to have conceived his inquiry as one that must start with an analysis of specifically "human" Being and then turn to the task of "overcoming" Western metaphysics. In characterizing his intentions this way, *Being and Time* created the impression that if we would only (1) make our own Being the primary topic and (2) view traditional philosophy as the culprit, then (3) we might somehow achieve a standpoint that is "after," or radically freed up from, this tradition. On all three counts, however, this impression is wrong. As the later Heidegger sees it in retrospect, neither something about ourselves, nor opposition to traditional metaphysics, nor the dream of a post-traditional philosophy define the direction of his inquiry. Rather, "thinking" must locate itself at and within the "site" or "clearing" where our relationships with things and people take place.

"The Question Concerning Technology" is one of many works in which Heidegger recasts his original project in terms of this "thinking." As its opening lines show, the discussion begins neither with ourselves nor with technological things but with their *relationship*. What is it like, Heidegger asks, to be "in the midst" of a technological existence? Presently, typically, we tend to be "chained" to technology; but analysis of precisely this condition can show the way to open up a "free"

relationship with technology instead. The analysis has four parts. First, Heidegger distinguishes a “correct” from the “true” understanding of technology. A correct understanding interprets technology the way many readers interpreted *Being and Time*, that is, in terms of what it is “for us.” Interpreted this way, technology seems obviously to be a human activity that provides the means to our ends. This “instrumentalist” interpretation is not wrong, but it fails to account for its own “uncanny” correctness. Hence, it only opens up a deeper question – namely, what is technology, “essentially,” such that “the instrumental” is already understood to define the very atmosphere in which (or “site” where) means, ends, and the “will to mastery” typically predominate? Second, with this question in mind, Heidegger considers instrumentality in terms of the notion of “for what end(s)?” and – through analyses of the traditional concepts of “cause” and of “*technē*” as a practical art involving a kind of bringing-forth (*poiēsis*) – he suggests that with technology comes a distinctive mode of disclosiveness, or revealedness, that is, a kind of ontological truth (*alētheia*).

Third, Heidegger develops the idea that technological truth needs to be treated not just as a disclosure but as a “sent” disclosure. Considered in this way, technological truth can be seen to account for the way we characteristically find ourselves already “put in the midst” of our busy instrumental circumstances. In *Being and Time*, Heidegger analyzed practical and theoretical being-in-the-world, respectively, in terms of relatively simple tasks and a critique of modern epistemology. In the “Technology” essay, however, he describes these activities in the more specifically contemporary terms of technoscientific practice and theory. Our activities, the things we encounter and deal with, and even we ourselves all seem to happen together in a “world” where everything is set up and “enframed” as part of a stockpile of available materials and personnel – what Heidegger calls a “standing-reserve” (*Bestand*), always ready for technologically determined purposes. Enframing (*Gestell*), then, is the “essence” of the technological – essence, not in the traditional sense of a permanent and unchangeable character or set of properties, but in the sense of a predominant way of disclosing meaning which “gives” the instrumentally useful its familiar “instrumental” sense. Heidegger goes on to consider the current hegemony of this gift of disclosure – that is, the way it infuses the world with a pervasive sense of the disposable usefulness of everything so that it tends to hide both other (i.e., non-instrumental) possibilities and also itself as precisely this sent, or occurrent, enframing.

Finally, Heidegger urges us to “thoughtfully reflect” upon the “eventuation” (*Ereignis*) of this enframing instead of “falling away” from it into the ever more frantic pursuit of instrumental means to technoscientifically defined ends. Becoming captive to this pursuit, he says, is the ever-present “danger” of our age. By reflecting upon the very occurrence of enframing, however, we may come to recognize a “saving power” – the other possibility into which enframing places us – namely, the possibility of opening up a “free relation with technology.” Such a relation, he concludes, would be one in which technology is “decisively confronted” and in which technological engagements, no matter how pervasive and compelling, do not close us off from non-instrumental possibilities. Heidegger leaves us with the provocative suggestion that such a relation – one that is not wholly captivated by technoscientific activities but also one that does not fancifully imagine being transported beyond or outside of these activities – would necessarily involve a transformation of the very site where all of this occurs. A free relation with technology would thus have to happen, he says, “in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it.”

The other essays in this section (as well as the Ihde and Verbeek selections in Part VI) each react quite differently to Heidegger’s holistic or “global” interpretation of technology relations as always taking place within an enframing “realm” of available things and personnel. Robert Scharff argues that, surprisingly, Comte and Heidegger actually share this interpretation. Both regard technoscience as nothing short of the “culmination” of the Western intellectual tradition; and both see themselves as thinking about the essential character of this culmination from *within* the experienced situation it defines, not from some imagined vantage point outside of it. The question, then, is how to understand their radically different reactions to the increasingly hegemonic reach of technology and science – the implication being, of course, that understanding the difference between Comte and Heidegger might also help illuminate current debates. Scharff suggests that the difference in their reactions is not a function of any disagreements about particular technologies or particular issues in epistemology. The real contrast is between an upbeat (and in some moods even utopian) Comte who is unable to even imagine an era “beyond” the technoscientific and a Heidegger who finds this same era deeply,

experientially, and ontologically unsatisfying. Comte conceives the future in a way that anticipates the army of technological optimists of the “developed” world yet to come – namely, in terms of how to encourage more of the same under ever better conditions. Heidegger, however, faces the problem – described in the final pages of “The Question Concerning Technology” and echoed by numerous technological critics and pessimists – of finding a way to think the “enframing” character of technoscience that both acknowledges our inevitably continuing to exist “in the midst” of this event and yet also does justice to all those experiences that do not fit “comfortably” within its enframing sense of what is real.

Some philosophers of technology have expressed a strong preference for Heidegger’s earlier analyses of practical and theoretical relations in *Being and Time* and reacted with disapproval toward his later thinking, both about technology and almost everything else. For example, phenomenologists and postphenomenologists like Ihde and Verbeek (see Chapters 46 and 47) as well as critical social theorists like Feenberg (below) and Marcuse (see Chapter 38) all argue that Heidegger’s earlier work offers a less reductive and more promising picture of our options in a technological era. They point to *Being and Time*’s analysis of tool use and “ready-to-hand” practical relations which, in comparison to Heidegger’s thinner and more reductive treatment of instrumentality in the “Technology” essay, seems more nuanced and pluralistic. Moreover, to many of these same critics, Heidegger’s later umbrella notion of a standing reserve (of useful material and personnel) seems to reflect a hopelessly dystopian attitude toward the present era.

Albert Borgmann’s “Focal Things and Practices,” is excerpted from his well-known *Technology and the Character of Contemporary Life* (1986), in which he argues for a “reform of technology” based on an elaboration and correction of Heidegger’s later account. Locating himself between technological determinists like Ellul and instrumentalists who view technology (in Heidegger’s phrase, merely “correctly”) as a collection of neutral means to freely chosen ends (see Mesthene, chapter 56), Borgmann agrees with Heidegger about the danger of modern technology. The world of modern industrial technology does indeed threaten to reduce our relations to the instrumental/utilitarian; and Heidegger is undoubtedly right that only by “raising the rule of technology from its anonymity” (i.e., think the enframing itself), might we learn to let something extra-technological – what Borgmann, renaming Heidegger’s idea of “things

thinging” and “shining forth,” calls “focal things” – enrich and bring greater purpose to our lives.

Borgmann argues, however, that what Heidegger says about such enriching experiences needs to be improved in two directions. First, he rejects Heidegger’s “misleading and dispiriting” tendency to appeal only to “the simple things of yesterday” as potentially enriching. Second, he complains that Heidegger fails to adequately trace out the way focal concerns shape our social relations as well as our relations with things. Borgmann analyzes activities like playing music, running, gardening, and the family meal as at least potentially providing occasions for the sort of “gathering and directing” of our concerns he has in mind. Serious runners, for example, will enhance their activity by using the latest and best gear, but only to the extent that this does not transform the activity itself into something no human runner could accomplish. So, too, the family meal might again become “a focal event par excellence” – that is, an event that brings scattered family members together, provides an occasion for cooperative preparation of carefully chosen foods, for reenacting cultural traditions and social practices, and for the intimate sharing of doubts and pleasures in conversation. Borgmann admits that focal events today are relatively isolated and in constant danger of being overtaken by the press of technological life. Running comes to mean 30 minutes on the treadmill, and meals a quick Big Mac or microwaved frozen dinner, eaten on the fly, with or without company. He insists, moreover, that technology itself has never produced anything which might properly serve as a focal concern. Nevertheless, there is nothing to prevent us from cultivating such concerns, glorying in their plurality, and “celebrating the social union that is fostered by that plurality.” Borgmann even suggests that a reversal of the current priorities of technological practice and focal concern might lead to the development of a new conception of the good life that is directed by focal practices and merely enhanced by technological means.

In their response to Borgmann, Hubert Dreyfus and Charles Spinosa join him in affirming Heidegger’s interpretation of the “danger” inherent in technology, but they object to Borgmann’s further claim that technology itself cannot be a source of focal concerns. The problem, in their view, is Borgmann’s reliance on Heidegger’s earlier rather than later thought. At first, Heidegger understood technology as simply the last, greatest expression of “subjectivity” – that is, of a world full of individual human selves, each treating everything as an

“object” of their desires and so as something to be controlled and/or consumed. Acceptance of this view forces Borgmann to conceive all focal concerns in terms of resistance to technological practices and thus to conceive these concerns as necessarily non-technological. For Dreyfus and Spinoza, however, Heidegger’s later notion of developing a “free relation” to technology offers a more positive possibility. In their postmodern construal, which they claim to validate with reference to Heidegger’s own writings, technological practices do indeed tend to fragment, or “disaggregate” our lives so that we lose any sense of our having single, unified self-identities; and the danger is indeed that this disaggregation threatens our ability to “disclose the world” in any way other than instrumentally and arbitrarily. Yet people like Borgmann are wrong to see only danger here. Dreyfus and Spinoza are not convinced – and do not think the later Heidegger still holds – that all disaggregation has to be viewed negatively. They therefore reject the idea that world-disclosing must ultimately be conceived in terms of some overarching personal or communal unity.

In a provocative interpretation of Heidegger’s notion of technological enframing’s “saving power,” they argue that entering into a free relation with technology really means “freeing us from having a total fixed identity so that we may experience ourselves as multiple identities disclosing multiple worlds.” In other words, Dreyfus and Spinoza see a potential benefit to be gained from the technology’s undermining of the notion of a subject-self with a single, unifying self-identity. Living with technology – which we will necessarily be doing in any event – appears to require living in a plurality of local worlds, with a plurality of focal skills, with at most a “poly-identity that is neither the identity of an arbitrary desiring subject nor the rudderless adaptability of a resource.” Dwelling in some of these local worlds, of course, can be expected to be short-lived – but no less enjoyable for that. Dreyfus and Spinoza mention, for example, Web-surfing, “zipping around an autobahn cloverleaf,” and participating in the mercurial creative period of a rock band, with each musician then going his or her own way. As they see it, Heidegger cannot be used to resurrect anything like Borgmann’s old idea of humanity eventually forming a “community of communities.” The only integrity we can expect our lives to have is the openness and flexibility to belong to and move around among many local worlds.

For Andrew Feenberg, neither Borgmann’s Heideggerianism nor the phenomenologies of Ihde or

Dreyfus and Spinoza can rescue Heidegger from his own inadequacies; moreover, their interpretations introduce additional problems of their own. Although Feenberg does not specifically mention Ihde or Dreyfus and Spinoza in the essay reprinted here, in his rejection of what he calls “idealist” readings of Heidegger’s analysis he does in fact have views like theirs in mind. If we take Heidegger at his word that the essence of technology can only be understood through our technological engagements with the world, says Feenberg, then the question immediately arises whether this engagement is merely an “attitude” or is “embedded in the actual design of modern technological devices.” If one answers that it is an attitude, then it follows that Heidegger’s so-called “free relation” with technology would amount to nothing more than a change in our outlook that leaves the device-filled world as we find it. In other words, when Heidegger’s defenders say that *we* are “active world-disclosers,” that *we* might become more “in tune” with technology, that technology solicits us to change *our* sense of personal identity, that *we* might move from one “world” to another by employing different sets of skills – all this language at least creates the impression that they, in spite of their use of Heidegger’s language about the “thinging of *things*,” understand themselves merely to be recommending the adoption of a new outlook toward those things.

Feenberg is too much opposed to the complacent sociopolitical conclusions that seem implicit in this approach to settle for its “aesthetic” image of how to react toward the present technoscientific hegemony. In recent work – especially in *Heidegger and Marcuse* (Routledge, 2005) and *Between Reason and Experience* (MIT, 2010) – Feenberg has been more inclined to accept Heidegger’s *diagnosis* of our current state of affairs. However, he still ultimately rejects what he sees as a “romantic” (i.e., merely subjectivist and idealist) *reaction* to this situation in both Heidegger himself and in most of his followers. For him, the problem with this reaction is that even when it involves expressing displeasure over this or that technology, it seems in general so accepting of the idea that technological practice *just is* the continual improvement of technological devices on the basis of ever better technoscientific theories and an ever more refined conception of instrumentalist praxis that their reaction itself constitutes a form of quietism. As a “critical” reaction to technoscientific optimism, it may indeed effect a change of attitude, but that is all. In the end, they leave us with a kind of technological thinking that is too strongly focused on and

deeply engaged with the “actual design of technological devices” to envisage any possibility of a widespread “democratic” political and social transformation of our technological engagements. More of Feenberg’s positive conception of this sort of “democratic rationalization” of technology can be found in Chapter 58 (and in *Between Experience and Reason*). In the present selection, Feenberg’s critique of Borgmann (and, by implication, Dreyfus and Spinoza) ends with the complaint that his account is typical of Heideggerians in not to address this deeper political issue.

According to Feenberg, the ultimate responsibility for all these difficulties lies in Heidegger’s own flawed way of posing his “question of technology.” Two related criticisms are central to Feenberg’s analysis. First, there is Heidegger’s demand that we consider only the “essence” of technology; second, there is the resultant “abstractness” of Heidegger’s thinking about it. As his analysis of instrumentalization shows, Feenberg interprets “essence” here in a fairly traditional way, as designating the fundamental, universal, unchanging characteristic(s) that define what something is. On the basis of this interpretation, he finds cause to complain that a Heideggerian “substantivist” analysis of technology remains remote from our actual engagements with it, and that from its high altitude, it is forced to merely vacillate between recommending a change of attitude and merely denouncing in very general terms how things are. Either way, Feenberg complains, the whole variety of very real differences in our actual relations with and modifications of technological devices stays out of view. He gives as an extended example the ways in which the production and use of the computer have mutually affected each other, so that it is simply false to imagine that some “inner, techno-logic” was spelling itself out in these devices which we were only able to witness.

Feenberg’s critique of Heidegger is in some ways representative of those influenced by critical social theory and neo-Marxism. Indeed, he actually says at one point that it is to the “requirements of capitalist economics,” not the essence of technology that we should look for an explanation of the hegemony of *Gestell*. Nevertheless, his concern for technoscientific reform speaks for other critics as well. In the end, for many critics, the main problem with Heidegger’s philosophy of technology is that it leaves us without any concrete sense of either (1) how technoscientific devices actually figure in everyday life or (2) how social and political change in a technological world might actually be achieved. Feenberg does not believe Heidegger’s own characterization of his thinking, where he describes himself as located “in the midst” of technological engagements and yet as also struggling to develop a free relation with technology that would alter the very “realm” in which these engagements take place. Instead, Feenberg thinks that because Heidegger calls this an “ontological” issue and (except for the embarrassment of his own participation in the Nazi movement) refuses to offer a specific (i.e., “ontic”) sociopolitical program, Heidegger’s critique of technology’s dangers – in spite of its insightful identification of the technological excesses of the present era – can only give us the useless advice that we should somehow “liberate” ourselves from our present technological engagements, or else wait for some sort of new God to “save” us (as Heidegger says in a famous newspaper interview, “Only a God Can Save Us”). The question of whether Feenberg’s interpretation of Heidegger is correct – and whether that makes any difference to the concrete question of how technological engagements might be delimited and transformed – has become a central issue in the debates over the importance of Heidegger’s work.

The Question Concerning Technology

Martin Heidegger

In what follows we shall be *questioning* concerning technology. Questioning builds a way. We would be advised, therefore, above all to pay heed to the way, and not to fix our attention on isolated sentences and topics. The way is one of thinking. All ways of thinking, more or less perceptibly, lead through language in a manner that is extraordinary. We shall be questioning concerning *technology*, and in so doing we should like to prepare a free relationship to it. The relationship will be free if it opens our human existence to the essence of technology. When we can respond to this essence, we shall be able to experience the technological within its own bounds.

Technology is not equivalent to the essence of technology. When we are seeking the essence of “tree,” we have to become aware that what pervades every tree, as tree, is not itself a tree that can be encountered among all the other trees.

Likewise, the essence of technology is by no means anything technological. Thus we shall never experience our relationship to the essence of technology so long as we merely represent and pursue the technological, put up with it, or evade it. Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like

to pay homage, makes us utterly blind to the essence of technology.

According to ancient doctrine, the essence of a thing is considered to be *what* the thing is. We ask the question concerning technology when we ask what it is. Everyone knows the two statements that answer our question. One says: Technology is a means to an end. The other says: Technology is a human activity. The two definitions of technology belong together. For to posit ends and procure and utilize the means to them is a human activity. The manufacture and utilization of equipment, tools, and machines, the manufactured and used things themselves, and the needs and ends that they serve, all belong to what technology is. The whole complex of these contrivances is technology. Technology itself is a contrivance – in Latin, an *instrumentum*.

The current conception of technology, according to which it is a means and a human activity, can therefore be called the instrumental and anthropological definition of technology.

Who would ever deny that it is correct? It is in obvious conformity with what we are envisaging when we talk about technology. The instrumental definition of technology is indeed so uncannily correct that it even holds for modern technology, of which, in other respects, we maintain with some justification that it is, in contrast to the older handicraft technology, something

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completely different and therefore new. Even the power plant with its turbines and generators is a man-made means to an end established by man. Even the jet aircraft and the high-frequency apparatus are means to ends. A radar station is of course less simple than a weather vane. To be sure, the construction of a high-frequency apparatus requires the interlocking of various processes of technical-industrial production. And certainly a saw-mill in a secluded valley of the Black Forest is a primitive means compared with the hydroelectric plant on the Rhine River.

But this much remains correct: Modern technology too is a means to an end. This is why the instrumental conception of technology conditions every attempt to bring man into the right relation to technology. Everything depends on our manipulating technology in the proper manner as a means. We will, as we say, "get" technology "intelligently in hand." We will master it. The will to mastery becomes all the more urgent the more technology threatens to slip from human control.

But suppose now that technology were no mere means: how would it stand with the will to master it? Yet we said, did we not, that the instrumental definition of technology is correct? To be sure. The correct always fixes upon something pertinent in whatever is under consideration. However, in order to be correct, this fixing by no means needs to uncover the thing in question in its essence. Only at the point where such an uncovering happens does the true appropriate. For that reason the merely correct is not yet the true. Only the true brings us into a free relationship with that which concerns us from its essence. Accordingly, the correct instrumental definition of technology still does not show us technology's essence. In order that we may arrive at this, or at least come close to it, we must seek the true by way of the correct. We must ask: What is the instrumental itself? Within what do such things as means and end belong? A means is that whereby something is effected and thus attained. Whatever has an effect as its consequence is called a cause. But not only that by means of which something else is effected is a cause. The end that determines the kind of means to be used may also be considered a cause. Wherever ends are pursued and means are employed, wherever instrumentality reigns, there reigns causality.

For centuries philosophy has taught that there are four causes: (1) the *causa materialis*, the material, the matter out of which, for example, a silver chalice is made, (2) the

causa formalis, the form, the shape into which the material enters; (3) the *causa finalis*, the end, for example, the sacrificial rite in relation to which the required chalice is determined as to its form and matter; (4) the *causa efficiens*, which brings about the effect that is the finished, actual chalice, in this instance, the silversmith. What technology is, when represented as a means, discloses itself when we trace instrumentality back to fourfold causality.

But suppose that causality, for its part, is veiled in darkness with respect to what it is? Certainly for centuries we have acted as though the doctrine of the four causes had fallen from heaven as a truth as clear as daylight. But it might be that the time has come to ask: Why are there only four causes? In relation to the aforementioned four, what does "cause" really mean? From whence does it come that the causal character of the four causes is so unifiedly determined that they belong together?

So long as we do not allow ourselves to go into these questions, causality, and with it instrumentality, and with this the accepted definition of technology, remain obscure and groundless.

For a long time we have been accustomed to representing cause as that which brings something about. In this connection, to bring about means to obtain results, effects. The *causa efficiens*, but one among the four causes, sets the standard for all causality. This goes so far that we no longer even count the *causa finalis*, telic finality, as causality. *Causa, casus*, belongs to the verb *cadere*, to fall, and means that which brings it about that something turns out as a result in such and such a way. The doctrine of the four causes goes back to Aristotle. But everything that later ages seek in Greek thought under the conception and rubric "causality" in the realm of Greek thought and for Greek thought *per se* has simply nothing at all to do with bringing about and effecting. What we call cause [*Ursache*] and the Romans call *causa* is called *aition* by the Greeks, that to which something else is indebted [*das, was ein anderes verschuldet*]. The four causes are the ways, all belonging at once to each other, of being responsible for something else. An example can clarify this.

Silver is that out of which the silver chalice is made. As this matter (*hyle*), it is co-responsible for the chalice. The chalice is indebted to, i.e., owes thanks to, the silver for that of which it consists. But the sacrificial vessel is indebted not only to the silver. As a chalice, that which is indebted to the silver appears in the aspect of a chalice, and not in that of a brooch or a ring. Thus the sacred

vessel is at the same time indebted to the aspect (*eidōs*) of chaliceness. Both the silver into which the aspect is admitted as chalice and the aspect in which the silver appears are in their respective ways co-responsible for the sacrificial vessel.

But there remains yet a third something that is above all responsible for the sacrificial vessel. It is that which in advance confines the chalice within the realm of consecration and bestowal. Through this the chalice is circumscribed as sacrificial vessel. Circumscribing gives bounds to the thing. "With the bounds the thing does not stop; rather, from within them it begins to be what after production it will be. That which gives bounds, that which completes, in this sense is called in Greek *telos*, which is all too often translated as "aim" and "purpose," and so misinterpreted. The *telos* is responsible for what as matter and what as aspect are together co-responsible for the sacrificial vessel.

Finally, there is a fourth participant in the responsibility for the finished sacrificial vessel's lying before us ready for use, i.e., the silversmith – but not at all because he, in working, brings about the finished sacrificial chalice as if it were the effect of a making; the silversmith is not a *causa efficiens*.

The Aristotelian doctrine neither knows the cause that is named by this term, nor uses a Greek word that would correspond to it.

The silversmith considers carefully and gathers together the three aforementioned ways of being responsible and indebted. To consider carefully [*überlegen*] is in Greek *legein*, *logos*, *Legein* is rooted in *apophainesthai*, to bring forward into appearance. The silversmith is co-responsible as that from which the sacred vessel's being brought forth and subsistence take and retain their first departure. The three previously mentioned ways of being responsible owe thanks to the pondering of the silversmith for the "that" and the "how" of their coming into appearance and into play for the production of the sacrificial vessel.

Thus four ways of owing hold sway in the sacrificial vessel that lies ready before us. They differ from one another, yet they belong together. What unites them from the beginning? In what does this playing in unison of the four ways of being responsible play? What is the source of the unity of the four causes? What, after all, does this owing and being responsible mean, thought as the Greeks thought it?

Today we are too easily inclined either to understand being responsible and being indebted moralistically as a lapse, or else to construe them in terms of effecting. In

either case we bar from ourselves the way to the primal meaning of that which is later called causality. So long as this way is not opened up to us we shall also fail to see what instrumentality, which is based on causality, properly is.

In order to guard against such misinterpretations of being responsible and being indebted, let us clarify the four ways of being responsible in terms of that for which they are responsible. According to our example, they are responsible for the silver chalice's lying ready before us as a sacrificial vessel. Lying before and lying ready (*hypokeisthai*) characterize the presenting of something that is present. The four ways of being responsible bring something into appearance. They let it come forth into presenting [*Anwesen*]. They set it free to that place and so start it on its way, namely, into its complete arrival. The principal characteristic of being responsible is this starting something on its way into arrival that being responsible is an occasioning or an inducing to go forward [*Ver-an-lassen*]. On the basis of a look at what the Greeks experienced in being responsible, in *aitia*, we now give this verb "to occasion" a more inclusive meaning, so that it now is the name for the essence of causality thought as the Greeks thought it. The common and narrower meaning of "occasion," in contrast, is nothing more than a colliding and releasing; it means a kind of secondary cause within the whole of causality.

But in what, then, does the playing in unison of the four ways of occasioning play? These let what is not yet present arrive into presenting. Accordingly, they are unifiedly governed by a bringing that brings what presences into appearance. Plato tells us what this bringing is in a sentence from the *Symposium* (205b): *hē gar toi ek tou mē ontois eis to on ionti hotoioun aitia pasa esti poiēsis*. "Every occasion for whatever passes beyond the nonpresent and goes forward into presenting is *poiēsis*, bringing-forth [*Her-vor-bringen*]."

It is of utmost importance that we think bringing-forth in its full scope and at the same time in the sense in which the Greeks thought it. Not only handicraft manufacture, not only artistic and poetical bringing into appearance and concrete imagery, is a bringing-forth, *poiēsis*. *Physis*, also, the arising of something from out of itself, is a bringing-forth, *poiēsis*. *Physis* is indeed *poiēsis* in the highest sense. For what presences by means of *physis* has the irruption belonging to bringing-forth, e.g., the bursting of a blossom into bloom, in itself (*en heautoi*). In contrast, what is brought forth by the artisan, or the artist, e.g., the silver chalice, has the irruption belonging

to bringing-forth, not in itself, but in another (*en allōi*), in the craftsman or artist.

The modes of occasioning, the four causes, are at play, then, within bringing-forth. Through bringing-forth the growing things of nature as well as whatever is completed through the crafts and the arts come at any given time to their appearance.

But how does bringing-forth happen, be it in nature or in handicraft and art? What is the bringing-forth in which the fourfold way of occasioning plays? Occasioning has to do with the presenting [*Anwesen*] of that which at any given time comes to appearance in bringing-forth. Bringing-forth brings out of concealment into unconcealment. Bringing-forth propriates only insofar as something concealed comes into unconcealment. This coming rests and moves freely within what we call revealing [*das Entbergen*]. The Greeks have the word *alētheia* for revealing. The Romans translate this with *veritas*. We say “truth” and usually understand it as correctness of representation.

But where have we strayed to? We are questioning concerning technology, and we have arrived now at *alētheia*, at revealing. What has the essence of technology to do with revealing? The answer: everything. For every bringing-forth is grounded in revealing. Bringing-forth, indeed, gathers within itself the four modes of occasioning – causality – and rules them throughout. Within its domain belong end and means as well as instrumentality. Instrumentality is considered to be the fundamental characteristic of technology. If we inquire step by step into what technology, represented as means, actually is, then we shall arrive at revealing. The possibility of all productive manufacturing lies in revealing.

Technology is therefore no mere means. Technology is a way of revealing. If we give heed to this, then another whole realm for the essence of technology will open itself up to us. It is the realm of revealing, i.e., of truth.

This prospect strikes us as strange. Indeed, it should do so, as persistently as possible and with so much urgency that we will finally take seriously the simple question of what the name “technology” means. The word stems from the Greek. *Technikon* means that which belongs to *technē*. We must observe two things with respect to the meaning of this word. One is that *technē* is the name not only for the activities and skills of the craftsman but also for the arts of the mind and the fine arts. *Technē* belongs to bringing-forth, to *poiēsis*, it is something poetic.

The other thing that we should observe with regard to *technē* is even more important. From earliest times until Plato the word *technē* is linked with the word *epistēmē*. Both words are terms for knowing in the widest sense. They mean to be entirely at home in something, to understand and be expert in it. Such knowing provides an opening up. As an opening up it is a revealing. Aristotle, in a discussion of special importance (*Nicomachean Ethics*, Bk. VI, chaps. 3 and 4), distinguishes between *epistēmē* and *technē* and indeed with respect to what and how they reveal. *Technē* is a mode of *alētheuein*. It reveals whatever does not bring itself forth and does not yet lie here before us, whatever can look and turn out now one way and now another. Whoever builds a house or a ship or forges a sacrificial chalice reveals what is to be brought forth, according to the terms of the four modes of occasioning. This revealing gathers together in advance the aspect and the matter of ship or house, with a view to the finished thing envisaged as completed, and from this gathering determines the manner of its construction. Thus what is decisive in *technē* does not at all lie in making and manipulating, nor in the using of means, but rather in the revealing mentioned before. It is as revealing, and not as manufacturing, that *technē* is a bringing-forth.

Thus the clue to what the word *technē* means and to how the Greeks defined it leads us into the same context that opened itself to us when we pursued the question of what instrumentality as such in truth might be.

Technology is a mode of revealing. Technology comes to presence in the realm where revealing and unconcealment take place, where *alētheia*, truth, happens.

In opposition to this definition of the essential domain of technology, one can object that it indeed holds for Greek thought and that at best it might apply to the techniques of the handicraftsman, but that it simply does not fit modern machine-powered technology. And it is precisely the latter and it alone that is the disturbing thing, that moves us to ask the question concerning technology *per se*. It is said that modern technology is something incomparably different from all earlier technologies because it is based on modern physics as an exact science. Meanwhile, we have come to understand more clearly that the reverse holds true as well: modern physics, as experimental, is dependent upon technical apparatus and upon progress in the building of apparatus. The establishing of this mutual relationship between technology and physics is correct. But it remains a merely historiological establishing of facts and says nothing about that in which this mutual

relationship is grounded. The decisive question still remains: Of what essence is modern technology that it thinks of putting exact science to use?

What is modern technology? It too is a revealing. Only when we allow our attention to rest on this fundamental characteristic does that which is new in modern technology show itself to us.

And yet, the revealing that holds sway throughout modern technology does not unfold into a bringing-forth in the sense of *poiēsis*. The revealing that rules in modern technology is a challenging [*herausfordern*], which puts to nature the unreasonable demand that it supply energy which can be extracted and stored as such. But does this not hold true for the old windmill as well? No. Its sails do indeed turn in the wind; they are left entirely to the wind's blowing. But the windmill does not unlock energy from the air currents in order to store it.

In contrast, a tract of land is challenged in the hauling out of coal and ore. The earth now reveals itself as a coal mining district, the soil as a mineral deposit. The field that the peasant formerly cultivated and set in order appears differently than it did when to set in order still meant to take care of and maintain. The work of the peasant does not challenge the soil of the field. In sowing grain it places seed in the keeping of the forces of growth and watches over its increase. But meanwhile even the cultivation of the field has come under the grip of another kind of setting-in-order, which *sets upon* nature. It sets upon it in the sense of challenging it. Agriculture is now the mechanized food industry. Air is now set upon to yield nitrogen, the earth to yield ore, ore to yield uranium, for example; uranium is set upon to yield atomic energy, which can be unleashed either for destructive or for peaceful purposes.

This setting-upon that challenges the energies of nature is an expediting, and in two ways. It expedites in that it unlocks and exposes. Yet that expediting is always itself directed from the beginning toward furthering something else, i.e., toward driving on to the maximum yield at the minimum expense. The coal that has been hauled out in some mining district has not been produced in order that it may simply be at hand somewhere or other. It is being stored; that is, it is on call, ready to deliver the sun's warmth that is stored in it. The sun's warmth is challenged forth for heat, which in turn is ordered to deliver steam whose pressure turns the wheels that keep a factory running.

The hydroelectric plant is set into the current of the Rhine. It sets the Rhine to supplying its hydraulic

pressure, which then sets the turbines turning. This turning sets those machines in motion whose thrust sets going the electric current for which the long-distance power station and its network of cables are set up to dispatch electricity. In the context of the interlocking processes pertaining to the orderly disposition of electrical energy, even the Rhine itself appears to be something at our command. The hydro-electric plant is not built into the Rhine River as was the old wooden bridge that joined bank with bank for hundreds of years. Rather, the river is dammed up into the power plant. What the river is now, namely, a water-power supplier, derives from the essence of the power station. In order that we may even remotely consider the monstrousness that reigns here, let us ponder for a moment the contrast that is spoken by the two titles: "The Rhine," as dammed up into the *power* works, and "The Rhine," as uttered by the *art-work*, in Hölderlin's hymn by that name. But, it will be replied, the Rhine is still a river in the landscape, is it not? Perhaps. But how? In no other way than as an object on call for inspection by a tour group ordered there by the vacation industry.

The revealing that rules throughout modern technology has the character of a setting-upon, in the sense of a challenging-forth. Such challenging happens in that the energy concealed in nature is unlocked, what is unlocked is transformed, what is transformed is stored up, what is stored up is in turn distributed, and what is distributed is switched about ever anew. Unlocking, transforming, storing, distributing, and switching about are ways of revealing. But the revealing never simply comes to an end. Neither does it run off into the indeterminate. The revealing reveals to itself its own manifoldly interlocking paths, through regulating their course. This regulating itself is, for its part, everywhere secured. Regulating and securing even become the chief characteristics of the revealing that challenges.

What kind of unconcealment is it, then, that is peculiar to that which results from this setting-upon that challenges? Everywhere everything is ordered to stand by, to be immediately on hand, indeed to stand there just so that it may be on call for a further ordering. Whatever is ordered about in this way has its own standing. We call it the standing-reserve [*Bestand*]. The word expresses here something more, and something more essential, than mere "stock." The word "standing-reserve" assumes the rank of an inclusive rubric. It designates nothing less than the way in which everything presences that is wrought upon by the revealing that challenges. Whatever stands by in the sense of standing-reserve no longer stands over against us as object.

Yet an airliner that stands on the runway is surely an object. Certainly. We can represent the machine so. But then it conceals itself as to what and how it is. Revealed, it stands on the taxi strip only as standing-reserve, inasmuch as it is ordered to insure the possibility of transportation. For this it must be in its whole structure and in every one of its constituent parts itself on call for duty, i.e., ready for takeoff. (Here it would be appropriate to discuss Hegel's definition of the machine as an autonomous tool. When applied to the tools of the craftsman, his characterization is correct. Characterized in this way, however, the machine is not thought at all from the essence of technology within which it belongs. Seen in terms of the standing-reserve, the machine is completely non-autonomous, for it has its standing only on the basis of the ordering of the orderable.)

The fact that now, wherever we try to point to modern technology as the revealing that challenges, the words "setting-upon," "ordering," "standing-reserve," obtrude and accumulate in a dry, monotonous, and therefore oppressive way – this fact has its basis in what is now coming to utterance.

Who accomplishes the challenging setting-upon through which what we call the actual is revealed as standing-reserve? Obviously, man. To what extent is man capable of such a revealing? Man can indeed conceive, fashion, and carry through this or that in one way or another. But man does not have control over unconcealment itself, in which at any given time the actual shows itself or withdraws. The fact that it has been showing itself in the light of Ideas ever since the time of Plato, Plato did not bring about. The thinker only responded to what addressed itself to him.

Only to the extent that man for his part is already challenged to exploit the energies of nature can this revealing that orders happen. If man is challenged, ordered, to do this, then does not man himself belong even more originally than nature within the standing-reserve? The current talk about human resources, about the supply of patients for a clinic, gives evidence of this. The forester who measures the felled timber in the woods and who to all appearances walks the forest path in the same way his grandfather did is today ordered by the industry that produces commercial woods, whether he knows it or not. He is made subordinate to the orderability of cellulose, which for its part is challenged forth by the need for paper, which is then delivered to newspapers and illustrated magazines. The latter, in their turn, set public opinion to swallowing what is printed, so that

a set configuration of opinion becomes available on demand. Yet precisely because man is challenged more originally than are the energies of nature, i.e., into the process of ordering, he never is transformed into mere standing-reserve. Since man drives technology forward, he takes part in ordering as a way of revealing. But the unconcealment itself, within which ordering unfolds, is never a human handiwork, any more than is the realm man traverses every time he as a subject relates to an object.

Where and how does this revealing happen if it is no mere handiwork of man? We need not look far. We need only apprehend in an unbiased way that which has already claimed man so decisively that he can only be man at any given time as the one so claimed. Wherever man opens his eyes and ears, unlocks his heart, and gives himself over to meditating and striving, shaping and working, entreating and thanking, he finds himself everywhere already brought into the unconcealed. The unconcealment of the unconcealed has already appropriated whenever it calls man forth into the modes of revealing allotted to him. When man, in his way, from within unconcealment reveals that which presences, he merely responds to the call of unconcealment, even when he contradicts it. Thus when man, investigating, observing, pursues nature as an area of his own conceiving, he has already been claimed by a way of revealing that challenges him to approach nature as an object of research, until even the object disappears into the objectlessness of standing-reserve.

Modern technology, as a revealing that orders, is thus no mere human doing. Therefore we must take the challenging that sets upon man to order the actual as standing-reserve in accordance with the way it shows itself. That challenging gathers man into ordering. This gathering concentrates man upon ordering the actual as standing-reserve.

That which primordially unfolds the mountains into mountain ranges and pervades them in their folded contiguity is the gathering that we call *Gebirg* [mountain chain].

That original gathering from which unfold the ways in which we have feelings of one kind or another we name *Gemüt* [disposition].

We now name the challenging claim that gathers man with a view to ordering the self-revealing as standing-reserve: *Ge-stell* [enframing].

We dare to use this word in a sense that has been thoroughly unfamiliar up to now.

According to ordinary usage, the word *Gestell* [frame] means some kind of apparatus, e.g., a bookrack. *Gestell* is also the name for a skeleton. And the employment of the word *Gestell* [enframing] that is now required of us seems equally eerie, not to speak of the arbitrariness with which words of a mature language are so misused. Can anything be more strange? Surely not. Yet this strangeness is an old custom of thought. And indeed thinkers follow this custom precisely at the point where it is a matter of thinking that which is highest. We, late born, are no longer in a position to appreciate the significance of Plato's daring to use the word *eidōs* for that which in everything and in each particular thing endures as present. For *eidōs*, in the common speech, meant the outward aspect [*Ansicht*] that a visible thing offers to the physical eye. Plato exacts of this word, however, something utterly extraordinary: that it name what precisely is not and never will be perceivable with physical eyes. But even this is by no means the full extent of what is extraordinary here. For *idea* names not only the nonsensuous aspect of what is physically visible. Aspect (*idea*) names and also is that which constitutes the essence in the audible, the tasteable, the tactile, in everything that is in any way accessible. Compared with the demands that Plato makes on language and thought in this and in other instances, the use of the word *Gestell* as the name for the essence of modern technology, which we are venturing, is almost harmless. Even so, the usage now required remains something exacting and is open to misinterpretation.

Enframing means the gathering together of the setting-upon that sets upon man, i.e., challenges him forth, to reveal the actual, in the mode of ordering, as standing-reserve. Enframing means the way of revealing that holds sway in the essence of modern technology and that is itself nothing technological. On the other hand, all those things that are so familiar to us and are standard parts of assembly, such as rods, pistons, and chassis, belong to the technological. The assembly itself, however, together with the aforementioned stockparts, fall within the sphere of technological activity. Such activity always merely responds to the challenge of enframing, but it never comprises enframing itself or brings it about.

The word *stellen* [to set] in the name *Ge-tell* [enframing] does not only mean challenging. At the same time it should preserve the suggestion of another *Stellen* from which it stems, namely that producing and presenting [*Her- und Dar-stellen*], which, in the sense of *poiēsis*, lets what presences come forth into unconcealment. This

producing that brings forth, e.g., erecting a statue in the temple precinct, and the ordering that challenges now under consideration are indeed fundamentally different, and yet they remain related in their essence. Both are ways of revealing, of *alētheia*. In enframing, the unconcealment propriates in conformity with which the work of modern technology reveals the actual as standing-reserve. This work is therefore neither only a human activity nor a mere means within such activity. The merely instrumental, merely anthropological definition of technology is therefore in principle untenable. And it may not be rounded out by being referred back to some metaphysical or religious explanation that undergirds it.

It remains true nonetheless that man in the technological age is, in a particularly striking way, challenged forth into revealing. Such revealing concerns nature, above all, as the chief storehouse of the standing energy reserve. Accordingly, man's ordering attitude and behavior display themselves first in the rise of modern physics as an exact science. Modern science's way of representing pursues and entraps nature as a calculable coherence of forces. Modern physics is not experimental physics because it applies apparatus to the questioning of nature. The reverse is true. Because physics, indeed already as pure theory, sets nature up to exhibit itself as a coherence of forces calculable in advance, it orders its experiments precisely for the purpose of asking whether and how nature reports itself when set up in this way.

But, after all, mathematical science arose almost two centuries before technology. How, then, could it have already been set upon by modern technology and placed in its service? The facts testify to the contrary. Surely technology got under way only when it could be supported by exact physical science. Reckoned chronologically, this is correct. Thought historically, it does not hit upon the truth.

The modern physical theory of nature prepares the way not simply for technology but for the essence of modern technology. For such gathering-together, which challenges man to reveal by way of ordering, already holds sway in physics. But in it that gathering does not yet come expressly to the fore. Modern physics is the herald of enframing, a herald whose provenance is still unknown. The essence of modern technology has for a long time been concealed, even where power machinery has been invented, where electrical technology is in full swing, and where atomic technology is well under way.

All coming to presence, not only modern technology, keeps itself everywhere concealed to the last.

Nevertheless, it remains, with respect to its holding sway, that which precedes all: the earliest. The Greek thinkers already knew of this when they said: That which is earlier with regard to its rise into dominance becomes manifest to us men only later. That which is primally early shows itself only ultimately to men. Therefore, in the realm of thinking, a painstaking effort to think through still more primally what was primally thought is not the absurd wish to revive what is past, but rather the sober readiness to be astounded before the coming of the dawn.

Chronologically speaking, modern physical science begins in the seventeenth century. In contrast, machine-power technology develops only in the second half of the eighteenth century. But modern technology, which for chronological reckoning is the later, is, from the point of view of the essence holding sway within it, historically earlier.

If modern physics must resign itself ever increasingly to the fact that its realm of representation remains inscrutable and incapable of being visualized, this resignation is not dictated by any committee of researchers. It is challenged forth by the rule of enframing, which demands that nature be orderable as standing-reserve. Hence physics, in its retreat from the kind of representation that turns only to objects, which has been the sole standard until recently, will never be able to renounce this one thing: that nature report itself in some way or other that is identifiable through calculation and that it remain orderable as a system of information. This system is then determined by a causality that has changed once again. Causality now displays neither the character of the occasioning that brings forth nor the nature of the *causa efficiens*, let alone that of the *causa formalis*. It seems as though causality is shrinking into a reporting – a reporting challenged forth – of standing-reserves that must be guaranteed either simultaneously or in sequence. To this shrinking would correspond the process of growing resignation that Heisenberg's lecture depicts in so impressive a manner.¹

Because the essence of modern technology lies in enframing, modern technology must employ exact physical science. Through its so doing the deceptive appearance arises that modern technology is applied physical science. This illusion can maintain itself precisely insofar as neither the essential provenance of modern science nor indeed the essence of modern technology is adequately sought in our questioning.

We are questioning concerning technology in order to bring to light: our relationship to its essence. The essence of modern technology shows itself in what we call enframing. But simply to point to this is still in no way to answer the question concerning technology, if to answer means to respond, in the sense of correspond, to the essence of what is being asked about.

Where do we find ourselves if now we think one step further regarding what enframing itself actually is? It is nothing technological, nothing on the order of a machine. It is the way in which the actual reveals itself as standing-reserve. Again we ask: Does such revealing happen somewhere beyond all human doing? No. But neither does it happen exclusively *in* man, or definitively *through* man.

Enframing is the gathering together which belongs to that setting-upon which challenges man and puts him in position to reveal the actual, in the mode of ordering, as standing-reserve. As the one who is challenged forth in this way, man stands within the essential realm of enframing. He can never take up a relationship to it only subsequently. Thus the question as to how we are to arrive at a relationship to the essence of technology, asked in this way, always comes too late. But never too late comes the question as to whether we actually experience ourselves as the ones whose activities everywhere, public and private, are challenged forth by enframing. Above all, never too late comes the question as to whether and how we actually admit ourselves into that wherein enframing itself essentially unfolds.

The essence of modern technology starts man upon the way of that revealing through which the actual everywhere, more or less distinctly, becomes standing-reserve. "To start upon a way" means "to send" in our ordinary language. We shall call the sending that gathers [*versammelnde Schicken*], that, first starts man upon a way of revealing, *destining* [*Geschick*]. It is from this destining that the essence of all history [*Geschichte*] is determined. History is neither simply the object of written chronicle nor merely the process of human activity. That activity first becomes history as something destined.² And it is only the destining into objectifying representation that makes the historical accessible as an object for historiography, i.e., for a science, and on this basis makes possible the current equating of the historical with that which is chronicled.

Enframing, as a challenging-forth into ordering, sends into a way of revealing. Enframing is an ordaining of destining, as is every way of revealing. Bringing-forth, *poiēsis*, is also a destining in this sense.

Always the unconcealment of that which is goes upon a way of revealing. Always the destining of revealing holds complete sway over men. But that destining is never a fate that compels. For man becomes truly free only insofar as he belongs to the realm of destining and so becomes one who listens, though not one who simply obeys.

The essence of freedom is *originally* not connected with the will or even with the causality of human willing.

Freedom governs the free space in the sense of the cleared, that is to say, the revealed. To the occurrence of revealing, i.e., of truth, freedom stands in the closest and most intimate kinship. All revealing belongs within a harboring and a concealing. But that which frees – the mystery – is concealed and always concealing itself. All revealing comes out of the free, goes into the free, and brings into the free. The freedom of the free consists neither in unfettered arbitrariness nor in the constraint of mere laws. Freedom is that which conceals in a way that opens to light, in whose clearing shimmers the veil that hides the essential occurrence of all truth and lets the veil appear as what veils. Freedom is the realm of the destining that at any given time starts a revealing on its way.

The essence of modern technology lies in enframing. Enframing belongs within the destining of revealing. These sentences express something different from the talk that we hear more frequently, to the effect that technology is the fate of our age, where “fate” means the inevitableness of an unalterable course.

But when we consider the essence of technology we experience enframing as a destining of revealing. In this way we are already sojourning within the free space of destining, a destining that in no way confines us to a stultified compulsion to push on blindly with technology or, what comes to the same, to rebel helplessly against it and curse it as the work of the devil. Quite to the contrary, when we once open ourselves expressly to the *essence* of technology we find ourselves unexpectedly taken into a freeing claim.

The essence of technology lies in enframing. Its holding sway belongs within destining. Since destining at any given time starts man on a way of revealing, man, thus under way, is continually approaching the brink of the possibility of pursuing and promulgating nothing but what is revealed in ordering, and of deriving all his standards on this basis. Through this the other possibility is blocked – that man might rather be admitted sooner and ever more primally to the essence of what is unconcealed and to its unconcealment, in order that he might experience as his essence the requisite belonging to revealing.

Placed between these possibilities, man is endangered by destining. The destining of revealing is as such, in every one of its modes, and therefore necessarily, *danger*.

In whatever way the destining of revealing may hold sway, the unconcealment in which everything that is shows itself at any given time harbors the danger that man may misconstrue the unconcealed and misinterpret it. Thus where everything that presences exhibits itself in the light of a cause-effect coherence, even God, for representational thinking, can lose all that is exalted and holy, the mysteriousness of his distance. In the light of causality, God can sink to the level of a cause, of *causa efficiens*. He then becomes even in theology the God of the philosophers, namely, of those who define the unconcealed and the concealed in terms of the causality of making, without ever considering the essential provenance of this causality.

In a similar way the unconcealment in accordance with which nature presents itself as a calculable complex of the effects of forces can indeed permit correct determinations; but precisely through these successes the danger may remain that in the midst of all that is correct the true will withdraw.

The destining of revealing is in itself not just any danger, but *the* danger.

Yet when destining reigns in the mode of enframing, it is the supreme danger. This danger attests itself to us in two ways. As soon as what is unconcealed no longer concerns man even as object, but exclusively as standing-reserve, and man in the midst of objectlessness is nothing but the orderer of the standing-reserve, then he comes to the very brink of a precipitous fall; that is, he comes to the point where he himself will have to be taken as standing-reserve. Meanwhile, man, precisely as the one so threatened, exalts himself and postures as lord of the earth. In this way the illusion comes to prevail that everything man encounters exists only insofar as it is his construct. This illusion gives rise in turn to one final delusion: it seems as though man everywhere and always encounters only himself. Heisenberg has with complete correctness pointed out that the actual must present itself to contemporary man in this way.³ *In truth, however, precisely nowhere does man today any longer encounter himself, i.e., his essence.* Man stands so decisively in subservience to the challenging-forth of enframing that he does not grasp enframing as a claim, that he fails to see himself as the one spoken to, and hence also fails in every way to hear in what respect he exists, in terms of his essence, in a realm where he is addressed, so that he *can never* encounter only himself.

But enframing does not simply endanger man in his relationship to himself and to everything that is. As a destining, it banishes man into the kind of revealing that is an ordering. Where this ordering holds sway, it drives out every other possibility of revealing. Above all, enframing conceals that revealing which, in the sense of *poiēsis*, lets what: presences come forth into appearance. As compared with that other revealing, the setting-upon that challenges forth thrusts man into a relation to whatever is that is at once antithetical and rigorously ordered. Where enframing holds sway, regulating and securing of the standing-reserve mark all revealing. They no longer even let their own fundamental characteristic appear, namely, this revealing as such.

Thus the challenging-enframing not only conceals a former way of revealing (bringing-forth) but also conceals revealing itself and with it that wherein unconcealment, i.e., truth, propriates.

Enframing blocks the shining-forth and holding sway of truth. The destining that sends into ordering is consequently the extreme danger. What is dangerous is not technology. Technology is not demonic, but its essence is mysterious. The essence of technology, as a destining of revealing, is the danger. The transformed meaning of the word “enframing” will perhaps become somewhat more familiar to us now if we think enframing in the sense of destining and danger.

The threat to man does not come in the first instance from the potentially lethal machines and apparatus of technology. The actual threat has already afflicted man in his essence. The rule of enframing threatens man with the possibility that it could be denied to him to enter into a more original revealing and hence to experience the call of a more primal truth.

Thus where enframing reigns, there is *danger* in the highest sense.

But where danger is, grows
The saving power also.

Let us think carefully about these words of Hölderlin.⁴ What does it mean to “save”? Usually we think that it means only to seize hold of a thing-threatened by ruin in order to secure it in its former continuance. But the verb “to save” says more. “To save” is to fetch something home into its essence, in order to bring the essence for the first time into its proper appearing. If the essence of technology, enframing, is the extreme danger, if there is truth in Hölderlin’s words, then the rule of enframing cannot exhaust itself solely in

blocking all lighting-up of every revealing, all appearing of truth. Rather, precisely the essence of technology must harbor in itself the growth of the saving power. But in that case, might not an adequate look into what enframing is, as a destining of revealing, bring the upsurge of the saving power into appearance?

In what respect does the saving power grow also there where the danger is? Where something grows, there it takes root, from thence it thrives. Both happen concealedly and quietly and in their own time. But according to the words of the poet we have no right whatsoever to expect that there where the danger is we should be able to lay hold of the saving power immediately and without preparation. Therefore we must consider now, in advance, in what respect the saving power does most profoundly take root and thence thrive even where the extreme danger lies – in the holding sway of enframing. In order to consider this it is necessary, as a last step upon our way, to look with yet clearer eyes into the danger. Accordingly, we must once more question concerning technology. For we have said that in technology’s essence roots and thrives the saving power.

But how shall we behold the saving power in the essence of technology so long as we do not consider in what sense of “essence” it is that enframing properly is the essence of technology?

Thus far we have understood “essence” in its current meaning. In the academic language of philosophy “essence” means *what* something is; in Latin, *quid*. *Quidditas*, whatness, provides the answer to the question concerning essence. For example, what pertains to all kinds of trees – oaks, beeches, birches, firs – is the same “treeness.” Under this inclusive genus – the “universal” – fall all actual and possible trees. Is then the essence of technology, enframing, the common genus for everything technological? If this were the case then the steam turbine, the radio transmitter, and the cyclotron would each be an enframing. But the word “enframing” does not mean here a tool or any kind of apparatus. Still less does it mean the general concept of such resources. The machines and apparatus are no more cases and kinds of enframing than are the man at the switchboard and the engineer in the drafting room. Each of these in its own way indeed belongs as stockpart, available resource, or executor, within enframing; but enframing is never the essence of technology in the sense of a genus. Enframing is a way of revealing that is a destining, namely, the way that challenges forth. The revealing that brings forth (*poiēsis*) is also a way that has the character of destining.

But these ways are not kinds that, arrayed beside one another, fall under the concept of revealing. Revealing is that destining which, ever suddenly and inexplicably to all thinking, apports itself into the revealing that brings forth and the revealing that challenges, and which allots itself to man. The revealing that challenges has its origin as a destining in bringing-forth. But at the same time enframing, in a way characteristic of a destining, blocks *poiēsis*.

Thus enframing, as a destining of revealing, is indeed the essence of technology, but never in the sense of genus and *essentia*. If we pay heed to this, something astounding strikes us: it is technology itself that makes the demand on us to think in another way what is usually understood by “essence.” But in what way?

If we speak of the “essence of a house” and the “essence of a state” we do not mean a generic type; rather we mean the ways in which house and state hold sway, administer themselves, develop and decay – the way they “essentially unfold” [*wesen*]. Johann Peter Hebel in a poem, “Ghost on Kanderer Street,” for which Goethe had a special fondness, uses the old word *die Wäsererei*. It means the city hall, inasmuch as there the life of the community gathers and village existence is constantly in play, i.e., essentially unfolds. It is from the verb *wesen* that the noun is derived. *Wesen* understood as a verb is the same as *währen* [to last or endure], not only in terms of meaning, but also in terms of the phonetic formation of the word. Socrates and Plato already think the essence of something as what it is that unfolds essentially, in the sense of what endures. But they think what endures is what remains permanently (*dei on*). And they find what endures permanently in what persists throughout all that happens, in what remains. That which remains they discover, in turn, in the aspect (*eidōs, idea*), for example, the Idea “house.”

The Idea “house” displays what anything is that is fashioned as a house. Particular, real, and possible houses, in contrast, are changing and transitory derivatives of the Idea and thus belong to what does not endure.

But it can never in any way be established that enduring is based solely on what Plato thinks as *idea* and Aristotle thinks as *to ti ēn einai* (that which any particular thing has always been), or what metaphysics in its most varied interpretations thinks as *essentia*.

All unfolding endures. But is enduring only permanent enduring? Does the essence of technology endure in the sense of the permanent enduring of an Idea that hovers over everything technological, thus making it seem that by

technology we mean some mythological abstraction? The way in which technology unfolds lets itself be seen only on the basis of that permanent enduring in which enframing appropriates as a destining of revealing. Goethe once uses the mysterious word *fortgewähren* [to grant continuously] in place of *fortwähren* [to endure continuously].⁵ He hears *währen* [to endure] and *gewähren* [to grant] here in one unarticulated accord. And if we now ponder more carefully than we did before what it is that properly endures and perhaps alone endures, we may venture to say: *Only what is granted endures. What endures primarily out of the earliest beginning is what grants.*

As the essencing of technology, enframing is what endures. Does enframing hold sway at all in the sense of granting? No doubt the question seems a horrendous blunder. For according to everything that has been said, enframing is rather a destining that gathers together into the revealing that challenges forth. Challenging is anything but a granting. So it seems, so long as we do not notice that the challenging-forth into the ordering of the actual as standing-reserve remains a destining that starts man upon a way of revealing. As this destining, the essential unfolding of technology gives man entry into something which, of himself, he can neither invent nor in any way make. For there is no such thing as a man who exists singly and solely on his own.

But if this destining, enframing, is the extreme danger, not only for man’s essential unfolding, but for all revealing as such, should this destining still be called a granting? Yes, most emphatically, if in this destining the saving power is said to grow. Every destining of revealing appropriates from a granting and as such a granting. For it is granting that first conveys to man that share in revealing that the propriative event of revealing needs. So needed and used, man is given to belong to the propriative event of truth. The granting that sends one way or another into revealing is as such the saving power. For the saving power lets man see and enter into the highest dignity of his essence. This dignity lies in keeping watch over the unconcealment – and with it, from the first, the concealment – of all essential unfolding on this earth. It is precisely in enframing, which threatens to sweep man away into ordering as the ostensibly sole way of revealing, and so thrusts man into the danger of the surrender of his free essence – it is precisely in this extreme danger that the innermost indestructible belongingness of man within granting may come to light, provided that we, for our part, begin to pay heed to the essence of technology.

Thus the essential unfolding of technology harbors in itself what we least suspect, the possible rise of the saving power.

Everything, then, depends upon this: that we ponder this rising and that, recollecting, we watch over it. How can this happen? Above all through our catching sight of the essential unfolding in technology, instead of merely gaping at the technological. So long as we represent technology as an instrument, we remain transfixed in the will to master it. We press on past the essence of technology.

When, however, we ask how the instrumental unfolds essentially as a kind of causality, then we experience this essential unfolding as the destining of a revealing.

When we consider, finally, that the essential unfolding of the essence of technology propriates in the granting that needs and uses man so that he may share in revealing, then the following becomes clear:

The essence of technology is in a lofty sense ambiguous. Such ambiguity points to the mystery of all revealing, i.e., of truth.

On the one hand, enframing challenges forth into the frenziedness of ordering that blocks every view into the propriative event of revealing and so radically endangers the relation to the essence of truth.

On the other hand, enframing propriates for its part in the granting that lets man endure – as yet inexperienced, but perhaps more experienced in the future – that he may be the one who is needed and used for the safekeeping of the essence of truth. Thus the rising of the saving power appears.

The irresistibility of ordering and the restraint of the saving power draw past each other like the paths of two stars in the course of the heavens. But precisely this, their passing by, is the hidden side of their nearness.

When we look into the ambiguous essence of technology, we behold the constellation, the stellar course of the mystery.

The question concerning technology is the question concerning the constellation in which revealing and concealing, in which the essential unfolding of truth propriates.

But what help is it to us to look into the constellation of truth? We look into the danger and see the growth of the saving power.

Through this we are not yet saved. But we are thereupon summoned to hope in the growing light of the saving power. How can this happen? Here and now and in little things, that we may foster the saving power

in its increase. This includes holding always before our eyes the extreme danger.

The essential unfolding of technology threatens revealing, threatens it with the possibility that all revealing will be consumed in ordering and that everything will present itself only in the unconcealment of standing-reserve. Human activity can never directly counter this danger. Human achievement alone can never banish it. But human reflection can ponder the fact that all saving power must be of a higher essence than what is endangered, though at the same time kindred to it.

But might there not perhaps be a more primally granted revealing that could bring the saving power into its first shining-forth in the midst of the danger that in the technological age rather conceals than shows itself?

There was a time when it was not technology alone that bore the name *technē*. Once the revealing that brings forth truth into the splendor of radiant appearance was also called *technē*.

There was a time when the bringing-forth of the true into the beautiful was called *technē*. The *poiēsis* of the fine arts was also called *technē*.

At the outset of the destining of the West, in Greece, the arts soared to the supreme height of the revealing granted them. They illuminated the presence [*Gegenwart*] of the gods and the dialogue of divine and human destinings. And art was called simply *technē*. It was a single, manifold revealing. It was pious, *promos*, i.e., yielding to the holding sway and the safekeeping of truth.

The arts were not derived from the artistic. Artworks were not enjoyed aesthetically. Art was not a sector of cultural activity.

What was art – perhaps only for that brief but magnificent age? Why did art bear the modest name *technē*? Because it was a revealing that brought forth and made present, and therefore belonged within *poiēsis*. It was finally that revealing which holds complete sway in all the fine arts, in poetry, and in everything poetical that obtained *poiēsis* as its proper name.

The same poet from whom we heard the words

But where danger is, grows
The saving power also...

says to us:

...poetically man dwells on this earth.

The poetical brings the true into the splendor of what Plato in the *Phaedrus* calls to *ekphanestaton*, that which shines forth most purely. The poetical thoroughly pervades every art, every revealing of essential unfolding into the beautiful.

Could it be that the fine arts are called to poetic revealing? Could it be that revealing lays claim to the arts most primally, so that they for their part may expressly foster the growth of the saving power, may awaken and found anew our vision of, and trust in, that which grants?

Whether art may be granted this highest possibility of its essence in the midst of the extreme danger, no one can tell. Yet we can be astounded. Before what? Before this other possibility: that the frenziedness of technology may entrench itself everywhere to such an extent that someday, throughout everything technological, the essence of technology may unfold essentially in the propriative event of truth.

Because the essence of technology is nothing technological, essential reflection upon technology and decisive

confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it.

Such a realm is art. But certainly only if reflection upon art, for its part, does not shut its eyes to the constellation of truth, concerning which we are *questioning*.

Thus questioning, we bear witness to the crisis that in our sheer preoccupation with technology we do not yet experience the essential unfolding of technology, that in our sheer aesthetic-mindedness we no longer guard and preserve the essential unfolding of art. Yet the more questioning we ponder the essence of technology, the more mysterious the essence of art becomes.

The closer we come to the danger, the more brightly do the ways into the saving power begin to shine and the more questioning we become. For questioning is the piety of thought.

Notes

- 1 W. Heisenberg, "Das Naturbild in der heutigen Physik," in *Die Künste im technischen Zeitalter* (Munich, 1954), pp. 43ff. [See also W. Heisenberg, *Physics and Philosophy: The Revolution in Modern Science* (New York: Harper & Row, 1958). – ED.]
- 2 See "On the Essence of Truth" (1930), first edition 1943, pp. 16ff.

- 3 "Das Naturbild," pp. 60ff.
- 4 [From "Patmos." Cf. *Friedrich Hölderlin Poems and Fragments*, trans. Michael Hamburger (Ann Arbor: The University of Michigan Press, 1966), pp. 462–63. – ED.]
- 5 "Die Wahlverwandtschaften," pt. 2, chap. 10, in the novel *Die wunderlichen Nachbarkinder*.

On Philosophy's "Ending" in Technoscience: Heidegger vs. Comte

Robert C. Scharff

I Introduction

The comparison of Comte and Heidegger developed in this essay begins by considering two remarkably similar features of their thinking, in order subsequently to highlight the one crucial issue over which they are in complete disagreement. On the one hand, first, both Comte and Heidegger see the technologized science (i.e., technoscience) that dominates the current age as nothing short of the culmination of the Western intellectual tradition; moreover, second, both of them hold that one can only understand this culminating event by becoming fully aware of the historically determinate character (i.e., historicity) of all thinking. On the other hand, while neither of them see the "dominance" of technoscience as entailing complete suppression of other (nonscientific) possibilities, for Comte all such other possibilities are regressive, whereas for Heidegger at least some of them would constitute our "saving grace." I am interested in this comparison because it involves what Heidegger calls, in pre-*Being and Time* language, the question of what it is to "be historical" and how this primal fact about us matters to philosophical (or more technically, post-philosophical) thinking.

What the later Heidegger understands by the task of "thinking" at the technoscientific "end of philosophy" is, of course, the subject of widespread disagreement.¹ For *some* of his critics, Heidegger's conception of

post-philosophical *Denken* makes him anti-technological; for others, it holds open the positive possibility of a transformed and liberating relation to technology.² For all their differences, however, a common thread runs through these interpretations. They are formulated by persons who see themselves *first* as critics of current philosophical practice and advocates with an agenda of what is to be done about it and only *then* as readers of Heidegger. There is certainly no crime in this; and it is easy to share some of their sentiments. Yet it may also be useful to recognize what this approach obscures. In their eagerness to speak as critics and advocates, they all tend to place at the periphery the topic Heidegger most wants to address. To put the point quickly, when Heidegger reflects on "the task of thinking" at the technoscientific end of philosophy, he is not primarily concerned either with the end itself, or with criticisms of it, or with what might emerge once we get past it. His main topic, in other words, is neither metaphysics and technoscience on the one hand nor the supposed features of a post-philosophical era on the other. For him, the primary issue is what kind of thinking might be possible, as he says, "at the end." It is this thinking – or for the moment, more precisely and modestly, just its "point of departure" and "task" – toward which he directs his attention.³

In this essay, then, I propose to directly consider Heidegger's own attempt to think "at" philosophy's end, instead of reading him through the agendas of his famous

interpreters. And it is in terms of this purpose that, in spite of appearances, Auguste Comte, the notorious nineteenth-century positivist who openly and happily concludes that our age of technologized science will never "end," becomes relevant. I shall argue that if we come to understand why Comte was unable to even conceive of the modern era's ending or being surpassed, this can actually shed light on Heidegger's claim that thinking "at" such an end is today what is most needed.

My discussion has three parts. First, I review briefly Comte's famous three-stage law, rejecting the usual practice of construing it as primarily either an empirical-naturalistic or a speculative-historical theory. Rather, I show that for Comte, the law serves above all as the basis of his reflective defense of the claim that the Western philosophical tradition is culminating in our scientific era – a defense that is laid out in such a way that it makes the very idea of a further stage literally unthinkable. Heidegger, too, argues that the Western tradition marks out a path by which the cosmology of the ancients fulfills itself in modern science. Hence in my second part, I show that the affinities between Comte and Heidegger are much greater than one might have expected. At the same time, however, while it is true that Comte and Heidegger do both tend to see the rise of modern science as a consummatory event *for the Western tradition*, their ideas of the significance of this event *for the future* are radically different. Unlike Comte, Heidegger finds this event deeply, experientially, and ontologically dissatisfying. Hence, whereas Comte is content to define philosophy's future scientifically, Heidegger realizes that he must try to work out an extra-philosophical way to "think" this dissatisfaction.⁴

In part III, I pursue further this contrast between the satisfied, optimistic Comte and the dissatisfied, historically burdened Heidegger. My point will be to emphasize what I believe is Heidegger's primary but often neglected motivation. In 1962, Heidegger characterized "Das Ende der Philosophie und die Aufgabe des Denkens" (EP) as an effort to "persist in questioning" through an "immanent critique" of *Sein und Zeit* (SZ). I take this to mean that he is above all moved, from the start to finish of his path of thinking, by a concern to follow out an experiential/ontological dissatisfaction with his "culminating" tradition that originates in the decade before SZ. My comparison with Comte is intended to put the focus squarely on this motivating dissatisfaction, so that Heidegger's trajectory is less likely to be construed as a function either of the agendas of his most famous

readers, or of the various techniques and approaches – whether, e.g., existential, phenomenological, Kantian, "destructive" or otherwise – that Heidegger attempts to enlist for his purposes at various stages of his thinking.

II Science and Comte's Three-Stage Law

According to Comte's famous three-stage law, "human intelligence in all of its inquiries ... successively makes use of three essentially different methods of philosophizing," so that "each branch of our knowledge ... necessarily passes through three different theoretical stages: the theological or fictive, the metaphysical or abstract, and the scientific or positive."⁵ Today, Comte's law is usually dismissed either as being empirically false or as fostering a presumptuous metanarrative about World History. Yet both of these criticisms hide more than they reveal. Comte's conceptions of "science," and of scientific thinking as an intellectual "stage," are far more sophisticated than logical positivism's; and his law is in the first instance neither an empirical thesis nor part of a speculative philosophy of history. Unlike later positivists, Comte does not reduce theology and metaphysics to failed efforts to be science. In fact, for him, theology, metaphysics, and science are not primarily "knowledge systems" at all, but rather *global "approaches" to our surroundings* – what Comte calls "ways of philosophizing." So, for him, thinking *occurs* in three ways: theologically, metaphysically, or scientifically. Each kind of thinking arises from a distinctive sense of experiential encounter that is articulated in a distinctive sort of "speculation" (i.e., theorizing). That all thinking follows a "method" simply means that whatever its specific rules/criteria, it manifests one of the three global outlooks.

For Comte, famously, **theology** constitutes a necessary intellectual "childhood." Both historically and as individuals, we initially lack both reliable theories about our surroundings, which must be based on previous observation, and fruitful observation, which needs guidance from established theory. We would thus have remained forever mired in a "vicious circle," had it not been for the "spontaneous conceptualizations" of primitive peoples. In an important way, then, their early fetishist or animistic conceptualizations deserve an epistemic respect not due the more sophisticated polytheisms and monotheisms that follow. For fetishism is

a direct, experience-based, creative, practical-minded response to surprising and disturbing encounters with our otherwise routine and predictable surroundings. It aims to restore sense to a temporarily disrupted existence – so that one can get on with life. Of course, says Comte, such early feeling- and imagination-driven accounts “overstimulate” the mind by promising answers to life’s unanswerable ultimate mysteries. Yet such feeling-based, imaginative speculation does teach us how to theorize.⁶ So, the theological era, especially the earliest part of it, is philosophically important – and not just for being a time of the first feeble stirrings of Reason, as the later positivists would have it. Most crucially, it is a period when all the human faculties achieve (“without prior deliberation”) their initial expression. It is the period when it becomes clear that we have these faculties, and that each of them has a role to play (albeit in retrospect, not yet the right one) in knowledge. Moreover, by giving us guidance for ritual and social interaction, theological speculation grounds our original form of universal praxis. As we might say now, Comte thus construes prayer and ritual as the first technology – i.e., as a first global effort to accommodate and restore the disrupted natural relations that initially stimulated speculation.

Especially given this praise for primitive forms of theology, it is important to note that, for Comte, it is not practical but theoretical dissatisfaction that drives the mind past the first stage and toward metaphysics. Readers of Heidegger should find it suggestive that Comte sees this development both as intellectually unavoidable and as something of a betrayal of an admirably concrete and intimate sort of originary relatedness to our natural and social surroundings. For the unsystematic and disparate schemes of fetishism and polytheism give way to monotheism, not out of any hope for greater human flourishing, but because reason demands a more systematic account of the universal cosmic necessity that it is thought must somehow underlie the multiple activities of the god(s). In this very effort, finally monotheism demonstrates how cognitively unsatisfying all theology must remain. For if there is such a cosmic necessity, then philosophy’s fundamental subject is the laws of this necessity and not the fact that the god(s) happen to make use of them.⁷ With the emergence of this realization, thinking turns metaphysical.

Not surprisingly, Comte’s concept of **metaphysics** foreshadows later positivism’s. As expressions of intellectual “adolescence,” metaphysical systems are both an advance over theology and yet ultimately a roadblock

to genuine natural knowledge. Taken as a whole, the metaphysical era is a basically unstable but necessary time of transition. It has earlier and later forms, but no substages. Though nature and nature’s laws are always its central concern, earlier metaphysical systems still tend to see natural phenomena as moved by God’s agency; later systems make the forces of “nature itself” the powers behind everything. To this extent, Comte’s depiction of metaphysics seems positivist in the familiar, later sense. His way of estimating its philosophical worth, however, is suggestively different. In the first place, he is as outspoken about the value of this intellectual stage for human progress as he is about its limitations. For him, it is just as important to praise the metaphysical era as the period of reason’s liberation from feelings and religious authority as it is to condemn it as a time of epistemic fixation on doctrines of inner essences, hidden causes, and a priori principles. Moreover, if like the later positivists he objects to the unscientific character of metaphysical speculation, this is not what Comte sees as its most serious fault. Far more disturbing to him is its tendency to become enamored of reason’s sheer logical power. The problem always runs the same course. Starting from supposedly self-evident conviction(s), metaphysical minds create competing dogmatic systems. Since each system is logically consistent, and Reason is the final court of appeal, all disputes are endless and unresolvable. Yet this cognitive result is not the worst of it. Given that their first commitment is always to the allegedly “self-evident,” metaphysical thinkers are never more than secondarily focused on practical concerns. All of them wind up being so inattentive to what is actually observable that it is pride and not truth which is primarily at stake in choosing among their systems.⁸ Ultimately, then, “pure” liberated reason provides us with neither genuine science nor a better life, and the presumption that our mere possession of reason somehow elevates us above the rest of nature is hollow. For Comte, the main problem with metaphysics is not that it succumbs to abstract thinking. Its real problem is that in glorifying the “life of reason,” it promotes infatuation with analysis, argument, unified systems, and formal rules – with the inevitable practical result, in the end, that force replaces intellect whenever changing hearts and minds is the goal.

Eventually, then, the mind faces the prospect of “maturity.” Metaphysical thinking, reluctantly realizing that it will always remain abstract and merely logical, transforms itself into **scientific**, or positive, reasoning when it becomes clear that although reason should not

be a slave to feelings or to alleged revelations, it is unfit to be its own authority. Three modern figures are historically crucial (and developmentally representative) in this transition. *Bacon* pioneers the move toward "observation," away from old intellectual "idols." *Descartes* turns philosophy toward epistemology, in recognition that if reason is to properly serve observation, its primary concern must lie with method. And regarding the proper fusion of intellect with experience, *Galileo* exemplifies how nature's laws are to be "discovered" and Bacon again illuminates the idea that applied knowledge is practical "power." Field by field, scientific naturalism (which explains mechanistically *how* things work) replaces metaphysical naturalism (which can only conjecture teleologically about *why* things work). Studies of observable phenomena replace the old search for answers to life's ultimate mysteries; and these studies organize themselves hierarchically – from mathematics, the simplest and most abstract, to sociology, the most complex and, *philosophically* speaking, most important. Here again, Comte gives life, not epistemology, the last word. For sociology gains its special significance not, as he puts it, "objectively," from criteria of reason, but "subjectively," from the needs of feeling, social sensibility, and altruistic love. It is understanding social behavior that will lead ultimately to the establishment of truly peaceful, prosperous societies.⁹ Positive/scientific knowledge is thus the basis of the third and final form of universal praxis – namely, a truly global technology that effectuates a control over material nature and a means of "social reorganization" that will bring into being the harmonious condition humanity has desired since its earliest experiences of cosmic disruption.

The point of this quick summary of Comte's conception of the transition from theological to scientific thinking is to make clear that the usual critiques of his three-stage law as either failing empirical warrant or as merely expressing historicist ideology miss its basic function as the *measure of Comte's own outlook mid philosophical self image*. Comte displays in this regard a historical-critical reflectiveness no later positivist would tolerate. From Mill and Mach to Reichenbach and Ayer, Comte's way of mixing historical and "subjective" considerations into his philosophical self-description would seem to undermine in principle positivism's supposedly "objective" orientation. To Comte, however, this criticism is confused, even self-deceiving. In his view no philosophy, not even positivism, succeeds in placing itself beyond its inheritance. The ahistorical attitude of the later positivists would strike him as ignorance, not

enlightenment.¹⁰ In fact, since science develops *from* theology and metaphysics, it is impossible even to recognize its "superiority" and "maturity" without understanding its indebtedness to and transformation of the thinking of the two earlier stages. Comte's reflective application of the three-stage law *to his own orientation* makes his positivism deeply different in spirit from that of its later proponents. But it also, I think, brings him some way toward Heidegger – above all in his identification of the positive stage as the "consummation" of Western intellectual development.

III Technoscience as the "Consummation" of Philosophy

Stated in Comte's own terms, his primary employment of the three-stage law takes the form of a historico-critical account of why one must now be a positivist. Restated in Heideggerian terms, Comte is committed to facing the reflective question of securing the proper access (*Zugang*) to philosophical inquiry, where this inquiry is understood as originating at the "ending" of the Western tradition. Or is he? Let us give conventional accounts their due. Comte does picture the Western tradition in three "stages," not multiple "epochs." He does say that cognitive activity precedes its practical applications; and he does "explain" historical development in terms of teleological covering law of progress. Even if his positivism also possesses surprisingly unpositivist features, how much less like Heideggerian *Denken* could Comte's positive philosophizing be?

Yet we have all learned from Heidegger that questions about other thinkers posed in this way belong to the discourse of the traditional metaphysics of presence. To ask about the "propositions" Comte asserts and "positions" he takes is to have nothing of "one's own" at stake in the asking – and so nothing to acquire or "appropriate" (*aneignen*) with one's answers. So, I follow Heidegger's example instead and ask: Toward what is Comte's work "on the way"? In other words, I submit Comte's *work* to what Heidegger called a "destructive" retrieval.¹¹ A "critical dismantling" of Comte's explicit pronouncements about his three-stage law can give us an originary "foreconception" of that hitherto unsatisfactorily articulated concern that is both at the heart of Comte's whole project and also still a vital issue today. This concern is: How is it today to *be* historical – as a philosopher and in one's own thinking?

With such a destructive retrieval in mind, we see easily how much is missed if Comte's law is construed as an objective theory of what once was and now is. True enough, Comte himself sometimes treats the law this way; but to see only this is to be ignorant of his own clear intentions. As noted above, Comte does not share the typical positivist vision of theology and metaphysics as mere expressions of superstition and nonsense. Nor does he see us as living "in" the scientific age, with theology and metaphysics effectively left behind us. In just these unpositivist ideas, we find his reasons for historicocritical reflection "on" science. He seeks two results. First, he intends to cultivate *in his own thinking* an awareness of positive philosophy's kinship with and debts to (not just superiority over) tradition. Second, he wants to monitor his own living-through and thinking-with an emerging transformation of prescientific inheritances that seems so far only partially visible in the successes of the natural and less "complex" sciences. In later positivism, sympathy for science *displaces* all concern for prescientific tradition. Why, we should ask, is Comte, in contrast, so insistently careful to *think in terms of* what he sees as our historically "cumulative" and inherited circumstances? What does Comte "already understand that he is unable to make known to us"?¹² From his texts, we can develop a foreconception of what is "underway" here.

Perhaps most suggestively, there is Comte's notion of time's "philosophical order" – an idea in terms of which, at the very start of his career, he expresses his concern for the current relevance of the intellectual past to the emerging third stage. For us positivists, he says, the

chronological order of epochs is emphatically not their philosophical order. Rather than say the past, the present, and the future, we should say the past, the future, and the present. Indeed, it is only when we have conceived the future by means of the past that we can profitably return to the present so as to grasp its true character.¹³

This passage is wonderfully destructible. In other words, it merits a triple reading – one that juxtaposes what Comte **asserts**, what he **intends**, and what he must somehow already **understand**. Of course, any attempt to "assert" The Temporal Order would be, in fine Cartesian style, a mistaken effort to fix the truth about time as if from Nowhere. Yet Comte explicitly depicts his circumstances differently. He characterizes them as the circumstances of someone who already "conceives the future by means of the past" – and moreover intends

this conceptual previsioning as being for the sake of a "return to the [unsatisfactorily lived-through] present." By contrast, later positivists engage in a familiar modernist double favoring of "the" present. First, they inflate it, over past and future, into a *focal Now* in which the mind is liberated from "former" thoughts and "future" guesswork, so it can focus on "today's" job of epistemic analysis and reconstruction. Second, their formal reconstructions are then themselves construed as if they were taking shape in a kind of timelessly *ideal Now* where epistemologists all possess the proper "criteria of rationality." In the usual accounts, Comte is just a somewhat more candid member of this band of good epistemologists – one who actually knows that, as Habermas puts it, "the real job ... of positivism ... [is] to justify the sciences' scientific belief in themselves by construing the history of the species as the history of the realization of the positive spirit."¹⁴

This interpretation, however, is quite wrong. Like a good Heideggerian hermeneut, Comte sees his thinking as originating in a lived, not a focal and idealized, present. It is, he says, a matter of "grasping the true character" of an *emerging* scientific era, and it is *his own reasoning* that he wishes to bring under this observation. His concern, then, is not the prescientific tradition as "the" past – i.e., as something he is "now" choosing to bring before us again so he can criticize it. Rather, Comte understands himself to be considering, let us call it, *the lingering of inherited ways "in" current practice*. Comte treats his theologico-metaphysical inheritance as making itself known to him in an experienced lack of fit between emergent scientific research and a received, still typically prescientific cluster of epistemic ideas that distort the natural sciences and contest the very idea of a human, "sociological" one.¹⁵ Thus, when he *speaks* of this tension between emergent practice and inherited conception, and *intends* to resolve the tension in favor of emergent practice, Comte articulates an *understanding* of his aim in terms of a "philosophically ordered" time. Comte is, as Heidegger would say, "on the way" here toward philosophizing in terms of a mode of temporalization which is *not* "chronological."

A destructive retrieval of Comte's work also sheds new light on his famous remark that "From science comes prevision; [and] from prevision comes action."¹⁶ On the standard view, this is reducible to Baconian sloganeering – or perhaps to an anticipation of the earlier Foucault. All genuine "theories" are *scientific* theories that predict the natural "order," and applied theories

constitute a technology of control that enables us to organize material and social life. In other words, "knowledge is power." This, however, is precisely not Comte's view. "Prevision" is not for him an exclusively scientific concern. All reasoning, even in fetishism, aims to find theories that enable us to reestablish the peaceful and predictable relations with our surroundings that are felt to precede our experiences of its disruption. At every stage, this aim is pursued by whatever method maximally improves upon the earlier ones. Hence, all that science really does is actually fulfill this oldest aim by successfully transforming its theological and metaphysical approaches.

Destructively retrieved, then, what Comte's three-stage narrative reveals is that to envisage history's "cumulative" meaning and time's "philosophical order," one must already understand human existence in a way that does not coincide with the definitions typical of any of the three stages. We who are living into the positive era are not, of course, either theological or metaphysical beings; but for Comte, neither are we fundamentally scientific. Whatever else may be open to us, we are at bottom already "practical" – in Comte's silently operative sense that we start with a globally benign sense of relation to the surroundings and live in the expectation that this condition can always be sustained or restored if properly "previsioned." Thus for Comte, it is just as wrong to say with the later positivists that all real philosophy is scientific, anti-religious, and anti-metaphysical as it is to say with the traditionalists that philosophy's origin is always mystic feeling or wonder. At different points in our history, the imaginative response to mystic feelings, the intellectual articulation of wonder, and the positive regard for observation have all been vital to our reasoning, and all are equally moved by the desire for prevision and for the satisfaction of natural and interpersonal need. For Comte, as I said above, modern technology is simply the third kind of applied prevision. It is to science what worship and contemplation are, respectively, to theology and metaphysics – namely, an action-oriented application of a "comprehensive system" – only this time, we really get what we understand ourselves to have wanted from the start.

In a crucial respect, then, Comte's story anticipates Heidegger's argument that while it is "chronologically correct" to say modern technology needs the "prior support" of the positive sciences, this statement cannot illuminate the "truth" about technology. Construing the three ways of thinking in terms of time considered in its "philosophical" instead of "chronological" order, Comte

has them originate in a practical need for a "relation of harmony between human beings and their surroundings." So for him, modern technology, like all technology when properly thought *for the future and in terms of the past* is, just as Heidegger says, "earlier" than science "from the point of view of the essence that holds sway within it."¹⁷ As with Heidegger's treatment of onto-theological epochs in the Western tradition, Comte does not dream of leaping beyond all previous eras, nor does he offer a metanarrative "logic" that would join the stages, substages, or systems within them – and this is not because he lacks the requisite pioneering spirit or philosophical imagination, but because he thinks the very idea of such leaps and logics is inappropriate.¹⁸ Employed reflectively, Comte's law is not a template for reckoning with the tradition from outside. "Progress" from fetishism to science is a matter of bringing to fruition a possibility *in* positive science. It is – to use Heidegger's phrasing for characterizing the end of metaphysics – a completing or "gathering" rather than "perfecting" of this possibility. And just as Heidegger has us "receive our very being" in taking up this possibility, Comte envisions human beings as becoming ever more like themselves. In other words, we enact an originary relatedness that experientially "engages" us before we reason, that is lived through before it is articulated, and that is always as much a matter of feeling and imagination (i.e., embodiment) as it is of reason. In this way, as Heidegger says, "the oldest of the old follows behind us in our thinking and yet it comes to meet us" in life from out ahead.¹⁹

Destructively retrieved, then, Comte's "cumulative" story of the tradition offers us a Janus face. In what he *says*, we hear the familiar song of scientism and its technological power. In what he *intends* by his story, however, there lies something more promising. Embedded in the usual talk of progress, there is an articulation of Comte's general understanding of what (in Heidegger's phrase) gets *disclosed* in the three kinds of philosophizing. In Comte's narrative, all thinking, in all three stages, originates in one very specific sense of disclosiveness – namely, the revealing of our surroundings as regular, regularizable, and responsive to human need. This sense of disclosiveness is understood as "older" than both modern science and any technology, ancient or modern. And since Comte construes science through this ruling disclosiveness and not in terms of its epistemic surface, he stays open to a proper recognition of the priority of the question of technology over that of science. Linking

“prevision” to the unfolding process itself instead of to modern science or to its type of technology, he lets prevision exhibit something of the “alēthic” character that Heidegger finds in both classical *technē* and modern technology. But the parallel goes even farther. For in the same general way that Heidegger contrasts Aristotle’s “poietic” *technē* with the more intrusive technology of modern science, Comte distinguishes early theology from today’s science by depicting the latter as less inclined to find/restore order than to demand/make it. In this way Comte’s account, like Heidegger’s, sees modern scientific activity as no longer a responsive “bringing-forth” of what does not otherwise bring itself to presence, but as an aggressive “setting-up that challenges” whatever is encountered.²⁰

To sum up this retrieval, Comte’s positivism seems to be *on the way*, as Heidegger says, toward thinking modern technoscience “in its essence.” By treating it, not as something now being resolutely chosen over past options, but rather as basically the successful articulation of a venerable disclosive process, the Comtean account even implies that this process itself is something more than “just” a human activity. In this sense, one might venture to suggest that Comte’s historico-critically reflective account of the scientific culmination of Western philosophizing is already on its way toward Heidegger’s later question, not of Being, but of Being’s presenting or eventuation.

IV Conclusion: Toward a Thinking “at” the End

Yet even if my retrieval of Comte is so far warranted, we should be on guard against too much enthusiasm for our newfound kinship. Foreconceptions, after all, are not only *of* something that is underway, they are also *for* someone to follow out. Too much stress on what Comte must *understand* at the expense of what he actually *says* would usurp instead of appropriate his work.²¹ So far, I have construed generously what is underway in Comte; but my ultimate aim is to highlight, by contrast, his most glaring divergence from Heidegger. For unlike Heidegger (and, presumably, unlike ourselves), on the question of what if anything comes *after* science, Comte is has nothing to say. Indeed for him, there is simply nothing to ask. That the third stage is the final stage seems established by the very fact that science is a *culminating occurrence* – i.e., an *ending* in which knowledge is henceforth

only “relative” to available evidence, never “absolutely” guaranteed by feeling, faith, or reason, and always ready to restore the natural and social order we expect.

We should not run past this point too quickly. It is not just that Comte stops with his arguments for a third stage. The question is, if Comte does not in fact think past the age of science, why does he fail to consider even the possibility? The answer, I think, does not lie in any theoretical or ideological convictions. It lies in the fact that *Comte has no factual-experiential incentive to move beyond his internalist vision of the third stage*. This, then, we should probably grant him: “For” Comte’s story, science may really *be* a successful gathering and completing of a disclosive process; and this completion may really *be* understood as an eventuation rather than an event; and technology may really *be* its especially intrusive mode of disclosing; and we may really *belong* to this eventuation, rather than the reverse. What we, considering these matters today, need to notice, however, is that to the Comte who tells this story, none of these ontological factors are ever explicitly identified – let alone are they ever elaborated and made the basis of any inquiry into something like Heidegger’s “distressing difficulty ... of an unsuitably thought relation between *Being and human being*.”²² Here we must remember that Comte speaks from an understanding and at a time when positive science (to say nothing of its “applications”) is still more promise than actualization, when naturalistic models for human-historical study are still more projected than deployed, and when prescientific thinking is still mostly seen as ill-fated rather than meaningless. In this milieu, he simply has no experiential basis for asking whether the positive stage might, in its eventual unfolding, mark out an essentially oppressive and occlusive ontological site. Thus, Comte is able to think science *as* a culmination, but he cannot think *at* its culmination – and so he cannot ask whether, as Heidegger puts it, “the world civilization just now beginning might one day overcome its technological-scientific-industrial character as the sole criterion of our world sojourn.”²³ One cannot think of overcoming what has not yet “arrived.”

By contrast, Heidegger finds this culmination – and specifically the experienced spread of its intrusive disclosure – profoundly unsatisfying. From start to finish, Heidegger’s rethinking of the Western tradition is informed by an issue Comte experiences no need to explore. For the twentieth-century Heidegger, but not for the nineteenth-century Comte, the fundamental question is: *How does it come to pass that today so much is*

encountered which seems ontologically "out of place" wherever knowing and acting occur in their usual senses? With no need to ask this question, Comte is free to consider the future "scientifically" and to assign positivism the job of articulating and defending it. But Heidegger must explore the possibility of a non-metaphysical "thinking" that might articulate his ontological dissatisfaction with the future so understood. Contrasting this thinking with the culminating (metaphysical) "philosophy," he asks,

is the end of philosophy ... already the complete actualization of all the possibilities in which the thinking of philosophy became set? Or is there a *first* possibility for thinking apart from the *last* possibility (of philosophy's dissolution into the technologized sciences), a first possibility from which the thinking of philosophy would have to start, but which as philosophy it could nevertheless not expressly experience or take up?²⁴

In the foreconception I have worked out above, Comte's tale of the Western tradition's ending articulates what Heidegger calls (with some conviction that this cannot literally be the case) philosophy's "last possibility." In my view, Comte's formulation of this possibility – framed in the midst of and as an emerging "positive spirit" – sheds light on how there might be for us, today, a "first possibility" that there could not be for him. Comte's Janus face, however, is crucial here. When we critically dismantle Comte's actual pronouncements, it is evident how they threaten to cover over what is foreconceptually most promising. Drawing on Heidegger's early language, we might say that the point must be to explicitly recognize this regressive tendency in Comte's pronouncements in order to learn how, for us, it could just as well serve

to manifest the *history of our very Dasein* – history not as the totality of public events but as the *mode of happening of this Dasein*. That such happening is possible and reigns in this way for thousands of years manifests a particular mode of Dasein's being, a specific tendency toward ... declining [*Verfallen*], from which it does not escape [and which] first really comes into its own *when Dasein rebels against this tendency*.²⁵

The aim of my destructive retrieval of Comte's historical-critical reflection on the meaning of the three-stage law for his own thinking has been to stress its promise – both *against* Comte's own frequently regressive portrayals of his results, and also *ahead* of all those "rebellious" later positivists who remain blind to the

promise of this reflective thinking because they refuse to see any value in it at all.

If Comte's tradition-bound gesturing and later positivism's more insistently scientific rebelliousness are manifestations of "decline," then by their "destruction" we may come to see how to strengthen Comte's deeper and more promising intentions *against* these tendencies.²⁶ The aim must be to discern Comte's real goal all the more clearly *in* the way its pursuit is continually undermined and diverted. If we engage in what Heidegger calls a "radial reflection in and from" the site of this diversion, we might ourselves "secure" (albeit not permanently "transcend") this site as a point of departure against our own tendency toward falling, or "declining" understanding.²⁷

Here, then, the real distance between Heidegger and Comte stands out clearly. Both may rightly be said to be thinking out of a concern with what it means to be historical, but only Heidegger makes *being historical itself* an explicit theme. Comte does insist that ideas cannot be understood apart from their history, and he does believe that historical-critical reflection on *being* a positivist is current philosophy's premier issue. But the record shows that he is unable to take these points to heart. By contrast, a central feature of SZ's characterization of its point of departure is that it articulates Heidegger's own experience of raising the Being-question and confronting "in" that very act of questioning a series of traditional prejudices that block it. He finds himself with a double experience of "*Perplexed, I raise again the question of Being ...*" / "*It's not worth asking because ...*" And this, for him, is a sufficient "beginning" – an interplay between inherited past and possible future, mediated by the dissatisfactions of present experience.

My aim in this essay has been to focus attention on this "reflective" feature of Heidegger's thinking by juxtaposing him with someone who, on the one hand, has a similarly "consummatory" understanding of technologized science and who is similarly convinced that philosophizing is an especially disciplined way of working out what it is to "be" historical, but someone who, on the other hand, also has no cause to make *this very point of departure itself* an issue. Viewed in this way, Heidegger's pervasive ontological dissatisfaction with the same "culminating eventuation" that leaves Comte happy eventually leads him to say, in effect, that; we must turn the Comtean position inside out. We must, that is, explicitly "make known" to ourselves an eventuation (*Ereignis*) Comte himself only silently "understood." "We may venture the step back out of philosophy into the thinking of Being," says Heidegger, "as

soon as we become at home in the provenance of thinking.”²⁸ This remark, as the title of the work in which it is made suggests, comes “out of the experience of thinking.” It is thus offered by someone who has already made an issue

out of *not* being at home – someone who was unwilling, already a decade before SZ, to simply assume that he knew how to *be* a philosopher, or at first, even how to articulate this as a problem.

Abbreviations

Comte’s Works

CPP *Cours de philosophie positive*, 6 vols. (Paris: Bachelier, 1830–42) [latest reprint, in two volumes, *Philosophie première: Cours de philosophie positive, leçons 1 à 45*, ed. Michel Serres, François Dagonet, and Allal Sinaceur, and *Physique sociale: Cours de philosophie positive, leçons 46–60*, ed. Jean-Paul Enthoven. Paris: Hermann, 1975], Subsequent French editions have various paginations for the same 60 “Lessons.” My citations are by volume, lesson, and first-edition pagination, and bracketed pages to the Frederick Ferré translation [F], *Introduction to Positive Philosophy* (Indianapolis, IN: Hackett, 1988).

DEP *Discours [préliminaire] sur l’esprit positif*, printed separately; also as introduction (same pagination) to *Traité philosophique d’astronomie populaire* (Paris: Carilian-Goeury) and Victor Dalmont, 1844) [trans. Edward Spencer Beesly, *A Discourse on the Positive Spirit* (London: William Reeves, 1903)].

SPP *Système de politique positive, ou traité de sociologie, instituant la religion de l’humanité*, 4 vols. (Paris: L. Mathias, 1851–4) [trans. J. H. Bridges et al., *System of Positive Polity*, 4 vols. (London: Longmans, Green, 1875–7)]. Six “early essays on social philosophy” in “Appendice général,” Vol. 4, cited as “SPP4a” to accommodate the separate French pagination.

Heidegger’s Works

SZ *Sein und Zeit*, 10th ed. (Tübingen: Max Niemeyer, 1963) [*Being and Time*, trans. John Macquarrie and Edward Robinson (New York: Harper & Row, 1962), and Joan Stambaugh (Albany: State University of New York Press, rev. ed. 2010)].

EP “Das Ende der Philosophie und die Aufgabe des Denkens” [trans. Joan Stambaugh, alterations by David Farrell Krell in *Basic Writings*, rev. ed., ed. D. F. Krell (New York: HarperCollins, 1993), 431–49].

FT “Die Frage nach der Technik,” in *Vorträge und Aufsätze* (Pfullingen: Günther Neske, 1954), 5–36 [trans. William Lovitt, alterations by David Farrell Krell, in *Basic Writings*, pp. 311–41].

SD *Zur Sache des Denkens* (Tübingen: Max Niemeyer, 1969) [*On Time and Being*, trans. Joan Stambaugh (New York: Harper & Row, 1972)]. Contains EP (SD German/English pagination given in brackets).

Notes

1 For Jacques Derrida, Heidegger’s critique of the philosophical, tradition never becomes radical enough, so that to some extent his thinking always “remains within metaphysics and only mak[es] explicit its principles” (“*Ousia and Grammiē*: Note on a Note from *Being and Time*,” in *Margins of Philosophy*, trans. Alan Bass [Chicago: University of Chicago Press, 1982], 48). For Hans-Georg Gadamer, Heidegger’s attempt to mark an end to “philosophy” appears “burdened with violence,” and Gadamer pointedly identifies his own universal hermeneutic as having “the truth of a corrective” against those misguided thinkers who “make radical inferences from everything” and assume “the role of prophet, Cassandra, preacher, or ... know-it-all” (“The History of Philosophy,” in *Heidegger’s Ways*, trans. John W. Stanley et al. [Albany: State University of New York Press, 1994], 165; *Truth, and Method*, 2nd ed., trans. Joel

Weinsheimer and Donald G. Marshall [New York: Continuum, 1989], xxxvii–xxxviii), and *Philosophical Apprenticeships*, trans. Robert R. Sullivan [Cambridge, MA: MIT Press, 1985], 186–9). According to Jürgen Habermas, late Heideggerian *Denken* is the expression of his mystical and politically motivated post-war *Ursprungsphilosophie* (*The Philosophical Discourse of Modernity: Twelve Lectures*, trans. Frederick Lawrence [Cambridge, MA: MIT Press, 1987], 152–60). And, to name just one more critic, Richard Rorty argues that although Heidegger himself ultimately fails to deconstruct the history of philosophy, he does manage “to further encapsulate and isolate it, thus enabling us to circumvent it” (“Deconstruction and Circumvention,” in his *Collected Papers, Vol. 2: Essays on Heidegger and Others* [Cambridge: Cambridge University Press, 1991], 105, my emphasis).

- 2 For the anti-technological interpretation, see, e.g., Andrew Feenberg, *Questioning Technology* (London: Routledge, 1999), in this volume, ch. 31. For the transformed relation construal, see, e.g., Hubert L. Dreyfus, "Heidegger on Gaining a Free Relation to Technology," in *Technology and the Politics of Knowledge*, ed. Andrew Feenberg (Bloomington: Indiana University Press, 1995), 97–107; and Hubert Dreyfus and Charles Spinosa, "Highway Bridges and Feasts: Heidegger and Borgmann on How to Affirm Technology," in this volume, ch. 30.
- 3 EP, 431 (61/55).
- 4 Though my focus will necessarily be on Heidegger's later work, where tradition is interpreted most explicitly in terms of its ending in modern [techno]science, I will have occasion to note that the attitude of (onto-logical) dissatisfaction is just as central to his earlier work as well.
- 5 CPP1 (1), 1 (F, 1–2) and SPP4a, 77/547, respectively. For detailed analyses of the three stages, see my *Comte After Positivism* (Cambridge: Cambridge University Press, 1995), 73–91; and "Comte, Philosophy, and the Question of Its History," *Philosophical Topics* 19/2 (1991), 184–99.
- 6 "[I]t is experience alone that has enabled us to estimate our abilities rightly, and, if man had not commenced by overestimating his forces, these would never have been able to acquire all the development of which they are capable" CPP1 (1), 10 (F, 5).
- 7 I note here that Comte, like Heidegger, understands the Western tradition in its dominant intellectual mood as onto-theological – yet also regards the Greek concern for Being, not Judeo-Christian variations on this theme, as the grounding experience of this mood. Comte, moreover, sees theology's influence on tradition as derivative and, in terms of its underlying impulses, relatively short-lived. Long before most people are ready to abandon God talk, he says, the "metaphysical" stage is already latent in the advanced theologian's efforts to reason logically, demand conceptual clarity, and engage in disputation.

There are other interesting parallels here between Comte and Heidegger on religion. Neither wants to claim that religious faith/experience, as such, plays a central role in the dominant Western tradition, apparently for similar reasons. Comte actually admires the act of believing faith for its felt intensity, its preoccupation with the concrete and experiential, and its way of informing the whole of one's life. For these reasons, he admires fetishism above any other theological outlook. Indeed, the spirit of fetishism is as central to his conception of positivist culture as to the positive spirit. As Juliette Grange rightly notes, the grand subjective synthesis of reason and feeling toward which our age aspires might well be called a "new fetishism" (*La philosophie d'Auguste Comte: Science, politique, religion* [Paris: Presses Universitaires de France, 1996], 17–19). For no amount of scientific progress will ever produce an "objective" or absolute synthesis, either

- of the natural or social order. Hence, our sense of the unity of nature and social harmony will always be only "subjective" or "fictional"; and it is in fetishism that we find the purest expression of both the struggle to "subordinate the subjective to the objective" – and that recognition of the "fundamental preponderance of the heart over the intellect" which mature positivism is finally in a position to appreciate fully (SPP3, 82–122/68–101, quoted from 121/100 and 120/99). On how Heidegger's religious struggles fuel his originary sense of religious experience as (in Kisiel's words) a "phenomenological paradigm" and his lifelong sense of the remoteness of metaphysicalized theology from "factual" religious life, see, e.g., Theodore Kisiel, *The Genesis of Heidegger's "Being and Time"* (Berkeley: University of California Press; 1993), esp. Ch. 2, quote from 80; and Thomas Sheehan, "Reading a Life: Heidegger and Hard Times," in *The Cambridge Companion to Heidegger*, 2nd ed., Charles Guignon (Cambridge: Cambridge University Press, 2006), 70–96.
- 8 In Comte's view, this weakness applies equally to systems of thought from the empiricist and from the rationalist traditions. For whether one's a priori commitment is to a substantive principle or to a methodological rule (e.g., "one always encounters nature via impressions or sense data"), the "system of thought" that results is just as closed and unreceptive to genuine "observation." (William James, for example, who knew Comte's positivism well, often remarked that classical empiricism is not very empirical.)
 - 9 Comte's lifelong "subjective" (i.e., ethico-political) interest in fostering the establishment of sociology is only one of several indications that his conception of the hierarchy of the sciences is not reductivist, in the manner of logical positivism. See Peter T. Manicas, *A History and Philosophy of the Social Sciences* (Oxford: Blackwell, 1987), 60–2.
 - 10 Actually, those who imagine themselves reasoning as if from nowhere, presuppositionless except for whatever methodological tools they bring with them to keep their thoughts legitimated, are in Comte's scheme acting more like metaphysicians than scientific thinkers. Of course for many purposes, the substitution of purely formal-systematic (*dogmatique*) accounts for historical ones, Comte admits, is a constant and even admirable "tendency" of the human mind. Yet ultimately, "an idea cannot be properly understood except through its history" CPP1 (1), 3 (F, 1); and those who construct such formalisms must never forget what is suppressed and smoothed over in the constructing CPP1 (2), 77–80 (F, 46–8). See also *Comte After Positivism*, 98–105.
 - 11 Heidegger first worked out this kind of acquisitive or appropriative reading of one's predecessors in the decade before SZ, especially in connection with his analysis of Wilhelm Dilthey's attempt to establish the foundations for genuinely human, as opposed to physical/material sciences.

- See my "Heidegger's 'Appropriation' of Dilthey before *Being and Time*," *Journal of the History of Philosophy* 35/1 (1997), 99–121.
- 12 SZ, 396. The subject of Heidegger's quote is, of course, Nietzsche (in his *Advantage and Disadvantage of History for Life*).
 - 13 SPP4a, 100/563.
 - 14 Jürgen Habermas, *Knowledge and Human Interests*, trans. Jeremy J. Shapiro (Boston: Beacon Press, 1971), 72.
 - 15 See, e.g., CPP1 (1), 31–56 (F, 18–33); and SPP1, 1–6 ("Preface"), 2–3/ix–xiii, 1–3.
 - 16 CPP1 (2), 63 (F, 38); DEP, 45/72; SPP1, 1–7, 321, 701–5/1–5, 257, 566–70. In the "Dedication" to his *Systeme*, Comte adds altruistic "Love" to the "Order" and "Progress" that the *Cours* envisions as promoted, respectively, by scientific knowledge and its application – for although "we grow tired of thinking, and even of acting; we never tire of loving" (SPP1, 1/1).
 - 17 Cf. FT, 21–2 (326–7) and, e.g., SPP4, 28ff./23ff.
 - 18 E.g., CPP1 (2), 82–4 (F, 49–50), where Comte affirms both pedagogical and epistemic advantages to be gained by replacing historical with formal accounts of the rise of science – yet stresses the necessarily "artificial" character of formal accounts and the danger that they will seriously distort the activity being systematized. Cf. on Heidegger, especially "The Age of the World Picture" (trans. William Lovitt, in *The Question Concerning Technology and Other Essays* [New York: Harper & Row, 1977], 115–54) and his remarks on Hegel in the "Protokoll" of the seminar on his "Time and Being" lecture, SD, 51–3 (48–50). It is helpful to know that, for Comte, it is not Hegel but Kant whose "reflective" rather than "constitutive" remarks on historical development he praised (*Comte After Positivism*, 54n.21).
 - 19 *Aus der Erfahrung des Denkens* (Pfullingen: Günther Neske, 1954), 19 ("The Thinker as Poet," in *Poetry, Language, and Thought*, trans. Albert Hofstadter [New York: Harper & Row, 1971], 10).
 - 20 My phrasing, of course, follows Heidegger's in FT, 10–16 (316–22). This point is of considerable importance for distinguishing Comte from other positivists as someone worth "retrieving"; insofar as he still acknowledges fundamentally different ancient and modern modes of technicity, he cannot yet be counted as an advocate of either instrumental rationality or Nature viewed as mere standing-reserve. This contrast is clear in Comte's remark that even now, fetishism's more spontaneous and responsive kind of speculation is still needed by scientists today whenever they confront situations where both plausible theories and reliable data are lacking (SPP3, 82–3/68–9). In the *Cours*, Comte says this is the standard condition of the fledgling science, sociology (CPP4 [48], 412–21).
 - 21 Indeed, my general view is that Comte is already too much of a Cartesian by inheritance to become the historically-reflective thinker he starts out to be. Hence the standard interpretations of Comte's work may not be very hermeneutical; but they were inevitable (see *Comte After Positivism*, Ch. 4, esp. 118–27).
 - 22 This is Heidegger's phrasing for that project which runs from the early "hermeneutics of facticity" to EP's "immanent criticism" of SZ, in the 1956 "Zusatz" to *Der Ursprung des Kunstwerkes* (Stuttgart: Reclam, 1960), 100 (trans. Albert Hofstadter in *Basic Writings*, 211).
 - 23 EP, 437 (67/60).
 - 24 EP, 435 (65/59).
 - 25 *Prolegomena zur Geschichte des Zeitbegriffs: Gesamtausgabe 20* (Frankfurt/Main: Vittorio Klostermann, 1979), 180 (*History of the Concept of Time: Prolegomena.*, trans. Theodore Kisiel [Bloomington: Indiana University Press, 1985], 129–30), emphasis altered.
 - 26 "Securing hermeneutical intentions against Verfallensein" is precisely the point of SZ's "repetitive" procedures, but the idea precedes SZ by several years. See, e.g., what Heidegger says on "ruinance" in the final section of the Winter Semester 1921–2 lecture course entitled "Vier formal-anzeigende Charaktere der Ruinance?" (*Gesamtausgabe 61* [Frankfurt/Main: Vittorio Klostermann, 1985], 140–55); and cf. Th. C. W. Oudemans, "Heidegger: Reading Against the Grain," in *Reading Heidegger from the Start*, ed. Theodore Kisiel and John van Buren (Albany: State University of New York Press, 1994), 39–45.
 - 27 The language is of course SZ's, but the expressed sentiment – namely, that interpreting past forms of philosophical inquiry, when done perspicaciously, can simultaneously be an exercise in philosophical self-understanding – is explicitly announced at least as early as the famous 1922 manuscript, "Phänomenologische Interpretation zu Aristoteles (Anzeige der hermeneutischen Situation)," first published in *Dilthey-Jahrbuch* 6 (1989), 239.
 - 28 *Aus der Erfahrung des Denkens*, 19 [10].

Focal Things and Practices

Albert Borgmann

23 Focal Things and Practices

To see that the force of nature can be encountered analogously in many other places, we must develop the general notions of focal things and practices. This is the first point of this chapter. The Latin word *focus*, its meaning and etymology, are our best guides to this task. But once we have learned tentatively to recognize the instances of focal things and practices in our midst, we must acknowledge their scattered and inconspicuous character too. Their hidden splendor comes to light when we consider Heidegger's reflections on simple and eminent things. But an inappropriate nostalgia clings to Heidegger's account. It can be dispelled, so I will argue, when we remember and realize more fully that the technological environment heightens rather than denies the radiance of genuine focal things and when we learn to understand that focal things require a practice to prosper within. These points I will try to give substance in the subsequent parts of this chapter by calling attention to the focal concerns of running and of the culture of the table.

The Latin word *focus* means hearth. ... [According to what I call the device paradigm,] the hearth or fireplace, a thing, [appears] as the counterpart to the central heating plant, a device. It [has been] pointed out that in a pretechnological house the fireplace constituted

a center of warmth, of light, and of daily practices. For the Romans the *focus* was holy, the place where the housegods resided. In ancient Greece, a baby was truly joined to the family and household when, it was carried about the hearth and placed before it. The union of a Roman marriage was sanctified at the hearth. And at least in the early periods the dead were buried by the hearth. The family ate by the hearth and made sacrifices to the housegods before and after the meal. The hearth sustained, ordered, and centered house and family.¹ Reflections of the hearth's significance can yet be seen in the fireplace of many American homes. The fireplace often has a central location in the house. Its fire is now symbolical since it rarely furnishes sufficient warmth. But the radiance, the sounds, and the fragrance of living fire consuming logs that are split, stacked, and felt in their grain have retained their force. There are no longer images of the ancestral gods placed by the fire; but there often are pictures of loved ones on or above the mantel, precious things of the family's history, or a clock, measuring time.²

The symbolical center of the house, the living room with the fireplace, often seems forbidding in comparison with the real center, the kitchen with its inviting smells and sounds. Accordingly, the architect Jeremiah Eck has rearranged homes to give them back a hearth, "a place of warmth and activity" that encompasses cooking, eating,

Albert Borgmann, "Focal Things and Practices" and "Wealth and the Good Life," from *Technology and the Character of Contemporary Life* (Chicago: University of Chicago Press, 1986), pp. 196–226, 285–289, abridged. Reprinted by permission of the University of Chicago Press.

and living and so is central to the house whether it literally has a fireplace or not.³ Thus we can satisfy, he says, “the need for a place of focus in our family lives.”⁴

“Focus,” in English, is now a technical term of geometry and optics. Johannes Kepler was the first so to use it, and he probably drew on the then already current sense of focus as the “burning point of lens or mirror.”⁵ Correspondingly, an optic or geometric focus is a point where lines or rays converge or from which they diverge in a regular or lawful way. Hence “focus” is used as a verb in optics to denote moving an object in relation to a lens or modifying a combination of lenses in relation to an object so that a clear and well-defined image is produced.

These technical senses of “focus” have happily converged with the original one in ordinary language. Figuratively they suggest that a focus gathers the relations of its context and radiates into its surroundings and informs them. To focus on something or to bring it into focus is to make it central, clear, and articulate. It is in the context of these historical and living senses of “focus” that I want to speak of focal things and practices. Wilderness on this continent, it now appears, is a focal thing. It provides a center of orientation; when we bring the surrounding technology into it, our relations to technology become clarified and well-defined. But just how strong its gathering and radiating force is requires further reflection. And surely there will be other focal things and practices: music, gardening, the culture of the table, or running.

We might in a tentative way be able to see these things as focal; what we see more clearly and readily is how inconspicuous, homely, and dispersed they are. This is in stark contrast to the focal things of pretechnological times, the Greek temple or the medieval cathedral that we have mentioned before. Martin Heidegger was deeply impressed by the orienting force of the Greek temple. For him, the temple not only gave a center of meaning to its world but had orienting power in the strong sense of first originating or establishing the world, of disclosing the world’s essential dimensions and criteria.⁶ Whether the thesis so extremely put is defensible or not, the Greek temple was certainly more than a self-sufficient architectural sculpture, more than a jewel of well-articulated and harmoniously balanced elements, more, even, than a shrine for the image of the goddess or the god. As Vincent Scully has shown, a temple or a temple precinct gathered and disclosed the land in which they were situated. The divinity of land and sea was focused in the temple.⁷

To see the work of art as the focus and origin of the world’s meaning was a pivotal discovery for Heidegger. He had begun in the modern tradition of Western philosophy where ... the sense of reality is to be grasped by determining the antecedent and controlling conditions of all there is (the *Bedingungen der Möglichkeit* as Immanuel Kant has it). Heidegger wanted to outdo this tradition in the radicality of his search for the fundamental conditions of being. Perhaps it was the relentlessness of his pursuit that disclosed the ultimate futility of it. At any rate, when the universal conditions are explicated in a suitably general and encompassing way, what truly matters still hangs in the balance because everything depends on how the conditions come to be actualized and instantiated.⁸ The preoccupation with antecedent conditions not only leaves this question unanswered; it may even make it inaccessible by leaving the impression that, once the general and fundamental matters are determined, nothing of consequence remains to be considered. Heidegger’s early work, however, already contained the seeds of its overcoming. In his determination to grasp reality in its concreteness, Heidegger had found and stressed the inexorable and unsurpassable givenness of human existence, and he had provided analyses of its pretechnological wholeness and its technological distraction though the significance of these descriptions for technology had remained concealed to him.⁹ And then he discovered that the unique event of significance in the singular work of art, in the prophet’s proclamation, and in the political deed was crucial. This insight was worked out in detail with regard to the artwork. But in an epilogue to the essay that develops this point, Heidegger recognized that the insight comes too late. To be sure, our time has brought forth admirable works of art. “But,” Heidegger insists, “the question remains: is art still an essential and necessary way in which that truth happens which is decisive for historical existence, or is art no longer of this character?”¹⁰

Heidegger began to see technology (in his more or less substantive sense) as the force that has eclipsed the focusing powers of pretechnological times. Technology becomes for him ... the final phase of a long metaphysical development. The philosophical concern with the conditions of the possibility of whatever is now itself seen as a move into the oblivion of what finally matters. But how are we to recover orientation in the oblivious and distracted era of technology when the great embodiments of meaning, the works of art, have lost

their focusing power? Amidst the complication of conditions, of the *Bedingungen*, we must uncover the simplicity of things, of the *Dinge*.¹¹ A jug, an earthen vessel from which we pour wine, is such a thing. It teaches us what it is to hold, to offer, to pour, and to give. In its clay, it gathers for us the earth as it does in containing the wine that has grown from the soil. It gathers the sky whose rain and sun are present in the wine. It refreshes and animates us in our mortality. And in the libation it acknowledges and calls on the divinities. In these ways the thing (in agreement with its etymologically original meaning) gathers and discloses what Heidegger calls the fourfold, the interplay of the crucial dimensions of earth and sky, mortals and divinities.¹² A thing, in Heidegger's eminent sense, is a focus; to speak of focal things is to emphasize the central point twice.

Still, Heidegger's account is but a suggestion fraught with difficulties. When Heidegger described the focusing power of the jug, he might have been thinking of a rural setting where wine jugs embody in their material, form, and craft a long and local tradition; where at noon one goes down to the cellar to draw a jug of table wine whose vintage one knows well; where at the noon meal the wine is thoughtfully poured and gratefully received.¹³ Under such circumstances, there might be a gathering and disclosure of the fourfold, one that is for the most part understood and in the background and may come to the fore on festive occasions. But all of this seems as remote to most of us and as muted in its focusing power as the Parthenon or the Cathedral of Chartres. How can so simple a thing as a jug provide that turning point in our relation to technology to which Heidegger is looking forward? Heidegger's proposal for a reform of technology is even more programmatic and terse than his analysis of technology.¹⁴ Both, however, are capable of fruitful development.¹⁵ Two points in Heidegger's consideration of the turn of technology must particularly be noted. The first serves to remind us of arguments already developed which must be kept in mind if we are to make room for focal things and practices. Heidegger says, broadly paraphrased, that the orienting force of simple things will come to the fore only as the rule of technology is raised from its anonymity, is disclosed as the orthodoxy that heretofore has been taken for granted and allowed to remain invisible.¹⁶ As long as we overlook the tightly patterned character of technology and believe that we live in a world of endlessly open and rich opportunities, as long as we ignore the definite ways in which we, acting technologically, have worked out the promise

of technology and remain vaguely enthralled by that promise, so long simple things and practices will seem burdensome, confining, and drab. But if we recognize the central vacuity of advanced technology, that emptiness can become the opening for focal things. It works both ways, of course. When we see a focal concern of ours threatened by technology, our sight for the liabilities of mature technology is sharpened.

A second point of Heidegger's is one that we must develop now. The things that gather the fourfold, Heidegger says, are inconspicuous and humble. And when we look at his litany of things, we also see that they are scattered and of yesterday: jug and bench, footbridge and plow, tree and pond, brook and hill, heron and deer, horse and bull, mirror and clasp, book and picture, crown and cross.¹⁷ That focal things and practices are inconspicuous is certainly true; they flourish at the margins of public attention. And they have suffered a diaspora; this too must be accepted, at least for now. That is not to say that a hidden center of these dispersed focuses may not emerge some day to unite them and bring them home. But it would clearly be a forced growth to proclaim such a unity now. A reform of technology that issues from focal concerns will be radical not in imposing a new and unified master plan on the technological universe but in discovering those sources of strength that will nourish principled and confident beginnings, measures, i.e., which will neither rival nor deny technology.

But there are two ways in which we must go beyond Heidegger. One step in the first direction has already been taken. It led us to see ... that the simple things of yesterday attain a new splendor in today's technological context. The suggestion in Heidegger's reflections that we have to seek out pretechnological enclaves to encounter focal things is misleading and dispiriting. Rather we must see any such enclave itself as a focal thing heightened by its technological context. The turn to things cannot be a setting aside and even less an escape from technology but a kind of affirmation of it. The second move beyond Heidegger is in the direction of practice, into the social and, later, the political situation of focal things.¹⁸ Though Heidegger assigns humans their place in the fourfold when he depicts the jug in which the fourfold is focused, we scarcely see the hand that holds the jug, and far less do we see of the social setting in which the pouring of the wine comes to pass. In his consideration of another thing, a bridge, Heidegger notes the human ways and works that are gathered and directed by the bridge.¹⁹ But these remarks too present

practices from the viewpoint of the focal thing. What must be shown is that focal things can prosper in human practices only. Before we can build a bridge, Heidegger suggests, we must be able to dwell.²⁰ But what does that mean concretely?

The consideration of the wilderness has disclosed a center that stands in a fruitful counter-position to technology. The wilderness is beyond the procurement of technology, and our response to it takes us past consumption. But it also teaches us to accept and to appropriate technology. We must now try to discover if such centers of orientation can be found in greater proximity and intimacy to the technological everyday life. And I believe they can be found if we follow up the hints that we have gathered from and against Heidegger, the suggestions that focal things seem humble and scattered but attain splendor in technology if we grasp technology properly, and that focal things require a practice for their welfare. Running and the culture of the table are such focal things and practices. We have all been touched by them in one way or another. If we have not participated in a vigorous or competitive run, we have certainly taken walks; we have felt with surprise, perhaps, the pleasure of touching the earth, of feeling the wind, smelling the rain, of having the blood course through our bodies more steadily. In the preparation of a meal we have enjoyed the simple tasks of washing leaves and cutting bread; we have felt the force and generosity of being served a good wine and homemade bread. Such experiences have been particularly vivid when we came upon them after much sitting and watching indoors, after a surfeit of readily available snacks and drinks. To encounter a few simple things was liberating and invigorating. The normal clutter and distraction fall away when, as the poet says,

there, in limpid brightness shine,
on the table, bread and wine.²¹

If such experiences are deeply touching, they are fleeting as well. There seems to be no thought or discourse that would shelter and nurture such events; not in politics certainly, nor in philosophy where the prevailing idiom sanctions and applies equally to lounging and walking, to Twinkies, and to bread, the staff of life. But the reflective care of the good life has not withered away. It has left the profession of philosophy and sprung up among practical people. In fact, there is a tradition in this country of persons who are engaged by life in its concreteness and simplicity and who are so filled with

this engagement that they have reached for the pen to become witnesses and teachers, speakers of deictic discourse. Melville and Thoreau are among the great prophets of this tradition. Its present health and extent are evident from the fact that it now has no overpowering heroes but many and various more or less eminent practitioners. Their work embraces a spectrum between down-to-earth instruction and soaring speculation. The span and center of their concerns vary greatly. But they all have their mooring in the attention to tangible and bodily things and practices, and they speak with an enthusiasm that is nourished by these focal concerns. Pirsig's book is an impressive and troubling monument in this tradition, impressive in the freshness of its observations and its pedagogical skill, troubling in its ambitious and failing efforts to deal with the large philosophical issues. Norman Maclean's *A River Runs through It* can be taken as a fly-fishing manual, a virtue that pleases its author.²² But it is a literary work of art most of all and a reflection on technology inasmuch as it presents the engaging life, both dark and bright, from which we have so recently emerged. Colin Fletcher's treatise of *The Complete Walker* is most narrowly a book of instruction about hiking and backpacking.²³ The focal significance of these things is found in the interstices of equipment and technique; and when the author explicitly engages in deictic discourse he has "an unholy awful time" with it.²⁴ Roger B. Swain's contemplation of gardening in *Earthly Pleasures* enlightens us in cool and graceful prose about the scientific basis and background of what we witness and undertake in our gardens.²⁵ Philosophical significance enters unbidden and easily in the reflections on time, purposiveness, and the familiar. Looking at these books, I see a stretch of water that extends beyond my vision, disappearing in the distance. But I can see that it is a strong and steady stream, and it may well have parts that are more magnificent than the ones I know.²⁶

To discover more clearly the currents and features of this, the other and more concealed, American mainstream, I take as witnesses two books where enthusiasm suffuses instruction vigorously, Robert Farrar Capon's *The Supper of the Lamb* and George Sheehan's *Running and Being*.²⁷ Both are centered on focal events, the great run and the great meal. The great run, where one exults in the strength of one's body, in the ease and the length of the stride, where nature speaks powerfully in the hills, the wind, the heat, where one takes endurance to the breaking point, and where one is finally engulfed by the

good will of the spectators and the fellow runners.²⁸ The great meal, the long session as Capon calls it, where the guests are thoughtfully invited, the table has been carefully set, where the food is the culmination of tradition, patience, and skill and the presence of the earth's most delectable textures and tastes, where there is an invocation of divinity at the beginning and memorable conversation throughout.²⁹

Such focal events are compact, and if seen only in their immediate temporal and spatial extent they are easily mistaken. They are more mistakable still when they are thought of as experiences in the subjective sense, events that have their real meaning in transporting a person into a certain mental or emotional state. Focal events, so conceived, fall under the rule of technology. For when a subjective state becomes decisive, the search for a machinery that is functionally equivalent to the traditional enactment of that state begins, and it is spurred by endeavors to find machineries that will procure the state more instantaneously, ubiquitously, more assuredly and easily. If, on the other hand, we guard focal things in their depth and integrity, then, to see them fully and truly, we must see them in context. Things that are deprived of their context become ambiguous.³⁰ The letter "a" by itself means nothing in particular. In the context of "table" it conveys or helps to convey a more definite meaning. But "table" it turn can mean many things. It means something more powerful in the text of Capon's book where he speaks of "The Vesting of the Table."³¹ But that text must finally be seen in the context and texture of the world. To say that something becomes ambiguous is to say that it is made to say less, little, or nothing. Thus to elaborate the context of focal events is to grant them their proper eloquence.

"The distance runner," Sheehan says, "is the least of all athletes. His sport the least of all sports."³² Running is simply to move through time and space, step-by-step. But there is splendor in that simplicity. In a car we move of course much faster, farther, and more comfortably. But we are not moving on our own power and in our own right. We cash in prior labor for present motion. Being beneficiaries of science and engineering and having worked to be able to pay for a car, gasoline, and roads, we now release what has been earned and stored and use it for transportation. But when these past efforts are consumed and consummated in my driving, I can at best take credit for what I have done. What I am doing now, driving, requires no effort, and little or no skill or discipline. I am a divided person; my achievement lies in

the past, my enjoyment in the present. But in the runner, effort and joy are one; the split between means and ends, labor and leisure is healed.³³ To be sure, if I have trained conscientiously, my past efforts will bear fruit in a race. But they are not just cashed in. My strength must be risked and enacted in the race which is itself a supreme effort and an occasion to expand my skill.

This unity of achievement and enjoyment, of competence and consummation, is just one aspect of a central wholeness to which running restores us. Good running engages mind and body. Here the mind is more than an intelligence that happens to be housed in a body. Rather the mind is the sensitivity and the endurance of the body.³⁴ Hence running in its fullness, as Sheehan stresses over and over again, is in principle different from exercise designed to procure physical health. The difference between running and physical exercise is strikingly exhibited in one and the same issue of the *New York Times Magazine*. It contains an account by Peter Wood of how, running the New York City Marathon, he took in the city with body and mind, and it has an account by Alexandra Penney of corporate fitness programs where executives, concerned about their Coronary Risk Factor Profile, run nowhere on treadmills or ride stationary bicycles.³⁵ In another issue, the *Magazine* shows executives exercising their bodies while busy-ing their dissociated minds with reading.³⁶ To be sure, unless a runner concentrates on bodily performance, often in an effort to run the best possible race, the mind wanders as the body runs. But as in free association we range about the future and the past, the actual and the possible, our mind, like our breathing, rhythmically gathers itself to the here and now, having spread itself to distant times and faraway places.

It is clear from these reflections that the runner is mindful of the body because the body is intimate with the world. The mind becomes relatively disembodied when the body is severed from the depth of the world, i.e., when the world is split into commodious surfaces and inaccessible machineries. Thus the unity of ends and means, of mind and body, and of body and world is one and the same. It makes itself felt in the vividness with which the runner experiences reality. "Somehow you feel more in touch," Wood says, "with the realities of a massive inner-city housing problem when you are running through it slowly enough to take in the grim details, and, surprisingly, cheered on by the remaining occupants."³⁷ As this last remark suggests, the wholeness that running establishes embraces the human family too.

The experience of that simple event releases an equally simple and profound sympathy. It is a natural goodwill, not in need of drugs nor dependent on a common enemy. It wells up from depths that have been forgotten, and it overwhelms the runners ever and again.³⁸ As Wood recounts his running through streets normally besieged by crime and violence, he remarks: "But we can only be amazed today at the warmth that emanates from streets usually better known for violent crime." And his response to the spectators' enthusiasm is this: "I feel a great proximity to the crowd, rushing past at all of nine miles per hour; a great affection for them individually; a commitment to run as well as I possibly can, to acknowledge their support."³⁹ For George Sheehan, finally, running discloses the divine. When he runs, he wrestles with God.⁴⁰ Serious running takes us to the limits of our being. We run into threatening and seemingly unbearable pain. Sometimes, of course, the plunge into that experience gets arrested in ambition and vanity. But it can take us further to the point where in suffering our limits we experience our greatness too. This, surely, is a hopeful place to escape technology, metaphysics, and the God of the philosophers and reach out to the God of Abraham, Isaac, and Jacob.⁴¹

If running allows us to center our lives by taking in the world through vigor and simplicity, the culture of the table does so by joining simplicity with cosmic wealth. Humans are such complex and capable beings that they can fairly comprehend the world and, containing it, constitute a cosmos in their own right. Because we are standing so eminently over against the world, to come in touch with the world becomes for us a challenge and a momentous event. In one sense, of course, we are always already in the world, breathing the air, touching the ground, feeling the sun. But as we can in another sense withdraw from the actual and present world, contemplating what is past and to come, what is possible and remote, we celebrate correspondingly our intimacy with the world. This we do most fundamentally when in eating we take in the world in its palpable, colorful, nourishing immediacy. Truly human eating is the union of the primal and the cosmic. In the simplicity of bread and wine, of meat and vegetable, the world is gathered.

The great meal of the day, be it at noon or in the evening, is a focal event par excellence. It gathers the scattered family around the table. And on the table it gathers the most delectable things nature has brought forth. But it also recollects and presents a tradition, the immemorial experiences of the race in identifying and

cultivating edible plants, in domesticating and butchering animals; it brings into focus closer relations of national or regional customs, and more intimate traditions still of family recipes and dishes. [...] this living texture is being rent through the procurement of food as a commodity and the replacement of the culture of the table by the food industry. Once food has become freely available, it is only consistent that the gathering of the meal is shattered and disintegrates into snacks, T.V. dinners, bites that are grabbed to be eaten; and eating itself is scattered around television shows, late and early meetings, activities, overtime work, and other business. This is increasingly the normal condition of technological eating. But it is within our power to clear a central space amid the clutter and distraction. We can begin with the simplicity of a meal that has a beginning, a middle, and an end and that breaks through the superficiality of convenience food in the simple steps of beginning with raw ingredients, preparing and transforming them, and bringing them to the table. In this way we can again become freeholders of our culture. We are disfranchised from world citizenship when the foods we eat are mere commodities. Being essentially opaque surfaces, they repel all efforts at extending our sensibility and competence into the deeper reaches of the world. A Big Mac and a Coke can overwhelm our taste-buds and accommodate our hunger. Technology is not, after all, a children's crusade but a principled and skillful enterprise of defining and satisfying human needs. Through the diversion and busyness of consumption we may have unlearned to feel constrained by the shallowness of commodities. But having gotten along for a time and quite well, it seemed, on institutional or convenience food, scales fall from our eyes when we step up to a festively set family table. The foods stand out more clearly, the fragrances are stronger, eating has once more become an occasion that engages and accepts us fully.

To understand the radiance and wealth of a festive meal we must be alive to the interplay of things and humans, of ends and means. At first a meal, once it is on the table, appears to have commodity character since it is now available before us, ready to be consumed without effort or merit. But though there is of course in any eating a moment of mere consuming, in a festive meal eating is one with an order and discipline that challenges and ennobles the participants. The great meal has its structure. It begins with a moment of reflection in which we place ourselves in the presence of the first and last

things. It has a sequence of courses; it requires and sponsors memorable conversation; and all this is enacted in the discipline called table manners. They are warranted when they constitute the respectful and skilled response to the great things that are coming to pass in the meal. We can see how order and discipline have collapsed when we eat a Big Mac. In consumption there is the pointlike and inconsequential conflation of a sharply delimited human need with an equally contextless and closely fitting commodity. In a Big Mac the sequence of courses has been compacted into one object and the discipline of table manners has been reduced to grabbing and eating. The social context reaches no further than the pleasant faces and quick hands of the people who run the fast-food outlet. In a festive meal, however, the food is served, one of the most generous gestures human beings are capable of. The serving is of a piece with garnishing; garnishing is the final phase of cooking, and cooking is one with preparing the food. And if we are blessed with rural circumstances, the preparation of food draws near the harvesting and the raising of the vegetables in the garden close by. This context of activities is embodied in persons. The dish and the cook, the vegetable and the gardener tell of one another. Especially when we are guests, much of the meal's deeper context is socially and conversationally mediated. But that mediation has translucence and intelligibility because it extends into the farther and deeper recesses without break and with a bodily immediacy that we too have enacted or at least witnessed firsthand. And what seems to be a mere receiving and consuming of food is in fact the enactment of generosity and gratitude, the affirmation of mutual and perhaps religious obligations. Thus eating in a focal setting differs sharply from the social and cultural anonymity of a fast-food outlet.

The pretechnological world was engaging through and through, and not always positively. There also was ignorance, to be sure, of the final workings of God and king; but even the unknown engaged one through mystery and awe. In this web of engagement, meals already had focal character, certainly as soon as there was anything like a culture of the table.⁴² Today, however, the great meal does not gather and order a web of thoroughgoing relations of engagement; within the technological setting it stands out as a place of profound calm, one in which we can leave behind the narrow concentration and one-sided strain of labor and the tiring and elusive diversity of consumption. In the technological setting, the culture of the table not only focuses our life; it is also

distinguished as a place of healing, one that restores us to the depth of the world and to the wholeness of our being.

As said before, we all have had occasion to experience the profound pleasure of an invigorating walk or a festive meal. And on such occasions we may have regretted the scarcity of such events; we might have been ready to allow such events a more regular and central place in our lives. But for the most part these events remain occasional, and indeed the ones that still grace us may be slipping from our grasp. . . . we have seen various aspects of this malaise, especially its connection with television. But why are we acting against our better insights and aspirations?⁴³ This at first seems all the more puzzling as the engagement in a focal activity is for most citizens of the technological society an instantaneous and ubiquitous possibility. On any day I can decide to run or to prepare a meal after work. Everyone has some sort of suitable equipment. At worst one has to stop on the way home to pick up this or that. It is of course technology that has opened up these very possibilities. But why are they lying fallow for the most part? There is a convergence of several factors. Labor is exhausting, especially when it is divided. When we come home, we often feel drained and crippled. Diversion and pleasurable consumption appear to be consonant with this sort of disability. They promise to untie the knots and to soothe the aches. And so they do at a shallow level of our existence. At any rate, the call for exertion and engagement seems like a cruel and unjust demand. We have sat in the easy chair, beer at hand and television before us: when we felt stirrings of ambition, we found it easy to ignore our superego.⁴⁴ But we also may have had our alibi refuted on occasion when someone to whom we could not say no prevailed on us to put on our coat and to step out into cold and windy weather to take a walk. At first our indignation grew. The discomfort was worse than we had thought. But gradually a transformation set in. Our gait became steady, our blood began to flow vigorously and wash away our tension, we smelled the rain, began thoughtfully to speak with our companion, and finally returned home settled, alert, and with a fatigue that was capable of restful sleep.

But why did such occurrences remain episodes also? The reason lies in the mistaken assumption that the shaping of our lives can be left to a series of individual decisions. Whatever goal in life we entrust to this kind of implementation we in fact surrender to erosion. Such a policy ignores both the frailty and strength of human

nature. On the spur of the moment, we normally act out what has been nurtured in our daily practices as they have been shaped by the norms of our time. When we sit in our easy chair and contemplate what to do, we are firmly enmeshed in the framework of technology with our labor behind us and the blessings of our labor about us, the diversions and enrichments of consumption. This arrangement has had our lifelong allegiance, and we know it to have the approval and support of our fellows. It would take superhuman strength to stand up to this order ever and again. If we are to challenge *the rule of technology*, we can do so only through *the practice of engagement*.

The human ability to establish and commit oneself to a practice reflects our capacity to comprehend the world, to harbor it in its expanse as a context that is oriented by its focal points. To found a practice is to guard a focal concern, to shelter it against the vicissitudes of fate and our frailty. John Rawls has pointed out that there is decisive difference between the justification of a practice and of a particular action falling under it.⁴⁵ Analogously, it is one thing to decide for a focal practice and quite another to decide for a particular action that appears to have focal character.⁴⁶ Putting the matter more clearly, we must say that without a practice an engaging action or event can momentarily light up our life, but it cannot order and orient it focally. Competence, excellence, or virtue, as Aristotle first saw, come into being as an *éthos*, a settled disposition and a way of life.⁴⁷ Through a practice, Alasdair MacIntyre says accordingly, “human powers to achieve excellence, and human conceptions of the ends and goods involved, are systematically extended.”⁴⁸ Through a practice we are able to accomplish what remains unattainable when aimed at in a series of individual decisions and acts.

How can a practice be established today? Here, as in the case of focal things, it is helpful to consider the foundation of pretechnological practices. In mythic times the latter were often established through the founding and consecrating act of a divine power or mythic ancestor. Such an act ... set up a sacred precinct and center that gave order to a violent and hostile world. A sacred practice, then, consisted in the regular reenactment of the founding act, and so it renewed and sustained the order of the world. Christianity came into being this way; the eucharistic meal, the Supper of the Lamb, is its central event, established with the instruction that it be reenacted. Clearly a focal practice today should have centering and orienting force as well. But it differs

in important regards from its grand precursors. A mythic focal practice derived much force from the power of its opposition. The alternative to the preservation of the cosmos was chaos, social and physical disorder and collapse. It is a reduction to see mythic practices merely as coping behavior of high survival value. A myth does not just aid survival; it defines what truly human life is. Still, as in the case of pretechnological morality, economic and social factors were interwoven with mythic practices. Thus the force of brute necessity supported, though it did not define, mythic focal practices. Since a mythic focal practice united in itself the social, the economic, and the cosmic, it was naturally a prominent and public affair. It rested securely in collective memory and in the mutual expectations of the people.

This sketch, of course, fails to consider many other kinds of pretechnological practices. But it does present one important aspect of them and more particularly one that serves well as a backdrop for focal practices in a technological setting. It is evident that technology is itself a sort of practice, and it procures its own kind of order and security. Its history contains great moments of innovation, but it did not arise out of a founding event that would have focal character; nor has it ... produced focal things. Thus it is not a *focal* practice, and it has indeed, so I have urged, a debilitating tendency to scatter our attention and to clutter our surroundings. A focal practice today, then, meets no tangible or overtly hostile opposition from its context and is so deprived of the wholesome vigor that derives from such opposition. But there is of course an opposition at a more profound and more subtle level. To feel the support of that opposing force one must have experienced the subtly debilitating character of technology, and above all one must understand, explicitly or implicitly, that the peril of technology lies not in this or that of its manifestations but *in the pervasiveness and consistency of its pattern*. There are always occasions where a Big Mac, an exercycle, or a television program are unobjectionable and truly helpful answers to human needs. This makes a case-by-case appraisal of technology so inconclusive. It is when we attempt to take the measure of technological life in its normal totality that we are distressed by its shallowness. And I believe that the more strongly we sense and the more clearly we understand the coherence and the character of technology, the more evident it becomes to us that technology must be countered by an equally patterned and social commitment, i.e., by a practice.

At this level the opposition of technology does become fruitful to focal practices. They can now be seen as restoring a depth and integrity to our lives that are in principle excluded within the paradigm of technology. MacIntyre, though his foil is the Enlightenment more than technology, captures this point by including in his definition of practice the notion of “goods internal to a practice.”⁴⁹ These are one with the practice and can only be obtained through that practice. The split between means and ends is healed. In contrast “there are those goods externally and contingently attached” to a practice; and in that case there “are always alternative ways for achieving such goods, and their achievement is never to be had *only* by engaging in some particular kind of practice.”⁵⁰ Thus practices (in a looser sense) that serve external goods are subvertible by technology. But MacIntyre’s point needs to be clarified and extended to include or emphasize not only the essential unity of human being and a particular sort of doing but also the tangible things in which the world comes to be focused. The importance of this point has been suggested by the consideration of running and the culture of the table. There are objections to this suggestion [...] Here I want to advance the thesis by considering Rawls’s contention that a practice is defined by rules. We can take a rule as an instruction for a particular domain of life to act in a certain way under specified circumstances. How important is the particular character of the tangible setting of the rules? Though Rawls does not address this question directly he suggests in using baseball for illustration that “a peculiarly shaped piece of wood” and a kind of bag become a bat and base only within the confines defined by the rules of baseball.⁵¹ Rules and the practice they define, we might argue in analogy to what Rawls says about their relation to particular cases, are logically prior to their tangible setting. But the opposite contention seems stronger to me. Clearly the possibilities and challenges of baseball are crucially determined by the layout and the surface of the field, the weight and resilience of the ball, the shape and size of the bat, etc. One might of course reply that there are rules that define the physical circumstances of the game. But this is to take “rule” in broader sense. Moreover it would be more accurate to say that the rules of this latter sort reflect and protect the identity of the original tangible circumstances in which the game grew up. The rules, too, that circumscribe the actions of the players can be taken as ways of securing and ordering the playful challenges that arise in the human inter-

play with reality. To be sure there are developments and innovations in sporting equipment. But either they quite change the nature of the sport as in pole vaulting, or they are restrained to preserve the identity of the game as in baseball.

It is certainly the purpose of a focal practice to guard in its undiminished depth and identity the thing that is central to the practice, to shield it against the technological diremption into means and end. Like values, rules and practices are recollections, anticipations, and, we can now say, guardians of the concrete things and events that finally matter. Practices protect focal things not only from technological subversion but also against human frailty. It was emphasized ... that the ultimately significant things to which we respond in deictic discourse cannot be possessed or controlled. Hence when we reach out for them, we miss them occasionally and sometimes for quite some time. Running becomes unrelieved pain and cooking a thankless chore. If in the technological mode we insisted on assured results or if more generally we estimated the value of future efforts on the basis of recent experience, focal things would vanish from our lives. A practice keeps faith with focal things and saves for them an opening in our lives. To be sure, eventually the practice needs to be empowered again by the reemergence of the great thing in its splendor. A practice that is not so revived degenerates into an empty and perhaps deadening ritual.

We can now summarize the significance of a focal practice and say that such a practice is required to counter technology in its patterned pervasiveness and to guard focal things in their depth and integrity. Countering technology through a practice is to take account of our susceptibility to technological distraction, and it is also to engage the peculiarly human strength of comprehension, i.e., the power to take in the world in its extent and significance and to respond through an enduring commitment. Practically a focal practice comes into being through resoluteness, either an explicit resolution where one vows regularly to engage in a focal activity from this day on or in a more implicit resolve that is nurtured by a focal thing in favorable circumstances and matures into a settled custom.

In considering these practical circumstances we must acknowledge a final difference between focal practices today and their eminent pretechnological predecessors. The latter, being public and prominent, commanded elaborate social and physical settings: hierarchies, offices, ceremonies, and choirs; edifices, altars, implements, and

vestments. In comparison our focal practices are humble and scattered. Sometimes they can hardly be called practices, being private and limited. Often they begin as a personal regimen and mature into a routine without ever attaining the social richness that distinguishes a practice. Given the often precarious and inchoate nature of focal practices, evidently focal things and practices, for all the splendor of their simplicity and their fruitful opposition to technology, must be further clarified in their relation to our everyday world if they are to be seen as a foundation for the reform of technology.

24 Wealth and the Good Life

Strong claims have been made for focal things and practices. Focal concerns supposedly allow us to center our lives and to launch a reform of technology and so to usher in the good life that has eluded technology. [...] focal practices today tend to be isolated and rudimentary. But these are marginal deficiencies, due to unfavorable circumstances. Surely there are central problems as well that pertain to focal practices no matter how well developed. Before we can proceed to suggestions about how technology may be reformed to make room for the good life, the most important objections regarding focal practices, the pivots of that reform, must be considered and, if possible, refuted. These disputations are not intended to furnish the impregnable defense of focal concerns, which ... is neither possible nor to be wished for. The deliberations of this chapter are rather efforts to connect the notion of a focal practice more closely with the prevailing conceptual and social situation and so to advance the standing of focal concerns in our midst. To make the technological universe hospitable to focal things turns out to be the heart of the reform of technology. What follows are first steps in this direction.

Among these, the first in turn requires us to consider the problem of the plurality of focal things and practices. It has a negative and positive aspect; negative because my devotion to a focal concern is rejected or challenged by the commitment of other people to contrary focal practices; positive because the plurality can have the character of a complementary richness in what is called a social union. The latter possibility, however, may be realized in the superficial diversity of various styles of consumption. As a counterforce to such shallowness I will consider in the first half of the present chapter the

mode of developing one's faculties which is guided by the so-called Aristotelian Principle. It defines a notion of excellence which revolves about a notion of complexity. The more complex the faculties to whose cultivation we are devoted, the more excellent our life. This turns out to be an ambiguous result. Excellence so defined is no longer a counterforce to technology. On the other hand, it is compatible with a notion of engagement that seems to capture the most important aspirations of focal concerns and at the same time avoids the occasionally, perhaps essentially, constricting effects of the latter. When we measure these findings against an actual focal concern, we will see, however, that it is misguided to think of focal things as being entered in a competition with the concept of engagement and the Aristotelian Principle in a quest to reform technology. Only things that we experience as greater and other than ourselves can move us to judge and change technology in the first place.

Given this clarification of focal concerns we can without fear of misunderstanding explicate their generic features. On the basis of this generic definition of focal things and practices, an explicit definition of the reform of technology becomes possible. A reform so defined is neither the modification nor the rejection of the technological paradigm but the recognition and restraint of the pattern of technology so as to give focal concerns a central place in our lives. The remainder of this chapter provides a twofold application and elaboration of that reform proposal. First and applied to the private and personal realm, it will be seen to engender an intelligently selective attitude toward technology and a life of wealth in a well-defined sense. Second and in regard to traditional excellence and the family, the reform of technology makes possible a revival of these institutions.

First, then, we must consider the question of the plurality of focal commitments. A focal concern, it has been said, centers one's life. It is a final and dominant end which alone truly matters and fulfills and which therefore assigns all other things and activities their rank and place. But it is obvious that the ultimacy and dominance of a focal concern is contradicted by the fact that there are a number of different and apparently competing concerns. It cannot be that both running and fly-fishing matter ultimately. If one does, the other cannot. Focal practices in pretechnological times clearly possessed this dominance and exclusiveness. In the early Middle Ages, everyone went to church on Sundays and holy days, and Hubert, who went hunting, was a sinner for that reason. If focal practices were to become prominent in the life of

this country, there surely would be a diversity of them. And would not sympathy require me to question other focal concerns and to win other people over to mine? Even if we heed the counsel of tolerance, the situation would remain unsettled and troubling. In reply we first must note how far removed we are from such a state of affairs and how many salutary measures would have to be taken before a prominent controversy about focal practices could arise.

But let us assume that there will be an evident plurality of focal concerns. How controversial would it be? It may be helpful to begin by considering the origins of that plurality. It became possible in the West when at the beginning of the modern era the unity of the Christian church was shattered through reform movements, scientific and geographical discoveries, and finally through the liberating forces of democracy and technology ... we saw that in light of the new scientific laws our actual world appears as one instantiation of all that is physically possible. Similarly, within the context of the immense information and the varied practical possibilities that technology has procured, every actual concern now appears as one surrounded by alternatives. The severing of the ties between focal concerns and social and economic necessity that has been repeatedly noted is just a corollary of this phenomenon.

But we also must remember that we would not want to regain the support of cogency when testifying on behalf of a focal power. This would, on the one hand, compromise the grace and depth of such a power and, on the other, degrade us as respondents to that power. Our parents in their old age, as said before, address us not inasmuch as we are weak and helpless but insofar as we are capable of gratitude and receptive to wisdom, tradition, and mortality. In short, the new adulthood and maturity that are required of us are of a piece with the peculiar radiance and dignity that focal concerns now have. This status of the focal thing has the technological setting for a necessary condition, and it has the plurality of alternative concerns as a compatible background. Perhaps one should take "compatible" in the original and strong sense. We should be able to suffer the contradiction that the background of alternatives constitutes along with the joy that comes from our focal practice. And what we suffer is not just the implicit denial of what matters most to us; we suffer being deprived of great and unreachable things that are sometimes placed not only beyond our time and energy but outside our very comprehension. Sheehan is an eloquent witness:

I may have difficulty comprehending the grasp that music has on its enthusiasts, but I see that as a deficiency in myself, not the music lovers. When a musician tells me Beethoven's *Opus 132* is not simply an hour of music but of universal truth, is in fact a flood of beauty and wisdom, I envy him. I don't label him a nut. And being a city kid, I may be slow to appreciate the impact of nature on those raised differently, but, again, I regret that failure. And when Pablo Casals said, as he did on his ninety-fifth birthday, "I pass hours looking at a tree or a flower. And sometimes I cry at their beauty," I don't think age has finally gotten to old Pablo. I cry for myself.⁵²

But can we not instead take the diversity of people's engagements in a positive way? Wilhelm von Humboldt, who is one of the authors ... of the liberal democratic notion of self-realization, has also pointed out that no one person can hope to realize all that human beings are capable of; we would in fact weaken our development if we tried. But far from being frustrated by our inevitable one-sidedness, we should embrace and develop our peculiarity and join it with those of others and through this connection experience and enjoy the fullness of humanity.⁵³ This is the idea of social union which Rawls has rediscovered and elaborated.⁵⁴ Clearly, it is an idea that affirms, deepens, and conjoins the notions of sympathy and tolerance.

It appears then that the plurality of focal concerns must be accepted and perhaps can even be seen in a positive light. But the latter possibility must be further pursued and taken to the point where it seems possible clearly to discern a unity underlying the plurality. We can begin with the apparent susceptibility of a social union to technological subversion. One might reply, as Rawls would, that the shallow and distracting diversity of self-realization that the consumption of commodities offers conflicts with the kind of self-development suggested by the Aristotelian Principle which is an integral part of a social union. The Principle says that "other things equal, human beings enjoy the exercise of their realized capacities (their innate or trained abilities), and this enjoyment increases the more the capacity is realized, or the greater its complexity."⁵⁵ Accordingly, people will not only prefer chess to checkers, as Rawls has it, but checkers to watching television and cooking a meal from basic ingredients to warming a frozen dinner. Rawls recognizes that the Principle is but a tendency and can be overridden. Yet he is confident that "the tendency postulated should be relatively strong and not easily counterbalanced."⁵⁶ But as we have seen, ... technology has not just counterbalanced but very nearly buried it. There is a

difference, however, between technological obliteration and subversion. Technology can overcome the wilderness by brute force, but it cannot bring it (easily and obviously) under its rule and procure it as a commodity. Conversely, technology could hardly annihilate values (such as freedom, prosperity, or pleasure), but it can surely subvert them by specifying them in terms of the availability and consumption of commodities. Accordingly, the Aristotelian Principle is not impugned as a counterforce to technology if it can be technologically overrun so long as it resists technological subversion. But does it? Clearly the concept of complexity is crucial here. Rawls contends that “until we have some relatively precise theory and measure of complexity” we can intuitively grasp the nature of complexity and rank various activities by complexity in accordance with a principle of inclusiveness where “cases of greater complexity are those in which one of the activities compared includes all the skills and discriminations of the other activity and some further ones in addition.”⁵⁷ Thus the computer game *Defender* might rank higher than fly-fishing since the former requires quicker hand-eye coordination, more intricate strategy, and evasive as well as aggressive skills. Similarly, exercising with a *Nautilus* might be more complex than running since the former allows one to sense and to work many more muscle groups. Theory here seems to conflict with considered judgment. Whether both can be saved in their essence and balanced in a reflective equilibrium is a question that will concern us in a moment.

Meanwhile let us note that the theory, i.e., the Aristotelian Principle, is attractive not only in helping to reconcile the variety of human endeavors within a social union but also in suggesting ways in which the variety of focal practices can be similarly united. It was pointed out ... that there is an apparent kinship among significant or focal things; and, symmetrically, there are common traits to be found among focal practices. These can be seen when we consider that although both Capon and a fast-food junkie are deeply concerned with food, Capon, I expect, would have a deeper appreciation of Sheehan’s concern than the junkie’s. Unlike the latter, both Capon and Sheehan practice the acquisition of skills, the fidelity to a daily discipline, the broadening of sensibility, the profound interaction of human beings, and the preservation and development of tradition. These traits we may bring together under the heading of engagement. The good life, then, is one of engagement, and engagement is variously realized by—various people. Engagement would not only harmonize the variety

among people but also within the life of one person. Sheehan, for instance, finds engagement not only in running but also in literature, and Capon finds it not only in the culture of the table but also in music.

Engagement is a more flexible and inclusive principle of ordering one’s life, and being so it meets the critique of dominant ends that Rawls puts forward. If such an end deserves its name and is clearly specified, Rawls argues, there is a danger of “fanaticism and inhumanity” because the narrowness of the goal does violence to the breadth of human capacities.⁵⁸ There seems to be intuitive confirmation of Rawls’s claim. Initially, the firm guidance that a dominant end affords in one’s life is appealing, as Rawls notes.⁵⁹ Taking up some thing and practice as a focal and dominant end, one does, as Sheehan did, experience a sense of clarity and liberation. One is no longer caught in obliging other people’s expectations and in struggling to balance a plethora of conflicting and confusing aims. Having centered my life in an ultimate concern, I have clear and principled answers to life’s endless and distracting demands. But both Sheehan and Capon testify to the dark night of the soul that settles upon one from time to time, not when one has allowed distraction to erode the core of one’s life but just when dedication to the focal thing has been vigorous and faithful.⁶⁰ And such darkness, depression, and collapse can be witnessed among people who have dedicated themselves to a cause that is more selfless and sublime than running or the culture of the table. These failures are so much more threatening if not devastating than those that occur under the guidance of inclusive ends because the former case admits of no alibi. One has dedicated oneself to one’s highest aspiration and profoundest experience, and one has failed. Where to turn now? In a life of an inclusive end, disappointment here allows one to turn elsewhere for consolation. The question then is whether the collective plurality and the individual restrictiveness of focal concerns can be overcome through the notion of an inclusive end, placed in a social union of persons who shape their lives according to the Aristotelian Principle or according to the concept of engagement. This problem is best approached by connecting it with a still further problem, the question, i.e., whether there can be engagement of an essentially technological or purely mental sort. We have touched on this area in discussing complexity as a mark of excellence in human activities. It seemed that playing the computer game *Defender* is more excellent in this sense than fly-fishing. Moreover it, or more

generally the playing of computer games, seems to satisfy the conditions of engagement. It certainly requires skill, discipline, and endurance; as the games develop technologically, more human capacities are called upon; and the computer game arcades have a social setting of their own and can lead to close human ties.⁶¹ In fact, is not the computer game console a focal thing? It certainly seems to challenge and fulfill the player and to center the player's life. "There's not a lot of fun things in life," says one. "It's taken away my boredom. I've never been as serious about anything as Pac Man."⁶²

The status of focal concerns as the basis of a reform of technology is now challenged in two ways. First, it appears that the ultimate givenness of a focal thing as something that unthinkably addresses us in its own right is denied by the Aristotelian Principle or the concept of engagement. If the latter have independent standing and guiding force, focal things are mere complements that are chosen according to convenience. Second, the essentially metatechnological status of focal things and practices which in the abstract would be compatible with the Aristotelian Principle and the notion of engagement is denied by the apparent existence of essentially technological engagement.⁶³ Let us try to meet these challenges by pursuing Rawls's goal of achieving a reflective equilibrium and assume to begin with that in our considered judgment fly-fishing is more excellent than playing Defender. Can we align this judgment with the cluster of theories composed of the Aristotelian Principle, the notion of engagement and of a technological focal concern? Fly-fishing is more complex, we might say, because it requires more encompassing and discriminating knowledge. One must know in what season and at what time of day certain insects are hatching and trout are feeding. One must be able to read the water to recognize the riffles and the pools where the big rainbows are lying in wait. There are more intricate bodily skills in casting a line that involves not just the pushing of buttons and the movement of a stick but the harmonious interplay of rod, line, and fly, compensating for the wind, avoiding the willows, using hand, arm, and shoulder while maintaining one's stance in a slippery streambed. And to have a line and finally the fly settle gently on the river, as gently nearly as a real insect might, is one of the most delicate maneuvers humans are capable of. Fly-fishing also centers one's life more clearly and discriminatingly. Just as the grizzly is a symbol of the vastness and power of the open land, so the trout is a focus of the health and fertility of a drainage or even of

a continent, considering the ravages of acid rain. To maintain the conditions that are conducive to big fish and to peaceful fishing is to take the measure of the world at large. In contrast, it appears, playing Defender requires a narrow range of highly sharpened skills, and it proceeds in utter indifference to the surrounding world. It is an activity that, given a sufficient store of energy and food, could proceed well underground should the natural environment have become unlivable.

The claim has been made, of course, that computer games allow one to become at home in the computer world. "We have a whole generation growing up," an educational consultant says, "who have no problem at all approaching the computer. They could become the haves."⁶⁴ "Kids are becoming masters of the computer," an astrophysicist contends. "When most grown-ups talk about computers, they fear the machines will dominate and displace. But these kids are learning to live and *play* with intelligent machines."⁶⁵ What the kids are learning to master is the enjoyment of a commodity; but with the supporting electronic and logical machinery they are as little familiar as consumers are with the substructure of the technological universe.⁶⁶

But what of the people who devote their lives to the design and construction of computers? Surely they have an intimate and competent grasp of what characterizes our era. Tracy Kidder has provided an illuminating account of work at the leading edge of technology, the story of the design and construction of a computer.⁶⁷ Such work is among the best technology has to offer. It is challenging and skillful, requiring creativity, enormous dedication, and discipline. Clearly it engages, excites, and fulfills its practitioners. It occupies the center of their lives and enforces profound personal interactions. It is practiced, at least by a good number of the workers, as art for art's sake, without emphasis on remuneration, with seemingly little support from the firm's executives, with no hope of gaining fame in the world at large, and with diffidence or indifference regarding the uses to which the product will be put. Still it seems to me, judging by the evidence of Kidder's book, that computer design is deeply flawed as a focal practice. Some of the flaws are due to unhappy social arrangements. It is at least conceivable that the accomplishments that are rightly celebrated in Kidder's story could come about under socially more balanced and stable circumstances. A more serious flaw is the purely mental and essentially disembodied character of this kind of engagement. But this one-sidedness it has

in common with writing music, poetry, and philosophy, with playing chess and reading novels.

Yet the poet in the stillness of writing and in the calm of speaking gathers and presents the world in the comprehensive and intimate ways that distinguish human beings. Through the poet's deictic discourse we come to comprehend the world more fully and are so empowered to inhabit it more appropriately in our tangible and bodily activities. Between poetry and practical engagement there is the complementary rhythm of comprehension and action, of systole and diastole. The focal significance of a mental activity should be judged, I believe, by the force and extent with which it gathers and illuminates the tangible world and our appropriation of it.

Is the design and construction of computers a focal concern by that standard? Not in the setting that Kidder presents. Work on the computer alienates most of the workers from the larger world. And the object of their endeavors to which they devote themselves as an end they know at the same time to be a means for whatever ends. They know that the intoxicating and engaging circumstances of their work have been granted them because for the company and the world at large the new computer will be a mere means. But these again are contingent circumstances. Inasmuch as computers embody and illuminate phenomena such as intelligence, organization, determinism, decidability, system, and the like, they surely have a kind of focal character, and a concern with computers in that sense is focal as well.⁶⁸ But the focal significance of work with computers seems precarious to me and requires for its health the essentially complementary concern with things in their own right. Otherwise the world is more likely lost than comprehended.

Have we reached a reflective equilibrium? It may seem as though a more precise inquiry of activities, traditionally thought to be excellent, will show them to be more complex than their more recent and technological rivals. Perhaps this welcome result is due to the fact that a more meticulous scrutiny comes closer to Rawls's "relatively precise theory and measure of complexity" which presumably would settle comparisons conclusively. But all this is semblance. What we have really done is to bring activities back to the things to which we respond in those activities. It is the dignity and greatness of a thing in its own right that give substance and guiding force to the notion of complexity. Complexity by itself and as a formal property is ... too flexible a notion to serve as a guide to the value of wild

nature; and so it is as a guide to the excellence of human activities.⁶⁹ Rawls's Aristotelian Principle is not, to be sure, accidentally tied to a formal notion of complexity.⁷⁰ The thrust of *A Theory of Justice*, consistent with its allegiance to the deontological tradition, is to keep the contingent and historical world at bay.⁷¹ Thus Rawls's theory screens out the presence of those things that alone, I believe, can orient our lives. To say this is, of course, to speak approximately and ambiguously. It is after all not finally decisive whether and how we succeed in securing an ordered and excellent life for world-lessly conceived subjects. The point is to remind or to suggest that in all significant reflection of the good life things in their own right have already graced us.

But if this is the pivot of ethics, is it not possible that a technological device or, more generally, a technological invention may someday address us as such a thing, one that, whatever its genesis, has taken on a character of its own, that challenges and fulfills us, that centers and illuminates our world? ... it is possible that such an invention will appear and that technology will give birth to a focal, thing or event. But none are to be found now, and we must not allow vague promises of technological magnificence to blight the simple splendor of the things that now center and sustain our lives. At the same time we must, in a new kind of maturity and adulthood, accept the plurality of focal concerns, and we can take pleasure in the social union that is fostered by that plurality. But the diverse and complementary nature of our concerns should not be seen as the convergence of the Aristotelian Principle and human finitude. That would diminish focal things to the indifferent furniture of an abstract principle. The threat of one-sidedness that Rawls fears if focal things and practices are taken as dominant ends does not really obtain. Significant or focal things ... have an unsurpassable depth which surely distinguishes them from a dominant end in Rawls's precise sense where such an end "is clearly specified as attaining some objective goal such as political power or material wealth."⁷² A dominant end in this sharp conception is more consonant with technology where gifted and ambitious people, dissatisfied with the shallowness of consumption, seek a transcendent goal and yet remain enthralled by technology in choosing a goal that has in principle procurable and controllable, i.e., measurable, character.

There remains one possibility of unity and coherence arising among the dispersed focal concerns. It appears when we remember that the variety of "focal" practices

in pretechnological societies was centered about one focus proper, religious in nature. The focus proper did not unite all the subordinate engaging activities as a rule covers its applications. Rather the central focus surpassed the peripheral ones in concreteness, depth, and significance. ... there may be a hidden focus of that sort now, or one may emerge sometime. But who is to say? To the blight of the enthrallment with technology there corresponds symmetrically the impatient waiting or insistence on the great epiphany of the world's central focus. Instead we should gratefully record the present wealth of focal things and practices, take these things to heart, and work toward a republic of focal concerns.

Having secured, to some extent, a place for the plurality, concreteness and simplicity of focal concerns, we must now show more soberly and specifically how they serve as a basis for the reform of technology. And the first question is: How broad a basis will it be? I have suggested ... that there is a wide and steady, if frequently concealed, current of focal practices that runs through the history of this country. It is the other American mainstream. Its various stretches are linked by the generic features that focal things have in common, and it may be helpful to outline this kinship more formally as a set of traits that focal things and practices exhibit for the most part. These traits are not conditions that are sufficient to qualify something as focal. Nor is each of these traits necessary. Rather these features reflect general recollections and anticipations of focal concerns.

These generic features are divided between the things and practices of focal concern. But the division is not sharp since things and practices are tightly and variously interwoven. The practice of fly-fishing is centered around a definite, independent, and resplendent thing: the trout. The thing in backpacking is expansive, broadly defined, and it exists in its own right: the wilderness. In the practice of running, the thing is always and already there, Sheehan's ocean road, for instance, or the course that the New York City Marathon takes. But it lies there, inconspicuous and indistinct, till the runners bring it into relief. And the great meal and its courses must be prepared and brought forth by the cook and the host. Still we might say this about focal things in general. They are concrete, tangible, and deep, admitting of no functional equivalents; they have a tradition, structure, and rhythm of their own. They are unprocurable and finally beyond our control. They engage us in the fullness of our capacities. And they thrive in a technological setting. A focal practice, generally, is the resolute and regular

dedication to a focal thing. It sponsors discipline and skill which are exercised in a unity of achievement and enjoyment, of mind, body, and the world, of myself and others, and in a social union.

This is just a summary of issues discussed before. An additional point must now be made. Focal practices are at ease with the natural sciences. Since focal things are concrete and tangible, they are at home in the possibility space that the sciences circumscribe. Because the givenness of these things is so eloquent and articulate, the scientific investigation of such things is not found to be a dissolution but an illumination of them. Correspondingly, the human being, as it is engaged and oriented by great things and is so an eminent focus itself, suffers no threat or diminishment from scientific examination. Capon and Sheehan testify to this openness. They use scientific insight gladly, easily, and often to bring out the splendor and depth of the things that matter to them. It is clear ... that the reform of technology would rest on a treacherous foundation if focal things and practices violated or resented the bounds of science.

We now turn explicitly to the reform of technology. It is evident ... that the reform must be one *of* and not merely one *within* the device paradigm. It is reasonable to expect that a reform of the paradigm would involve a restructuring of the device, perhaps the deletion, addition, and rearrangement of internal features. And this would lead, one might think, to the construction of different, perhaps intrinsically and necessarily benign technological devices. But I believe the device paradigm is perfect in its way, and if concrete pefections within the overall pattern are to be achieved, this will be the task of research and development scientists and engineers, not of philosophers. A reform of the paradigm is even less, of course, a dismantling of technology or of the technological universe. It is rather *the recognition and the restraint* of the paradigm. To restrain the paradigm is to restrict it to its proper sphere. Its proper sphere is the background or periphery of focal things and practices. Technology so reformed is no longer the characteristic and dominant way in which we take up with reality; rather it is a way of proceeding that we follow at certain times and up to a point, one that is left behind when we reach the threshold of our focal and final concerns. The concerns that move us to undertake a reform of the paradigm lead to reforms within the paradigm as well. Since a focal practice discloses the significance of things and the dignity of humans, it engenders a concern for the safety and well-being of things and persons. Consequently,

focal concerns will stress and support the paradigm's native tendency toward safety, both locally and globally. It will concur with the efforts of consumer advocates and environmentalists, not of course to save and entrench the rule of technology but to provide a secure margin for what matters centrally.

But is this really a radical and remarkable reform proposal? Is it not indistinguishable from all the programs that are worried about the excesses of technology, about the imbalance between means and ends, about the suppression of the value question, and about the enslavement of humankind by its own invention? Would it not be fair to say that these programs have anticipated the goal of the present reform proposal, namely, to restrict technology to the status of a means and to introduce new ends? The question is simply unanswerable because it is deeply ambiguous. If by new ends we mean different commodities, then the present proposal differs sharply from traditional programs of reform. Reform must make room for focal things and practices. In a broad sense, these are the ends that technology should serve. But this broader sense of the means-ends relation is in conflict with the means-ends structure, embodied in the device paradigm. We can put the point at issue clearly, if baldly, this way. Both the common and the present reform proposals revolve about a means-ends distinction. In the common view, the 'distinction is placed within the device paradigm, in alignment with the machinery-commodity distinction. Thus the role of technology remains invisible and unchallenged. The present proposal is to restrict the entire paradigm, both the machinery and the commodities, to the status of a means and let focal things and practices be our ends. The conflict between these two views is easily overlooked. It is that unresolved conflict that infects the question above with ambiguity. More important, as argued repeatedly ... the sharpness, pervasiveness, and concealment of the technological means-ends relation exert a nearly irresistible pressure toward resolving the ambiguity in favor of technology. Most traditional reform proposals are finally ensnared by the device paradigm and fail to challenge the rule of technology and its debilitating consequences. Hence a radical reform, as said above, requires *the recognition* and the restraint of the device paradigm, a recognition that is guided by a focal concern. Such recognition can [...] shade over into an implicit understanding though explication, it is hoped, would sharpen it.

Let me now draw out the concrete consequences of this kind of reform. I begin with particular illustrations and proceed to broader observations. Sheehan's focal

concern is running, but he does not run everywhere he wants to go. To get to work he drives a car. He depends on that technological device and its entire associated machinery of production, service, resources, and roads. Clearly, one in Sheehan's position would want the car to be as perfect a technological device as possible: safe, reliable, easy to operate, free of maintenance. Since runners deeply enjoy the air, the trees, and the open spaces that grace their running, and since human vigor and health are essential to their enterprise, it would be consistent of them to want an environmentally benign car, one that is free of pollution and requires a minimum of resources for its production and operation. Since runners express themselves through running, they would not need to do so through the glitter, size, and newness of their vehicles.⁷³

At the threshold of their focal concern, runners leave technology behind, technology, i.e., as a way of taking up with the world. The products of technology remain ubiquitous, of course: clothing, shoes, watches, and the roads. But technology can produce instruments as well as devices, objects that call forth engagement and allow for a more skilled and intimate contact with the world.⁷⁴ Runners appreciate shoes that are light, firm, and shock absorbing. They allow one to move faster, farther, and more fluidly. But runners would not want to have such movement procured by a motorcycle, nor would they, on the other side, want to obtain merely the physiological benefit of such bodily movement from a treadmill.

A focal practice engenders an intelligent, and selective attitude toward technology. It leads to a simplification and perfection of technology in the background of one's focal concern and to a discerning use of technological products at the center of one's practice. I am not, of course, describing an evident development or state of affairs. It does appear from what little we know statistically of the runners in this country, for instance, that they lead a more engaged, discriminating, and a socially more profound life.⁷⁵ I am rather concerned to draw out the consequences that naturally follow for technology from a focal commitment and from a recognition of the device pattern. There is much diffidence, I suspect, among people whose life is centered, even in their work, around a great concern. Music is surely one of these. But at times, it seems to me, musicians confine the radiance, the rhythm, and the order of music and the ennobling competence that it requires to the hours and places of performance. The entrenchment

of technology may make it seem quixotic to want to lead a fully musical life or to change the larger technological setting so that it would be more hospitable and attentive to music. Moreover, as social creatures we seek the approval of our fellows according to the prevailing standards. One may be a runner first and most of all; but one wants to prove too that one has been successful in the received sense. Proof requires at least the display, if not the consumption, of expensive commodities. Such inconsistency is regrettable, not because we just have to have reform of technology but because it is a partial disavowal of one's central concern. To have a focal thing radiate transformatively into its environment is not to exact some kind of service from it but to grant it its proper eloquence.

There is of course intuitive evidence for the thesis that a focal commitment leads to an intelligent limitation of technology. There are people who, struck by a focal concern, remove much technological clutter from their lives. In happy situations, the personal and private reforms take three directions. The first is of course to clear a central space for the focal thing, to establish an inviolate time for running, or to establish a hearth in one's home for the culture of the table. And this central clearing goes hand in hand, as just suggested, with a newly discriminating use of technology.⁷⁶ The second direction of reform is the simplification of the context that surrounds and supports the focal area. And then there is a third endeavor, that of extending the sphere of engagement as far as possible. Having experienced the depth of things and the pleasure of full-bodied competence at the center, one seeks to extend such excellence to the margins of life. "Do it yourself" is the maxim of this tendency and "self-sufficiency" its goal. But the tendencies for which these titles stand also exhibit the dangers of this third direction of reform. Engagement, however skilled and disciplined, becomes disoriented when it exhausts itself in the building, rebuilding, refinement, and maintenance of stages on which nothing is ever enacted. People finish their basements, fertilize their lawns, fix their cars. What for? The peripheral engagement suffocates the center, and festivity, joy, and humor disappear. Similarly, the striving for self-sufficiency may open up a world of close and intimate relations with things and people. But the demands of the goal draw a narrow and impermeable boundary about that world. There is no time to be a citizen of the cultural and political world at large and no possibility of assuming one's responsibility in it. The antidote to such disorientation and constriction is the

appropriate acceptance of technology. In one or another area of one's life one should gratefully accept the disburdenment from daily and time-consuming chores and allow celebration and world citizenship to prosper in the time that has been gained.

What emerges here is a distinct notion of the good life or more precisely the private or personal side of one. Clearly, it will remain crippled if it cannot unfold into the world of labor and the public realm. . . . To begin on the side of leisure and privacy is to acknowledge the presently dispersed and limited standing of focal powers. It is also to avail oneself of the immediate and undeniably large discretion one has in shaping one's free time and private sphere.⁷⁷ Even within these boundaries the good life that is centered on focal concerns is distinctive enough. Evidently, it is a favored and prosperous life. It possesses the time and the implements that are needed to devote oneself to a great calling. Technology provides us with the leisure, the space, the books, the instruments, the equipment, and the instruction that allow us to become equal to some great thing that has beckoned us from afar or that has come to us through a tradition. The citizen of the technological society has been spared the abysmal bitterness of knowing himself or herself to be capable of some excellence or achievement and of being at the same time worn-out by poor and endless work, with no time to spare and no possibility of acquiring the implements of one's desire. That bitterness is aggravated when one has a gifted child that is similarly deprived, and is exacerbated further through class distinctions where one sees richer but less gifted and dedicated persons showered with opportunities of excellence. There is prosperity also in knowing that one is able to engage in a focal practice with a great certainty of physical health and economic security. One can be relatively sure that the joy that one receives from a focal thing will not be overshadowed by the sudden loss of a loved one with whom that joy is shared. And one prospers not only in being engaged in a profound and living center but also in having a view of the world at large in its essential political, cultural, and scientific dimensions. Such a life is centrally prosperous, of course, in opening up a familiar world where things stand out clearly and steadily, where life has a rhythm and depth, where we encounter our fellow human beings in the fullness of their capacities, and where we know ourselves to be equal to that world in depth and strength.

This kind of prosperity is made possible by technology, and it is centered in a focal concern. Let us call it wealth

to distinguish it from the prosperity that is confined to technology and that I want to call affluence. Affluence consists in the possession and consumption of the most numerous, refined, and varied commodities. This superlative formulation betrays its relative character. "Really" to be affluent is to live now and to rank close to the top of the hierarchy of inequality. All of the citizens of a typical technological society are more affluent than anyone in the Middle Ages. But this affluence, astounding when seen over time, is dimmed or even insensible at any one time for all but those who have a disproportionately large share of it. Affluence, strictly defined, has an undeniable glamour. It is the embodiment of the free, rich, and imperial life that technology has promised. So at least it appears from below whence it is seen by most people. Wealth in comparison is homely, homely in the sense of being plain and simple but homely also in allowing us to be at home in our world, intimate with its great things, and familiar with our fellow human beings. This simplicity, as said before, has its own splendor that is more sustaining than the glamour of affluence which leaves its beneficiaries, so we hear, sad and bored.⁷⁸ Wealth is a romantic notion also in that it continues and develops a tradition of concerns and of excellence that is roofed on the other side of the modern divide, i.e., of the Enlightenment. A life of wealth is certainly not romantic in the sense of constituting an uncomprehending rejection of the modern era and a utopian reform proposal.⁷⁹

[...] I will conclude this chapter by considering the narrower sphere of wealth and by connecting it with the traditional notions of excellence and of the family. ... I suggested that the virtues of world citizenship, of gallantry, musicianship, and charity still command an uneasy sort of allegiance and that it is natural, therefore, to measure the technological culture by these standards. Perhaps people are ready to accept the distressing results of such measurement with a rueful sort of agreement. But obviously the acceptance of the standards, if there is one, is not strong enough to engender the reforms that the pursuit of traditional excellence would demand. This, I believe, is due to the fact that the traditional virtues have for too long been uprooted from the soil that used to nourish them. Values, standards, and rules, I have urged repeatedly, are recollections and anticipations of great things and events. They provide bonds of continuity with past greatness and allow us to ready ourselves and our children for the great things we look forward to. Rules and values inform and are acted out in practices. A virtue is the practiced and accomplished faculty that makes one equal to a great event. From such considera-

tions it is evident that the real circumstances and forces to which the traditional values, virtues, and rules used to answer are all but beyond recollection, and there is little in the technological universe that they can anticipate and ready us for. The peculiar character of technological reality has escaped the attention of the modern students of ethics.

To sketch a notion of excellence that is appropriate to technology is, in one sense, simply to present another version of the reform of technology that has been developed so far. But it is also to uncover and to strengthen ties to a tradition that the modern era has neglected to its peril. As regards world citizenship today, the problem is not confinement but the proliferation of channels of communication and of information. From the mass of available information we select by the criteria of utility and entertainment. We pay attention to information that is useful to the maintenance and advancement of technology, and we consume those news items that divert us. In the latter case the world is shredded into colorful bits of entertainment, and the distracted kind of knowledge that corresponds to that sort of information is the very opposite of the principled appropriation of the world that is meant by world citizenship.⁸⁰ The realm of technically useful information does not provide access to world citizenship either. Technical information is taken up primarily in one's work. Since most work in technology is unskilled, the demands on technical knowledge are low, and most people know little of science, engineering, economics, and politics. The people at the leading edge of technology have difficulty in absorbing and integrating the information that pertains to their field.⁸¹ But even if the flood of technical information is appropriately channeled, as I think it can be, its mastery still constitutes knowledge of the social machinery, of the means rather than the ends of life. What is needed if we are to make the world truly and finally ours again is the recovery of a center and a standpoint from which one can tell what matters in the world and what merely clutters it up. A focal concern is that center of orientation. What is at issue here comes to the fore when we compare the simple and authentic world appropriation of someone like Mother Teresa with the shallow and vagrant omniscience of a technocrat.

Gallantry in a life of wealth is the fitness of the human body for the greatness and the playfulness of the world. Thus it has a grounding and a dignity that are lost in traditional gallantry, a loss that leaves the latter open to the technological concept of the perfect body where

the body is narcissistically stylized into a glamorous something by whatever scientific means and according to the prevailing fashion. In the case of musicianship the tradition of excellence is unbroken and has expanded into jazz and popular music. What the notion of wealth can contribute to the central splendor and competence of music is to make us sensible to the confinement and the procurement of music. Confinement and procurement are aspects of the same phenomenon. The discipline and the rhythmic grace and order that characterize music are often confined, as said above, to the performance proper and are not allowed to inform the broader environment. This is because the unreformed structure of the technological universe leaves no room for such forces. Accordingly, music is allowed to conform to technology and is procured as a commodity that is widely and inconsequentially consumed. A focal concern for musicianship, then, will curtail the consumption of music and secure a more influential position for the authentic devotion to music.

Finally, one may hope that focal practices will lead to a deepening of charity and compassion. Focal practices provide a profounder commerce with reality and bring us closer to that intensity of experience where the world engages one painfully in hunger, disease, and confinement. A focal practice also discloses fellow human beings more fully and may make us more sensitive to the plight of those persons whose integrity is violated or suppressed. In short, a life of engagement may dispel the astounding callousness that insulates the citizens of the technological societies from the well-known misery in much of the world. The crucial point has been well made by Duane Elgin:

When people deliberately choose to live closer to the level of material sufficiency, they are brought closer to the reality of material existence for a majority of persons on this planet. There is not the day-to-day insulation from material poverty that accompanies the hypnosis of a culture of affluence.⁸²

The plight of the family, finally, consists ... in the absorption of its tasks and substance by technology. The reduction of the household to the family and the growing emptiness of family life leave the parents bewildered and the children without guidance. Since less and less of vital significance remains entrusted to the family, the parents have ceased to embody rightful authority and a tradition of competence, and correspondingly there is less and less legitimate reason to hold children to any kind of discipline. Parental love is deprived of tangible and serious circumstances in which to realize itself. Focal practices naturally reside in the family, and the parents are the ones who should initiate and train their children in them. Surely parental love is one of the deepest forms of sympathy. But sympathy needs enthusiasm to have substance. Families, I have found, that we are willing to call healthy, close, or warm turn out, on closer inspection, to be centered on a focal concern. And even in families that exhibit the typical looseness of structure, the diffidence of parents, and the impertinence of children, we can often discover a bond of respect and deep affection between parent and youngster, one that is secured in a common concern such as a sport and keeps the family from being scattered to the winds.

Notes

- 1 See *Paulys Realencyclopädie der classischen Altertumswissenschaft* (Stuttgart, 1893–1963), 15:615–17; See also Fustel de Coulanges, “The Sacred Fire,” in *The Ancient City*, trans. Willard Small (Garden City, N.Y., n.d. [first published in 1864]), pp. 25–33.
- 2 See Kent C. Bloomer and Charles W. Moore, *Body, Memory, and Architecture*. (New Haven, 1977), pp. 2–3 and 50–51.
- 3 See Jeremiah Eck, “Home Is Where the Hearth Is,” *Quest* 3 (April 1979): 12.
- 4 *Ibid.*, p. 11.
- 5 See *The Oxford English Dictionary*.
- 6 See Martin Heidegger, “The Origin of the Work of Art,” in *Poetry, Language, Thought*, trans. Albert Hofstadter (New York, 1971), pp. 15–87.
- 7 See Vincent Scully, *The Earth, the Temple, and the Gods* (New Haven, 1962).
- 8 See my *The Philosophy of Language* (The Hague, 1974), pp. 126–31.
- 9 See Heidegger, *Being and Time*, trans. John Macquarrie and Edward Robinson (New York, 1962), pp. 95–107, 163–68, 210–24.
- 10 See Heidegger, “The Origin of the Work of Art,” p. 80.
- 11 See Heidegger, “The Thing,” in *Poetry, Language, Thought*, pp. 163–82. Heidegger alludes to the turn from the *Bedingungen* to the *Dinge* on p. 179 of the original, “Das Ding,” in *Vorträge und Aufsätze* (Pfullingen, 1959). He alludes to the turn from technology to (focal) things in “The Question Concerning Technology,” in *The Question*

- Concerning Technology and Other Essays*, trans. William Lovitt (New York, 1977), p. 43.
- 12 See Heidegger, "The Thing."
 - 13 See M. F. K. Fisher, *The Cooking of Provincial France* (New York, 1968), p. 50.
 - 14 Though there are seeds for a reform of technology to be found in Heidegger as I want to show, Heidegger insists that "philosophy will not be able to effect an immediate transformation of the present condition of the world. Only a god can save us." See "Only a God Can Save Us: Der Spiegel's Interview with Martin Heidegger," trans. Maria P. Alter and John D. Caputo, *Philosophy Today* 20 (1976): 277.
 - 15 I am not concerned to establish or defend the claim that my account of Heidegger or my development of his views are authoritative. It is merely a matter here of acknowledging a debt.
 - 16 See Heidegger, "The Question Concerning Technology," p. 43; Langdon Winner makes a similar point in "The Political Philosophy of Alternative Technology," in *Technology and Man's Future*, ed. Albert H. Teich, 3d ed. (New York, 1981), pp. 369–73.
 - 17 See Heidegger, "The Thing," pp. 180–82.
 - 18 The need of complementing Heidegger's notion of the thing with the notion of practice was brought home to me by Hubert L. Dreyfus's essay, "Holism and Hermeneutics," *Review of Metaphysics* 34 (1980): 22–23.
 - 19 See Heidegger, "Building Dwelling Thinking," in *Poetry, Language, Thought*, pp. 152–53.
 - 20 *Ibid.*, pp. 148–49.
 - 21 Georg Trakl, quoted by Heidegger in "Language," in *Poetry, Language, Thought*, pp. 194–95 (I have taken some liberty with Hofstadter's translation).
 - 22 See Norman Maclean, *A River Runs through It and Other Stories* (Chicago, 1976). Only the first of the three stories instructs the reader about fly fishing.
 - 23 See Colin Fletcher, *The Complete Walker* (New York, 1971).
 - 24 *Ibid.*, p. 9.
 - 25 See Roger B. Swain, *Earthly Pleasures: Tales from a Biologist's Garden* (New York, 1981).
 - 26 Here are a few more: Wendell Berry, *Farming: A Handbook* (New York, 1970); Stephen Kiesling, *The Shell Game: Reflections on Rowing and the Pursuit of Excellence* (New York, 1982), John Richard Young, *Schooling for Young Riders* (Norman, Okla., 1970); W. Timothy Gallwey, *The Inner Game of Tennis* (New York, 1974), Ruedi Bear, *Pianta Su: Ski Like the Best* (Boston, 1976). Such books must be sharply distinguished from those that promise to teach accomplishments without effort and in no time. The latter kind of book is technological in intent and fraudulent in fact.
 - 27 See Robert Farrar Capon, *The Supper of the Lamb: A Culinary Reflection* (Garden City, N.Y., 1969); and George Sheehan, *Running and Being: The Total Experience* (New York, 1978).
 - 28 See Sheehan, pp. 211–20 and elsewhere.
 - 29 See Capon, pp. 167–181.
 - 30 See my "Mind, Body, and World," *Philosophical Forum* 8 (1976): 76–79. ...
 - 31 See Capon, pp. 176–77.
 - 32 See Sheehan, p. 127.
 - 33 On the unity of achievement and enjoyment, see Alasdair MacIntyre, *After Virtue* (Notre Dame, Ind., 1981), p. 184.
 - 34 See my "Mind, Body, and World," pp. 68–86.
 - 35 See Peter Wood, "Seeing New York on the Run," *New York Times Magazine*, 7 October 1979; Alexandra Penney, "Health and Grooming: Shaping Up the Corporate Image," *ibid.*
 - 36 See *New York Times Magazine*, 3 August 1980, pp. 20–21.
 - 37 See Wood, p. 112.
 - 38 See Sheehan, pp. 211–17.
 - 39 See Wood, p. 116.
 - 40 See Sheehan, pp. 221–31 and *passim*.
 - 41 There is substantial anthropological evidence to show that running has been a profound focal practice in certain pre-technological cultures. I am unable to discuss it here. Nor have I discussed the problem, here and elsewhere touched upon, of technology and religion. The present study, I believe, has important implications for that issue, but to draw them out would require more space and circumspection than are available now. I have made attempts to provide an explication in "Christianity and the Cultural Center of Gravity," *Listening* 18 (1983): 93–102; and in "Prospects for the Theology of Technology," *Theology and Technology*, ed. Carl Mitcham and Jim Grote (Lanham, Md., 1984), pp. 305–22.
 - 42 See M. F. K. Fisher, pp. 9–31.
 - 43 For what social and empirical basis there is to this question see Chapter 24.
 - 44 Some therapists advise lying down till these stirrings go away.
 - 45 See John Rawls, "Two Concepts of Rules," *Philosophical Review* 64 (1955): 3–32.
 - 46 Conversely, it is one thing to break a practice and quite another to omit a particular action. For we define ourselves and our lives in our practices; hence to break a practice is to jeopardize one's identity while omitting a particular action is relatively inconsequential.
 - 47 See Aristotle's *Nicomachean Ethics*, the beginning of Book Two in particular.
 - 48 See MacIntyre, p. 175.
 - 49 *Ibid.*, pp. 175–77.
 - 50 *Ibid.*, p. 176.
 - 51 See Rawls, p. 25.
 - 52 See George Sheehan, *Running and Being* (New York, 1978), p. 102.

- 53 See Wilhelm von Humboldt, "Ideen zu einem Versuch, die Grenzen der Wirksamkeit des Staats zu bestimmen," in *Werke*, ed. Andreas Flitner and Klaus Giel (Stuttgart, 1960–64), 1:64–69.
- 54 John Rawls, *A Theory of Justice* (Cambridge, Mass., 1971), pp. 520–29.
- 55 *Ibid.*, p. 426.
- 56 *Ibid.*, p. 429.
- 57 *Ibid.*, p. 427.
- 58 *Ibid.*, p. 554.
- 59 *Ibid.*, p. 552.
- 60 See Robert Farrar Capon, *The Supper of the Lamb* (Garden City, N.Y., 1969), pp. 182–91; and Sheehan, pp. 238–40.
- 61 See Aaron Latham, "Video Games Star War," *New York Times Magazine*, 25 October 1981; "Invasion of the Video Creatures," *Newsweek*, 16 November 1981, pp. 90–94; "Games That Play People," *Time*, 18 January 1982, pp. 50–58.
- 62 See *Time*, p. 56.
- 63 How can there be technological engagement if technology is defined as disengaging? The answer is that technology in this essay is defined according to the device paradigm, and so defined it becomes disengaging primarily (a) in consumption and (b) in the mature phase after it has taken the ironical turn. Hence the possibility of technological engagement suggests that technology could achieve an alternative maturity.
- There is already technological engagement in the sense that certain activities essentially depend on technological products as alpine skiing or bicycle racing do. But note that the technological devices do not procure but mediate engagement. The engagement is finally with slopes, snow conditions, courses, turns, etc. And there is full and skilled bodily engagement too.
- 64 See *Newsweek*, 16 November 1981, p. 94.
- 65 *Ibid.*, p. 90.
- 66 Along similar lines one could show that running is more excellent than exercising with a Nautilus.
- 67 See Tracy Kidder, *The Soul of a New Machine* (Boston, 1981).
- 68 Remember Daniel Bell's remark ... that the computer is the "thing" in which the postindustrial society is coming to be symbolized. For a treatise in support of the thesis, see Douglas R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York, 1979).
- 69 Engagement, too, taken as a formal notion or as a concept of a certain sort of worldlessly conceived human existence, fails as a guide to enduring excellence. But understood as a term that recollects and anticipates the human response to focal things, it is a helpful vocable, and I will continue so to use it.
- 70 Aristotle's Principle is not so dependent on complexity since it is balanced by the rightful assumption and careful explication of a definite and articulate world. ...
- 71 Rawls attempts to control the empirical world by admitting it into the design of the just society in an orderly sequence of four stages (see *A Theory of Justice*, pp. 195–201). This procedure does succeed in occluding the good life of focal things and practices. The apparent opening, so Rawls hopes, will be filled with the good life that springs from rationality, the Aristotelian Principle, and social union. But as we saw, the hope is not fulfilled. Instead ... the technological society emerges as the only possible but unacknowledged realization of Rawls's just society. One might argue, incidentally, that technology is not only an indispensable aid but also a guide for Rawls's theory which is designed to make justice available in the technological sense. I believe, however, that, appearances to the contrary, the formidable machinery of Rawls's theory bespeaks a commitment to fairness, openness, and compassion primarily and secondarily, at most, to technology.
- 72 See Rawls, p. 554.
- 73 On the general rise and decline of the car as a symbol of success, see Daniel Yankelovich, *New Rules: Searching for Self-Fulfillment in a World Turned Upside Down* (Toronto, 1982), pp. 36–39.
- 74 Although these technological instruments are translucent relative to the world and so permit engagement with the world, they still possess an opaque machinery that mediates engagement but is not itself experienced either directly or through social mediation. See also the remarks in n. 63 above.
- 75 See "Who Is the American Runner?" *Runner's World* 15 (December 1980): 36–42.
- 76 Capon's book is the most impressive document of such discriminating use of technology.
- 77 A point that is emphatically made by E. F. Schumacher in *Small Is Beautiful* (New York, 1973) and in *Good Work* (New York, 1979); by Duane Elgin in *Voluntary Simplicity* (New York, 1981); and by Yankelovich in *New Rules*.
- 78 See Roger Rosenblatt, "The Sad Truth about Big Spenders," *Time*, 8 December 1980, pp. 84 and 89.
- 79 On the confusions that beset romanticism in its opposition to technology, see Lewis Mumford, *Technics and Civilization* (New York, 1963), pp. 285–303.
- 80 See Daniel J. Boorstin, *Democracy and Its Discontents* (New York, 1975), pp. 12–25.
- 81 See Elgin, pp. 251–71. In believing that the mass of complex technical information poses a mortal threat to bureaucracies, Elgin, it seems to me, indulges in the unwarranted pessimism of the optimists.
- 82 *Ibid.*, p. 71.

Heidegger and Borgmann on How to Affirm Technology

Hubert L. Dreyfus and Charles Spinosa

Albert Borgmann advances an American frontiersman's version of the question concerning technology that was pursued by Heidegger almost half a century ago among the peasants in the Black Forest. Since the *critique* of technology pioneered by these thinkers has by now become widely known, we would like to address a subsequent question with which each has also struggled. How can we relate ourselves to technology in a way that not only resists its devastation but also gives it a positive role in our lives? This is an extremely difficult question to which no one has yet given an adequate response, but it is perhaps *the* question for our generation. Through a sympathetic examination of the Borgmannian and Heideggerian alternatives, we hope we can show that Heidegger suggests a more coherent and credible answer than Borgmann's.

1 The Essence of Technology

In writing about technology, Heidegger formulates the goal we are concerned with here as that of gaining a free relation to technology – a way of living with technology that does not allow it to “warp, confuse, and lay waste our nature.”¹ According to Heidegger our nature is to be world disclosers. That is, by means of our equipment and coordinated practices we human beings open coherent,

distinct contexts or worlds in which we perceive, act, and think. Each such world makes possible a distinct and pervasive way in which things, people, and selves can appear and in which certain ways of acting make sense. The Heidegger of *Being and Time* called a world an understanding of being and argued that such an understanding of being is what makes it possible for us to encounter people and things as such. He considered his discovery of the ontological difference – the difference between the understanding of being and the beings that can show up given an understanding of being – his single great contribution to Western thought.

Middle Heidegger (roughly from the 1930s to 1950) added that there have been a series of total understandings of being in the West, each focused by a cultural paradigm which he called a work of art.² He distinguished roughly six epochs in our changing understanding of being. First things were understood on the model of wild nature as *physis*, i.e. as springing forth on their own. Then on the basis of *poiesis*, or nurturing, things were dealt with as needing to be helped to come forth. This was followed by an understanding of things as finished works, which in turn led to the understanding of all beings as *creatures* produced by a creator God. This religious world gave way to the modern one in which everything was organized to stand over against and satisfy the desires of autonomous and stable subjects. In 1950,

Hubert Dreyfus and Charles Spinosa, originally “Highway Bridges and Feasts: Heidegger and Borgmann on How to Affirm Technology,” from *Man and World*, 30/2 (1997), p. 159–177. Reprinted by permission of Springer.

Heidegger claimed that we were entering a final epoch which he called *the technological understanding of being*.

But until late in his development, Heidegger was not clear as to how technology worked. He held for a long time that the danger of technology was that man was dominating everything and exploiting all beings for his own satisfaction, as if man were a subject in control and the objectification of everything were the problem. Thus, in 1940 he says:

Man is what lies at the bottom of all beings; and that is, in modern terms, at the bottom of all objectification and representability.³

To test this early claim we turn to the work of Albert Borgmann since he has given us the best account of this aspect of Heidegger's thinking. Rather than doing an exegesis of Heidegger's texts, Borgmann does just what Heidegger wants his readers to do. He follows Heidegger on his path of thought, which always means finding the phenomena about which Heidegger is thinking. In *Technology and the Character of Contemporary Life*, Borgmann draws attention to the phenomenon of the technological device. Before the triumph of technological devices, people primarily engaged in practices that nurtured or crafted various things. So gardeners developed the skills and put in the effort necessary for nurturing plants, musicians acquired the skill necessary for bringing forth music, the fireplace had to be filled with wood of certain types and carefully maintained in order to provide warmth for the family. Technology, as Borgmann understands it, belongs to the last stage in the history of the understandings of being in the West. It replaces the worlds of *poiesis*, craftsmen, and Christians with a world in which subjects control objects. In such a world the things that call for and focus nurturing, craftsmanly, or praising practices are replaced by devices that offer a more and more transparent or commodious way of satisfying a desire. Thus the wood-burning fireplace as the foyer or focus of family activity is replaced by the stove and then by the furnace.

As Heidegger's thinking about technology deepened, however, he saw that even objects cannot resist the advance of technology. He came to see this in two steps. First, he saw that the nature of technology does not depend on subjects understanding and using objects. In 1946 he said that exploitation and control are not the subject's doing; "that man becomes the subject and the world the object, is a consequence of technology's nature

establishing itself, and not the other way around."⁴ And in his final analysis of technology, Heidegger was critical of those who, still caught in the subject/object picture, thought that technology was dangerous because it embodied instrumental reason. Modern technology, he insists, is "something completely different and therefore new."⁵ The goal of technology Heidegger then tells us, is the more and more flexible and efficient ordering of resources, not as objects to satisfy our desires, but simply for the sake of ordering. He writes:

Everywhere everything is ordered to stand by, to be immediately at hand, indeed to stand there just so that it may be on call for a further ordering. Whatever is ordered about in this way ... we call ... standing-reserve. ... Whatever stands by in the sense of standing reserve no longer stands over against us as object.⁶

Like late Heidegger, recent Borgmann sees that the direction technology is taking will eventually get rid altogether of objects. In his latest book, *Crossing the Postmodern Divide*, Borgmann takes up the difference between *modern* and *postmodern* technology. He distinguishes *modern hard* technology from *postmodern soft* technology. On Borgmann's account, modern technology, by rigidity and control, overcame the resistance of nature and succeeded in fabricating impressive structures such as railroad bridges as well as a host of standard durable devices. *Postmodern* technology, by being flexible and adaptive, produces instead a diverse array of quality goods such as high-tech athletic shoes designed specifically for each particular athletic activity.

Borgmann notes that as our postmodern society has moved from production to service industries our products have evolved from sophisticated goods to information. He further sees that this postmodern instrumental reality is giving way in its turn to the hyperreality of simulators that seek to get rid of the limitations imposed by the real world. Taken to the limit the simulator puts an improved reality completely at our disposal. Thus the limit of postmodernity, as Borgmann understands it, would be reached, not by the total objectification and exploitation of nature, but by getting rid of natural objects and replacing them with simulacra that are completely under our control. The essential feature of such hyperreality on Borgmann's account is that it is "entirely subject to my desire."⁷ Thus for Borgmann the *object* disappears precisely to the extent that the *subject* gains total control. But Borgmann adds

the important qualification that in gaining total control, the postmodern subject is reduced to “a point of arbitrary desires.”⁸ In the end, Borgmann’s postmodern hyperreality would eliminate both objects and modernist subjects who have long-term identities and commitments. Nevertheless, Borgmann still remains within the field of subjectivity by maintaining that hyperreality is driven by the satisfaction of desires.

Even though he wrote almost half a century ago, Heidegger already had a similar account of the last stage of modernity. Like Borgmann he saw that information is replacing objects in our lives, and Heidegger and Borgmann would agree that information’s main characteristic is that it can be easily transformed. But, whereas Borgmann sees the goal of these transformations as serving a minimal subject’s desires, Heidegger claims that “both the subject and the object are sucked up as standing-reserve.”⁹ To see what he means by this, we can begin by examining Heidegger’s half-century-old example. Heidegger describes the hydroelectric power station on the Rhine as his paradigm technological device because for him electricity is the paradigm technological stuff. He says:

The revealing that rules throughout modern technology has the character of a setting-upon, in the sense of a challenging-forth. That challenging happens in that the energy concealed in nature is unlocked, what is unlocked is transformed, what is transformed is stored up, what is stored up is, in turn, distributed, and what is distributed is switched about *ever anew*.¹⁰

But we can see now that electricity is not a perfect example of technological stuff because it ends up finally turned into light, heat, or motion to satisfy some subject’s desire. Heidegger’s intuition is that treating everything as standing reserve or, as we might better say, resources, makes possible *endless* disaggregation, redistribution, and reaggregation *for its own sake*. As soon as he sees that information is truly endlessly transformable Heidegger switches to computer manipulation of information as his paradigm.¹¹

As noted, when Heidegger says that technology is not instrumental and objectifying but “something entirely new,” he means that, along with objects, subjects are eliminated by this new mode of being. Thus for Heidegger post-modern technology is not the culmination of the modern subject’s controlling of objects but a new stage in the understanding of being. Heidegger,

standing on Nietzsche’s shoulders, gains a glimpse of this new understanding when he interprets Nietzsche as holding that the will to power is not the will to gain control for the sake of satisfying one’s desires – even arbitrary ones – but the tendency in the practices to produce and maintain flexible ordering so that the fixity of even the past can be conquered; this cashes out as flexible ordering for the sake of more ordering and reordering without limit, which, according to Heidegger, Nietzsche expresses as the eternal return of the same.¹² Thanks to Nietzsche, Heidegger could sense that, when everything becomes standing reserve or resources, people and things will no longer be understood as having essences or identities or, for people, the goal of satisfying arbitrary desires, but back in 1955 he could not yet make out just how such a world would look.

Now, half a century after Heidegger wrote *The Question Concerning Technology*, the new understanding of being is becoming evident. A concrete example of this change and of an old fashioned subject’s resistance to it can be seen in a recent *New York Times* article entitled: “An Era When Fluidity Has Replaced Maturity” (March 20th, 1995). The author, Michiko Kakutani, laments that “for many people ... shape-shifting and metamorphosis seem to have replaced the conventional process of maturation.” She then quotes a psychiatrist, Robert Jay Lifton, who notes in his book *The Protean Self* that “We are becoming fluid and many-sided. Without quite realizing it, we have been evolving a sense of self appropriate to the restlessness and flux of our time.”¹³ Kakutani then comments:

Certainly signs of the flux and restlessness Mr. Lifton describes can be found everywhere one looks. On a superficial cultural level, we are surrounded by images of shape-shifting and reinvention, from sci-fi creatures who “morph” from form to form, to children’s toys [she has in mind Transformers that metamorphose from people into vehicles]; from Madonna’s ever expanding gallery of ready-to-wear personas to New Age mystics who claim they can “channel” other people or remember “previous” lives.¹⁴

In a quite different domain, in a talk at Berkeley on the difference between the modern library culture and the new information-retrieval culture, Terry Winograd notes a series of oppositions which, when organized into a chart, show the transformation of the Modern into the Postmodern along the lines that Heidegger described. Here are a few of the oppositions that Winograd found:

<i>Library Culture</i>	<i>Information-Retrieval Culture</i>
Careful selection:	Access to everything:
a. quality of editions	a. inclusiveness of editions
b. perspicuous descriptions on cards to enable judgment	b. operational training on search engines to enable coping
c. authenticity of the text	c. availability of texts
Classification:	Diversification:
a. disciplinary standards	a. user friendliness
b. stable, organized, defined by specific interests	b. hypertext – following all lines of curiosity
Permanent collections:	Dynamic collections:
a. preservation of a fixed text	a. intertextual evolution
b. browsing	b. surfing the web

It is clear from these opposed lists that more has changed than the move from control of objects to flexibility of storage and access. What is being stored and accessed is no longer a fixed body of objects with fixed identities and contents. Moreover, the user seeking the information is not a subject who desires a more complete and reliable model of the world, but a protean being ready to be opened up to ever new horizons. In short, the postmodern human being is not interested in collecting but is constituted by connecting.

The perfect postmodern artifact is, thus, the Internet, and Sherry Turkle has described how the Net is changing the background practices that determine the kinds of selves we can be. In her recent book, *Life on the Screen: Identity in the Age of the Internet*, she details “the ability of the Internet to change popular understandings of identity.” On the Internet, she tells us, “we are encouraged to think of ourselves as fluid, emergent, decentralized, multiplicitous, and ever in process.”¹⁵ Thus “the Internet has become a significant social laboratory for experimenting with the constructions and reconstructions of self that characterize postmodern life.”¹⁶ Precisely what sort of identity does the Net encourage us to construct?

There seem to be two answers that Turkle does not clearly distinguish. She uses as her paradigm Net experience the MUD, which is an acronym for Multi-User Dungeon – a virtual space popular with adults that has its origin in a teenagers’ role-playing game. A MUD, she says, “can become a context for discovering who one is and wishes to be.”¹⁷ Thus some people explore roles in order to become more clearly and confidently themselves. The Net then functions in the old subject/object mode “to facilitate self knowledge and personal growth.”¹⁸ But, on the other

hand, although Turkle continues to use the out-dated, modernist language of personal growth, she sees that the computer and the Internet promote something totally different and new. “MUDs,” she tells us, “make possible the creation of an identity so fluid and multiple that it strains the limits of the notion.”¹⁹ Indeed, the MUD’s disembodiment and lack of commitment enables people to be many selves without having to integrate these selves or to use them to improve a single identity. As Turkle notes:

In MUDs you can write and revise your character’s self-description whenever you wish. On some MUDs you can even create a character that “morphs” into another with the command “morph.”²⁰

Once we become accustomed to the age of the Net, we shall have many different skills for identity construction, and we shall move around virtual spaces and real spaces seeking ways to exercise these skills, powers, and passions as best we can. We might imagine people joining in this or that activity with a particular identity for so long as the identity and activity are exhilarating and then moving on to new identities and activities. Such people would thrive on having no home community and no home sense of self. The promise of the Net is that we will all develop sufficient skills to do one kind of work with one set of partners and then move on to do some other kind of work with other partners. The style that would govern such a society would be one of intense, but short, involvements, and everything would be done to maintain and develop the flexible disaggregation and reaggregation of various skills and faculties. Desires and their satisfaction would give way to having the thrill of the moment.

Communities of such people would not seem like communities by today's standards. They would not have a core cadre who remained in them over long periods of time. Rather, tomorrow's communities would live and die on the model of rock groups. For a while there would be an intense effort among a group of people and an enormous flowering of talent and artistry, and then that activity would get stale, and the members would go their own ways, joining other communities.²¹ If you think that today's rock groups are a special case, consider how today's businesses are getting much work done by so-called hot groups. Notoriously, the Apple Macintosh was the result of the work of such a group. More and more products are appearing that have come about through such efforts. In such a world not only fixed identities but even desiring subjects would, indeed, have been sucked up as standing reserve.

2 Heidegger's Proposal

In order to explain Heidegger's positive response to technological things, we shall generalize Heidegger's description of the gathering power of mostly Black Forest things²² by using Borgmann's American account of what he calls focal practices. We will then be in a position to see how, given their shared view of how things and their local worlds resist technology, Borgmann's understanding of technological practices as still enmeshed with subjectivity leads him to the conclusion that technological things cannot solicit focal practices, while Heidegger's account of postmodern technological practices as radically different from modern subject/object practices enables him to see a positive role for technological things, and the practices they solicit.

In "The Thing" (1949) and "Building Dwelling Thinking" (1951), Heidegger explores a kind of gathering that would enable us to resist postmodern technological practices. In these essays, he turns from the cultural gathering he explored in "The Origin of the Work of Art" (that sets up shared meaningful differences and thereby unifies an entire culture) to local gatherings that set up local worlds. Such local worlds occur around some everyday thing that temporarily brings into their own both the thing itself and those involved in the typical activity concerning the use of the thing. Heidegger calls this event a *thing thinging* and the tendency in the practices to bring things and people into their own, *appropriation*. Albert Borgmann has usefully called the practices that support

this local gathering *focal practices*.²³ Heidegger's examples of things that focus such local gathering are a wine jug and an old stone bridge. Such things gather Black Forest peasant practices, but, as Borgmann has seen, the family meal acts as a focal thing when it draws on the culinary and social skills of family members and solicits fathers, mothers, husbands, wives, children, familiar warmth, good humor, and loyalty to come to the fore in their excellence, or in, as Heidegger would say, their ownmost.

Heidegger describes such focal practices in general terms by saying that when things thing they bring together earth and sky, divinities and mortals. When he speaks this way, his thinking draws on Hölderlin's difficult poetic terms of art; yet, what Heidegger means has its own coherence so long as we keep the phenomenon of a thing thinging before us. Heidegger, thinking of the taken-for-granted practices that ground situations and make them matter to us, calls them *earth*. In the example of the family meal we have borrowed from Borgmann, the grounding practices would be the traditional practices that produce, sustain, and develop the nuclear family. It is essential to the way these earthy practices operate that they make family gathering matter. For families, such dining practices are not simply options for the family to indulge in or not. They are the basis upon which all manifest options appear. To ground mattering such practices must remain in the background. Thus, Heidegger conceives of the earth as being fruitful by virtue of being withdrawing and hidden.

By *sky*, Heidegger means the disclosed or manifest stable possibilities for action that arise in focal situations.²⁴ When a focal situation is happening, one feels that certain actions are appropriate. At dinner, actions such as reminiscences, warm conversation, and even debate about events that have befallen family members during the day, as well as questions to draw people out are solicited. But, lecturing, impromptu combat, private jokes, and brooding silence are discouraged. What particular possibilities are relevant is determined by the situation itself.

In describing the cultural works of art that provide unified understandings of being, Heidegger was content with the categories of earth and world which map roughly on the thing's earth and sky. But when Heidegger thinks of focal practices, he also thinks in terms of *divinities*. When a focal event such as a family meal is working to the point where it has its particular integrity, one feels extraordinarily in tune with all that is happening, a special graceful ease takes over, and events seem to

unfold of their own momentum – all combining to make the moment all the more centered and more a gift. A reverential sentiment arises; one feels thankful or grateful for receiving all that is brought out by this particular situation. Such sentiments are frequently manifested in practices such as toasting or in wishing others could be joining in such a moment. The older practice for expressing this sentiment was, of course, saying grace. Borgmann expresses a similar insight when, in speaking of a baseball game as attuning people, he says:

Given such attunement, banter and laughter flow naturally across strangers and unite them into a community. When reality and community conspire this way, divinity descends on the game.²⁵

Our sense that we did not and could not make the occasion a center of focal meaning by our own effort but rather that the special attunement required for such an occasion to work has to be granted to us is what Heidegger wants to capture in his claim that when a thing things the divinities must be present. How the power of the divinities will be understood will depend on the understanding of being of the culture but the phenomenon Heidegger describes is cross-cultural.

The fourth element of what Heidegger calls the four-fold is the *mortals*. By using this term, Heidegger is describing us as disclosers and he thinks that death primarily reveals our disclosive way of being to us. When he speaks of death, he does not mean demise or a medically defined death. He means an attribute of the way human practices work that causes mortals (later Heidegger's word for people who are inside a focal practice) to understand that they have no fixed identity and so must be ready to relinquish their current identity in order to assume the identity that their practices next call them into attunement with.²⁶ Of course, one needs an account of how such a multiplicity of identities and worlds differs from the morphing and hot groups we have just been describing. We will come back to this question shortly.

So far, following Borgmann, we have described the phenomenon of a thing thinking in its most glamorized form where we experience the family coming together as an integrated whole at a particular moment around a particular event. Heidegger calls this heightened version of a thing thinking a thing “shining forth.”²⁷ But if we focus exclusively on the glamorized version, we can easily miss two other essential features of things that Heidegger attends to in “Building Dwelling Thinking.”

The first is that things thing even when we do not respond to them with full attention. For instance, when we walk off a crowded street into a cathedral, our whole demeanor changes even if we are not alert to it. We relax in its cool darkness that solicits meditateness. Our sense of what is loud and soft changes, and we quiet our conversation. In general, we manifest and become centered in whatever reverential practices remain in our post-Christian way of life. Heidegger claims that things like bridges and town squares establish location and thereby thing even in ways more privative than our cathedral example. He seems to mean that so long as people who regularly encounter a thing are socialized to respond to it appropriately, their practices are organized around the thing, and its solicitations are taken into account even when no one notices.

Instead of cathedrals, Heidegger uses various sorts of bridges as examples of things thinging but not shining. His list of bridges includes a bridge from almost every major epoch in his history of the Western understandings of being. Heidegger's account could begin with the *physis* bridge – say some rocks or a fallen tree – which just flashes up to reward those who are alert to the offerings of nature. But he, in fact, begins his list with a bridge from the age of *poiesis*: “the river bridge near the country town [that] brings wagon and horse teams to the surrounding villages.”²⁸ Then there is the bridge from high medieval times when being was understood as *createdness*. It “leads from the precincts of the castle to the cathedral square.” Oddly enough there is no bridge from the subject/object days but Borgmann has leapt into the breach with magnificent accounts of the heroic effort involved in constructing railroad bridges, and poets, starting with Walt Whitman, have seen in the massive iron structure of the Brooklyn bridge an emblem of the imposing power and optimism of America.²⁹ Such a modern bridge is solid and reliable but it is rigid and locks into place the locations it connects.

After having briefly and soberly mentioned the *poiesis* bridge, Heidegger redescribes it in the style of Black Forest kitsch for which he is infamous. “The old stone bridge's humble brook crossing gives to the harvest wagon its passage from the fields into the village and carries the lumber cart from the field path to the road.” Passages like this one seem to support Borgmann's contention that “an inappropriate nostalgia clings to Heidegger's account”³⁰ and that the things he names are “scattered and of yesterday.”³¹ And it is true that Heidegger distrusts typewriters³² phonographs, and

television.³³ Borgmann finds “Heidegger’s reflections that we have to seek out pretechnological enclaves to encounter focal things ... misleading and dispiriting.”³⁴

While Borgmann shares Heidegger’s distrust of technological *devices*, he, nonetheless, sees himself as different from Heidegger in that he finds a positive place for what he calls technological *instruments* in supporting traditional things and the practices they focus. He mentions the way hi-tech running shoes enhance running,³⁵ and one might add in the same vein that the dishwasher is a transparent technological instrument that supports, rather than interferes with or detracts from, the joys of the “great meal of the day.” Still, according to Borgmann, what gets supported can never be technological devices since such devices, by satisfying our arbitrary desires as quickly and transparently as possible, cannot focus our practices and our lives but only disperse them.³⁶

But if there were a way that technological devices could thing and thereby gather us, then one could be drawn into a positive relationship with them without becoming a resource engaged in this disaggregation and reaggregation of things and oneself and thereby losing one’s nature as a discloser. Precisely in response to this possibility, Heidegger, while still thinking of bridges, overcomes his Black Forest nostalgia and suggests a radical possibility unexplored by Borgmann. In reading Heidegger’s list of bridges from various epochs, each of which things inconspicuously “in its own way,” no one seems to have noticed the last bridge in the series. After his kitschy remarks on the humble old stone bridge, Heidegger continues: “The highway bridge is tied into the network of long-distance traffic, paced as calculated for maximum yield.”³⁷ Clearly Heidegger is thinking of the postmodern autobahn interchange, in the middle of nowhere, connecting many highways so as to provide easy access to as many destinations as possible. Surely, one might think, Heidegger’s point is that such a technological artifact could not possibly thing. Yet Heidegger continues:

Ever differently the bridge escorts the lingering and hastening ways of men to and fro ... The bridge *gathers*, as a passage that crosses, before the divinities – whether we explicitly think of, and visibly *give thanks for*, their presence, as in the figure of the saint of the bridge, or whether that divine presence is hidden or even pushed aside.³⁸

Heidegger is here following out his sense that different things thing with different modes of revealing, that is,

that each “*gathers to itself in its own way earth and sky, divinities and mortals.*”³⁹ Figuring out what Heidegger might mean here is not a question of arcane Heidegger exegesis but an opportunity to return to the difficult question we raised at the beginning: How can we relate ourselves to technology in a positive way while resisting its devastation of our essence as world disclosers? In Heidegger’s terms we must ask, How can a technological artifact like the highway bridge, dedicated as it is to optimizing options, gather the fourfold? Or, following Borgmann’s sense of the phenomenon, we can ask how could a technological device like the highway bridge give one’s activity a temporary focus? Granted that the highway bridge is a flexible resource, how can we get in tune with it without becoming flexible resources ourselves? How can mortals morph?

To answer this question about how we can respond to technology as disclosers or mortals, we must first get a clear picture of exactly what it is like to be turned into resources responding to each situation according to whichever of our disaggregated skills is solicited most strongly. We can get a hint of what such optimizing of disaggregated skills looks like if we think of the relations among a pack of today’s teenagers. When a group of teenagers wants to get a new CD, the one with the car (with the driving skills and capacity) will be most important until they get to the store; then the one with the money (with purchasing skills and capacity) will lead; and then when they want to play the CD, the one with the CD player (with CD playing skills and capacity) will be out front. In each moment, the others will coordinate themselves to bring out maximally whatever other relevant skills (or possessions) they have such as chatting pleasantly, carrying stuff, reading maps, tuning the car radio, making wisecracks, and scouting out things that could be done for free. Consequently, they will be developing these other skills too.

If people lived their whole lives in this improvising mode, they would understand themselves only in terms of the skills that made the most sense at the moment. They would not see themselves as having a coordinated network of skills, but only in being led by chance to exercise some skill or other. Hence, they would not experience themselves as satisfying desires so much as getting along adaptably. Satisfying a desire here and there might be some small part of that.

If we now turn back to the autobahn “bridge” example, we can see the encounter with the interchange as a chance to let different skills be exercised. So on a sunny

day we may encounter an interchange outside of Freiburg as we drive to a meeting in town as soliciting us to reschedule our meeting at Lake Constance. We take the appropriate exit and then use our cellular phone to make sure others do the same.

We can begin to understand how Heidegger thinks we can respond to technological things without becoming a collection of disaggregated skills, if we ask how the bridge could gather the fourfold. What is manifest like the *sky* are multiple possibilities. The interchange connects anywhere to anywhere else – strictly speaking it does not even connect two banks. All that is left of *earth* is that it matters that there are such possibilities, although it does not matter that there are these specific ones. But what about the *divinities*? Heidegger has to admit that they have been pushed aside. As one speeds around a clover leaf one has no pre-modern sense of having received a gift. Neither is there a modern sense, such as one might experience on a solid, iron railroad bridge, that human beings have here achieved a great triumph. All one is left with is a sense of flexibility and excitement. One senses how easy it would be to go anywhere. If one is in tune with technological flexibility, one feels *lucky* to be open to so many possibilities.

We can see that for Heidegger the interchange bridge is certainly not the best kind of bridge but it does have its style, and one can be sensitive to it in the way it solicits. The next question is, whether in getting in tune with the, thinking of the highway bridge one is turned into a resource with no stable identity and no world that one is disclosing or whether one still has some sense of having an identity and of contributing to disclosing. This is where Heidegger's stress on our being *mortals* becomes essential. To understand oneself as mortal means to understand one's identity and world as fragile and temporary and requiring one's active engagement. In the case of the highway bridge, it means that, even while getting in tune with being a flexible resource, one does not understand oneself as being a resource all the time and everywhere. One does not always feel pressured, for instance, to optimize one's vacation possibilities by refusing to get stuck on back roads and sticking to the interstates. Rather, as one speeds along the overpass, one senses one's mortality, namely that one has other skills for bringing out other sorts of things, and therefore one is never wholly a resource.⁴⁰

We have just described what may seem to be a paradox. We have said that even a technological thing may gather together earth, sky, mortals, and maybe even divinities,

which are supposed to be the aspects of practices that gather people, equipment, and activities into local worlds, with roles, habitual practices, and a style that provide disclosers with a sense of integrity or centeredness. But technological things notoriously disperse us into a bunch of disaggregated skills with a style of flexible dispersion. So what could they gather into a local world? There is only one answer here. Neither equipment nor roles could be gathered, but the skills for treating ourselves as disaggregated skills and the world as a series of open possibilities are what are drawn together so that various dispersed skillful performances become possible.

But if we focus on the skills for dispersing alone, then the dangerous seduction of technology is enhanced. Because the word processor makes writing easy for desiring subjects and this ease in writing solicits us to enter discourses rather than produce finished works, the word processor attached to the Net solicits us to substitute it for pens and typewriters, thereby eliminating the equipment *and the skills* that were appropriate for modern subject/object practices. It takes a real commitment to focal practices based on stable subjects and objects to go on writing personal letters with a fountain pen and to insist that papers written on the word processor must reach an elegant finish. If the tendency to rely completely on the flexibility of technological devices is not resisted, we will be left with only one kind of writing implement promoting one style of practice, namely those of endless transformation and enhancement. Likewise, if we live our lives in front of our home entertainment centers where we can morph at will from being audiophiles to sports fans to distance learners, our sense of being mortals who can open various worlds and have various identities will be lost as we, indeed, become pure resources.⁴¹

Resistance to technological practices by cultivating focal practices is the primary solution Borgmann gives to saving ourselves from technological devastation. Borgmann cannot find anything more positive in technology – other than indulging in good running shoes and a Big Mac every now and then – because he sees technology as the highest form of subjectivity. It may fragment our identities, but it maintains us as desiring beings not world disclosers. In contrast, since Heidegger sees technology as disaggregating our identities into a contingently built up collection of skills, technological things solicit certain skills without requiring that we take ourselves as having one style of identity or another. This absence of identity may make our mode of

being as world disclosers impossible for us. This would be what Heidegger calls the greatest danger. But this absence of an identity also allows us to become sensitive to the various identities we have when we are engaged in disclosing the different worlds focused by different styles of things. For, although even dispersive technological skills will always gather in some fashion as they develop, the role of mortals as active world disclosers will only be preserved if it is at least possible for the gathering of these background skills to be experienced as such. And this experience will only be possible in technology if one can shift back and forth between pre-technological identities with their style of coping and a technological style. As such disclosers we can then respond to technological things as revealing one kind of world among others. Hence, Heidegger's view of technology allows him to find a positive relation to it, but only so long as we maintain skills for disclosing other kinds of local worlds. Freeing us from having a total fixed identity so that we may experience ourselves as multiple identities disclosing multiple worlds is what Heidegger calls technology's saving power.⁴²

We have seen that for Heidegger being gathered by and nurturing non-technological things makes possible being gathered by technological things. Thus, living in a plurality of local worlds is not only desirable, as Borgmann sees, but is actually necessary if we are to give a positive place to technological devices. Both thinkers must, therefore, face the question that Borgmann faces in his recent book, as to how to live in a plurality of communities of focal celebration. If we try to organize our lives so as to maximize the number of focal worlds we dwell in each day, we will find ourselves teaching, then running, then making dinner, then clearing up just in time to play chamber music. Such a controlling approach will produce a subject that is always outside the current world, planning the next. Indeed such willful organization runs against the responsiveness necessary for dwelling in local worlds at all. But if, on the other hand, one goes from world to world fully absorbed in each and then fully open to whatever thing grabs one next, one will exist either as a collection of unrelated selves or as no self at all, drifting in a disoriented way among worlds. To avoid such a morphing or empty identities, one wants a life where engaging in one focal practice leads naturally to engaging in another – a life of affiliations such that one regularly is solicited to do the next focal thing when the current one is becoming irrelevant. Borgmann has intimations of such a life:

Musicians recognize gardeners; horse people understand artisans....The experience of this kinship ... opens up a wider reality that allows one to refocus one's life when failing strength or changing circumstances withdraw a focal thing.⁴³

Such a plurality of focal skills not only enables one to move from world to world; it gives one a sort of poly-identity that is neither the identity of an arbitrary desiring subject nor the rudderless adaptability of a resource.

Such a kinship of mortals opens new possibilities for relations among communities. As Borgmann says:

People who have been captivated by music ... will make music themselves, but they will not exclude the runners or condemn the writers. In fact, they may run and write themselves or have spouses or acquaintances who do. There is an interlacing of communities of celebration.⁴⁴

Here, we suspect, we can find a positive place for technological devices. For there is room in such interconnecting worlds not only for a joyful family dinner, writing to a life-long friend, and attending the local concert but also for surfing on the Internet and happily zipping around an autobahn cloverleaf in tune with technology and glad that one is open to the possibilities of connecting with each of these worlds and many others.

But Borgmann does not end with his account of the interlacing of communities, which is where Heidegger, when he is thinking of things thinging, would end. Borgmann writes:

To conclude matters in this way ... would suppress a profound need and a crucial fact of communal celebration, namely religion. People feel a deep desire for comprehensive and comprehending orientation.⁴⁵

Borgmann thinks that, fortunately, we postmoderns are more mature than former believers who excluded communities other than their own. Thus we can build a world that promotes both local worlds and a "community of communities" that satisfies everyone's need for comprehensiveness. To accept the view that our concerns form what Borgmann calls a *community of communities* is to embrace one, overarching understanding of being of the sort that Heidegger in his middle period hoped might once again shine forth in a unifying cultural paradigm. So we find that Borgmann, like middle Heidegger, entertains the possibility that "a hidden center of these dispersed focuses may emerge some

day to unite them.”⁴⁶ Moreover, such a focus would “surpass the peripheral ones in concreteness, depth, and significance.”⁴⁷

Heidegger’s thinking until 1955, when he wrote “The Question Concerning Technology,” was like Borgmann’s current thinking in that for him preserving things was compatible with awaiting a single God.⁴⁸ Heidegger said as early as 1946 that the divinities were traces of the lost godhead.⁴⁹ But Heidegger came to think that there was an essential antagonism between a unified understanding of being and local worlds. Of course, he always realized that there would be an antagonism between the style set up by a cultural paradigm and things that could only be brought out in their ownness in a style different from the dominant cultural style. Such things would inevitably be dispersed to the margins of the culture. There, as Borgmann so well sees, they will shine in contrast to the dominant style but will have to resist being considered irrelevant or even wicked.⁵⁰ But, if there is a single understanding of being, even those things that come into their own in the dominant cultural style will be inhibited as things. Already in his “Thing” essay Heidegger goes out of his way to point out that, even though the original meaning of “thing” in German is a gathering to discuss a matter of concern to the community, in the case of the thing thinging, the gathering in question must be self contained. The focal occasion must determine which community concerns are relevant rather than the reverse.⁵¹

Given the way local worlds establish their own internal coherence that resists any imposition from outside there is bound to be a tension between the glorious cultural paradigm that establishes an understanding of being for a whole culture and the humble inconspicuous things. The shining of one would wash out the shining of the others. The tendency toward one unified world would impede the gathering of local worlds. Given this tension, in a late seminar Heidegger abandoned what he had considered up to then his crucial contribution to philosophy, the notion of a single understanding of being and its correlated notion of the ontological difference between being and beings. He remarks that “from the perspective of appropriation [the tendency in the practices to bring things out in their ownmost] it becomes necessary to free thinking from the ontological difference.” He continues, “From the perspective of appropriation, [letting-presence] shows itself as the relation of world and thing, a relation which could in a way be understood as the relation of being and beings. But then its peculiar quality would be lost.”⁵² What presumably would be lost would be the self-enclosed local character of worlds focused by things thinking. It follows that, as mortal disclosers of worlds in the plural, the only integrity we can hope to achieve is our openness to dwelling in many worlds and the capacity to move among them. Only such a capacity allows us to accept Heidegger’s and Borgmann’s criticism of technology and still have Heidegger’s genuinely positive relationship to technological things.

Notes

An earlier version of this essay was delivered as the 1996 Bugbee Lecture at the University of Montana. We would like thank Albert Borgmann, David Hoy, and Julian Young for their helpful comments on earlier drafts of this paper.

- 1 Martin Heidegger, *Discourse on Thinking*, trans. John M. Anderson and E. Hans Freund (New York: Harper & Row, 1966) 54.
- 2 Heidegger’s main example of cultural paradigms are works of art, but he does allow that there can be other kinds of paradigm, Truth, or the cultural paradigm, can also establish itself through the actions of a god, a statesman, or a thinker.
- 3 Martin Heidegger, *Nietzsche*, Vol. 4 (New York: Harper & Row, 1982) 28.
- 4 Martin Heidegger, “What are Poets For?” *Poetry, Language, Thought* (New York: Harper & Row, 1971) 112.
- 5 Martin Heidegger, “The Question Concerning Technology,” *The Question Concerning Technology and Other Essays*, trans. William Lovitt (New York: Harper & Row, 1977) 5.
- 6 Heidegger, “The Question Concerning Technology” 17.
- 7 Albert Borgmann, *Crossing the Postmodern Divide* (Chicago: University of Chicago Press, 1992) 88.
- 8 Borgmann, *Crossing* 108.
- 9 Martin Heidegger, “Science and Reflection,” *The Question Concerning Technology and Other Essays* 173.
- 10 Heidegger, “The Question Concerning Technology” 16 (emphasis ours).
- 11 See Martin Heidegger, “On the Way to Language” (1959), trans. Peter D. Hertz, *On the Way to Language* (New York: Harper & Row, 1971) 132. See also Martin Heidegger, “Memorial Address” (1959), *Discourse on Thinking*,

- trans. John M. Anderson and E. Hans Freund (New York: Harper, 1966) 46.
- 12 Martin Heidegger, *What is Called Thinking?*, trans. Fred D. Wieck and J. Glenn Gray (New York: Harper & Row, 1968) 104–109.
 - 13 Robert Jay Lifton as quoted by Michiko Kakutani, “When Fluidity Replaces Maturity,” *New York Times*, 20 March 1995, C 11.
 - 14 Michiko Kakutani, “When Fluidity Replaces Maturity.”
 - 15 Sherry Turkle, *Life on the Screen: Identity in the Age of the Internet* (New York: Simon & Schuster, 1995) 263–264.
 - 16 Turkle, 180.
 - 17 Turkle, 180.
 - 18 Turkle, 185.
 - 19 Turkle, 12.
 - 20 Turkle, 192.
 - 21 In his account of brief habits, Nietzsche describes a life similar to moving from one hot group to another. Brief habits are neither like long-lasting habits that produce stable identities, nor like constant improvisation. For Nietzsche, the best life occurs when one is fully committed to acting out of one brief habit until it becomes irrelevant and another takes over. See Friedrich Nietzsche, *The Gay Science*, trans. Walter Kaufmann (New York: Vintage, 1974) §295, 236–237.
 - 22 Martin Heidegger, “The Thing,” in *Poetry, Language, Thought*, 182.
 - 23 Albert Borgmann, *Technology and the Character of Contemporary Life* (Chicago: University of Chicago Press, 1984) 196–210.
 - 24 Martin Heidegger, “Building Dwelling Thinking,” *Poetry, Language, Thought* 149.
 - 25 Borgmann, *Crossing the Postmodern Divide* 135.
 - 26 Heidegger, “The Thing,” *Poetry, Language, Thought* 178–179.
 - 27 Heidegger, “The Thing” 182.
 - 28 Heidegger, “Building Dwelling Thinking” 152.
 - 29 Borgmann, *Crossing the Postmodern Divide*, 27–34.
 - 30 Borgmann, *Technology and the Character of Contemporary Life* 196.
 - 31 Borgmann, *Technology and the Character of Contemporary Life* 199.
 - 32 Martin Heidegger, *Parmenides*, trans. Andre Schuwer and Richard Rojcewicz (Bloomington: Indiana University Press, 1992) 85.
 - 33 See Footnote #41.
 - 34 Borgmann, *Technology and the Character of Contemporary Life* 200.
 - 35 Borgmann, *Technology and the Character of Contemporary Life* 221.
 - 36 In an attempt to overcome the residual nostalgia in any position that holds that technological devices can never have a centering role in a meaningful life, Robert Pirsig has argued in *Zen and the Art of Motorcycle Maintenance* that, if properly understood and maintained, technological devices can focus practices that enable us to live in harmony with technology. Although the motorcycle is a technological device, understanding and caring for it can help one to resist the modern tendency to use whatever is at hand as a commodity to satisfy one’s desires and then dispose of it. But, as Borgmann points out, this saving stance of understanding and maintenance is doomed as our devices, for example computers, become more and more reliable while being constructed of such minute and complex parts that understanding and repairing them is no longer an option.
 - 37 Heidegger, “Building Dwelling Thinking” 152.
 - 38 Heidegger, “Building Dwelling Thinking” 152–153.
 - 39 Heidegger, “Building Dwelling Thinking” 153.
 - 40 If we take the case of writing implements, we can more clearly see both the positive role that can be played by technological things as well as the special danger they present to which Borgmann has made us sensitive. Like bridges, the style of writing implements reflects their place in the history of being. The fountain pen solicits us to write to someone for whom the personality of our handwriting will make a difference. When involved in the practices that make the fountain pen seem important, we care about such matters as life plans, stable identities, character, views of the world, and so on. We are subjects dealing with other subjects. A typewriter, however, will serve us better if we are recording business matters or writing factual reports simply to convey information. A word processor hooked up to the Net with its great flexibility solicits us to select from a huge number of options in order to produce technical or scholarly papers that enter a network of conversations. And using a word processor one cannot help but feel lucky that one does not have to worry about erasing, retyping, literally cutting and pasting to move text around, and mailing the final product. But, as Borgmann points out, a device is not neutral; it affects the possibilities that show up for us. If one has a word processor and a modem, the text no longer appears to be a piece of work that one finishes and then publishes. It evolves through many drafts none of which is final. Circulating texts on the Net is the culmination of the dissolution of the finished object, where different versions (of what would have before been called a single text) are contributed to by many people. With such multiple contributions, not only is the physical work dispersed but so is the author. Such authorial dispersion is a part of the general dispersion of identity that Sherry Turkle describes.
 - 41 Heidegger writes in “The Thing:”

- Man ... now receives instant information, by radio, of events which he formerly learned about only years later, if at all. The germination and growth of plants, which remained hidden throughout the seasons, is now exhibited publicly in a minute, on film. Distant sites of the most ancient cultures are shown on film as if they stood this very moment amidst today's street traffic.... The peak of this abolition of every possibility of remoteness is reached by television, which will soon pervade and dominate the whole machinery of communication. (165)
- 42 Martin Heidegger, "The Turning," *The Question Concerning Technology and Other Essays* 43, where Heidegger claims that our turning away from a technological understanding of being will, at least initially, be a matter of turning to multiple worlds where things thing.
- 43 Borgmann, *Crossing the Postmodern Divide* 122.
- 44 Borgmann, *Crossing the Postmodern Divide* 141.
- 45 Borgmann, *Crossing the Postmodern Divide* 144.
- 46 Borgmann, *Technology and the Character of Contemporary Life* 199.
- 47 Borgmann, *Technology and the Character of Contemporary Life* 218.
- 48 Heidegger, "The Question Concerning Technology" 33–35.
- 49 Heidegger, "What are Poets For?" 97.
- 50 Borgmann, *Technology and the Character of Contemporary Life*, 212.
- 51 To put this in terms of meals, we can remember that in Virginia Woolf's *To the Lighthouse* arguments about politics brought in from outside almost ruin Mrs. Ramsay's family dinner which only works when the participants become so absorbed in the food that they stop paying attention to external concerns and get in tune with the actual occasion. The same thing happens in the film *Babette's Feast*. The members of an ascetic religious community go into the feast resolved to be true to their dead founder's principles and not to enjoy the food. Bickering and silence ensues until the wine and food makes them forget their founder's concerns and attunes them to the past and present relationships that are in accord with the gathering.
- 52 Martin Heidegger, "Summary of a Seminar on the Lecture 'Time and Being,'" *On Time and Being*, trans. Joan Stambaugh (New York: Harper Torch-book, 1972) 37.

Philosophy of Technology at the Crossroads: Critique of Heidegger and Borgmann

Andrew Feenberg

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

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

On the other hand, those few philosophers, notably Albert Borgmann, who continue the earlier interrogation

of technology have hesitated to assimilate the advances of the new technology studies. They remain faithful to the determinist premises of an earlier generation of founders of the field, such as Ellul, Heidegger, and the Frankfurt School. For these thinkers modernity continues to be characterized by a unique form of technical action and thought that threatens nontechnical values as it extends itself ever deeper into social life. They argue that technology is not neutral. The tools we use shape our way of life in modern societies where technique has become all-pervasive. The results of this process are disastrous: the triumph of technological thinking, the domination of nature, and the shattering of community. On this account, modernity is fundamentally flawed.

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

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a theory of modernity without losing the conceptual space opened by social science for imagining a radically different technological future.

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

Heidegger

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

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

Translated out of Heidegger's ontological language, this seems to mean that technology is a cultural form

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

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

Heidegger's basic claim that we are caught in the grip of our own techniques is thus all too believable. Increasingly, we lose sight of what is sacrificed in the mobilization of human beings and resources for goals that remain ultimately obscure. So far so good. But there are significant ambiguities in Heidegger's approach. He warns us that the essence of technology is nothing technological; that is to say, technology cannot be understood through its usefulness, but only through our specifically technological engagement with the world. But is that engagement merely an attitude or is it embedded in the actual design of modern technological devices? In the former case, we could achieve the "free relation" to technology that Heidegger demands without changing technology itself. But that is an idealistic solution in the bad sense, and one that a generation of environmental action would seem decisively to refute.

Heidegger's defenders point out that his critique of technology is not concerned merely with human attitudes but also with the way being reveals itself. Again roughly translated out of Heidegger's language, this means that the modern world has a technological form

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

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

A Contemporary Critique

Technology and meaning

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

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

a traditional kitchen serving the needs of a whole family.

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

The unity of the family, ritually reaffirmed each evening, no longer has a comparable locus of expression. One need not claim that the rise of fast food causes the decline of the traditional family to believe that there is a significant connection. Simplifying personal access to food scatters people who need no longer construct the rituals of everyday interaction around the necessities of daily living. Focal things require a certain effort, it is true, but without that effort, the rewards of a meaningful life are lost in the vapid disengagement of the operator of a smoothly functioning machinery (Borgmann 1984, 204 ff.).

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

Borgmann's critique of technological society usefully concretizes themes in Heidegger. His dualism of device and meaning is also structurally similar to Habermas's distinction of work and interaction (Habermas 1970). This dualism always seems to appear where the essence of technology is in question.⁶ It offers a way of theorizing the larger philosophical significance of the modernization process, and it reminds us of the existence of dimensions of human experience that are suppressed by facile scientism and the uncritical celebration of technology. Borgmann's contrast between the decontextualization of the device and the essentially contextual focal thing reprises Heidegger's distinction between modern technological enframing and the "gathering" power of traditional craft production that draws people and nature together around a materialized site of encounter. Borgmann's solution, bounding the technical sphere to

restore the centrality of meaning, is reminiscent of Habermas's strategy (although apparently not due to his influence). It offers a more understandable response to invasive technology than anything in Heidegger.

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

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

Interpreting the computer

I would like to pursue this contention further with a specific example that illustrates concretely my reasons for objecting to Borgmann's approach. The example I have chosen, human communication by computer, is one on which Borgmann has commented fairly extensively.

While not everyone who shares the essentialist view will agree with his very negative conclusions, his position adequately represents that style of technology critique and is therefore worth evaluating here at some length.⁷

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

Plugged into the network of communications and computers, they seem to enjoy omniscience and omnipotence; severed from their network, they turn out to be insubstantial and disoriented. They no longer command the world as persons in their own right. Their conversation is without depth and wit; their attention is roving and vacuous; their sense of place is uncertain and fickle. (Borgmann 1992, 108)

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

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

In the first place, the computer was not destined by some inner technologic to serve as a communications medium. The major networks, such as the French Teletel or the Internet were originally conceived by technocrats

and engineers as instruments for the distribution of data. What actually happened in the course of the implementation of these networks? Users appropriated them for unintended purposes and converted them into communications media. Soon they were flooded with messages that were considered trivial or offensive by their creators. Teletel quickly became the world's first and largest electronic singles bar (Feenberg 1995, chap. 7). The Internet is overloaded with political debates dismissed as "trash" by unsympathetic critics. Less visible, at least to journalists, but more significant, there gradually appeared all sorts of other applications of computers to human communication, from business meetings to education, from discussions among medical patients, literary critics, and political activists to online journals and conferences.

How does Borgmann's critique fare in the light of this history? It seems to me there is an element of ingratitude in it. Because Borgmann takes it for granted that the computer is useful for human communication, he appreciates neither the process of making it so nor the hermeneutic transformation it underwent in that process. He therefore also overlooks the political implications of the history sketched above. Today the networks constitute a fundamental scene of human activity. To impose a narrow regimen of data transmission, to the exclusion of all human contact, would surely be perceived as totalitarian in any ordinary institution. Why is it not a liberation to break such limitations in the virtual world that now surrounds us?

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

Consider for example the discussion group on the Prodigy Medical Support Bulletin Board devoted to ALS (amyotrophic lateral sclerosis or Lou Gehrig's disease). In 1995, when I studied it, there were about five hundred patients and caregivers reading exchanges in which some dozens of participants were actively engaged (Feenberg

et al. 1996). Much of the conversation consisted of exchanges of feelings about dependency, illness, and dying. There was a long running discussion of problems of sexuality. Patients and caregivers wrote in both general and personal terms about the persistence of desire and the obstacles to satisfaction. The frankness of this discussion may owe something to the anonymity of the online environment, appropriated here for very different purposes than those Borgmann criticizes. Here the very limitations of the medium open doors that might have remained closed in a face-to-face setting.

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

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

Borgmann's critique of technology pursues the larger connections and social implications masked by the

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

I propose a very different conceptualization that includes the integration of technologies to larger technical systems and nature, and to the symbolic orders of ethics and aesthetics, as well as their relation to the life and learning processes of workers and users and the social organization of work and use. On the essentialist account, one could still admit the existence of these aspects of technical life, but they would be extrinsic social influences or consequences. Essentialism proposes to treat all these dimensions of technology as merely contingent and to hand them over to sociology while retaining the unchanging essence for philosophy. A certain conception of philosophy is implied in this approach.

Instrumentalization Theory

The irony of Parmenides

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

is a radical redefinition of technology that crosses the usual line between artifacts and social relations assumed by common sense and philosophers alike.

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

I now attempt to work out this historical concept of essence as it applies to technology. Is the result still sufficiently “philosophical” to qualify as philosophy? In claiming that it is, I realize that I am challenging a certain prejudice against the concrete that is an occupational hazard of philosophy. Plato is usually blamed for this, but in a late dialogue Parmenides mocks the young Socrates’ reluctance to admit that there are ideal forms of “hair or mud or dirt or any other trivial and undignified objects” (Cornford 1957, 130C–E).¹⁰ Surely the time has come to let the social dimension of technology into the charmed circle of philosophical reflection. Let me now offer, if only schematically, a way of achieving this.

Primary instrumentalization: Functionalization

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

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

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

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

Decontextualization. To reconstitute natural objects as technical objects, they must be de-worlded, artificially separated from the context in which they are originally found so as to be integrated to a technical system. The isolation of the object exposes it to a utilitarian evaluation. The tree conceived as lumber and eventually cut down, stripped of bark, and chopped into boards is

encountered through its usefulness rather than in all its manifold interconnections with its environment and the other species with which it coexists. The isolated object reveals itself as containing technical schemas, potentials in human action systems, which are made available by decontextualization. Thus inventions such as the knife or the wheel take qualities such as the sharpness or roundness of some natural thing, a rock or tree trunk, for example, and release them as technical properties. The role these qualities may have played in nature is obliterated in the process. Nature is fragmented into usable bits and pieces that appear as technically useful after being abstracted from all specific contexts.

Reductionism. Reductionism refers to the process in which the de-worlded things are simplified, stripped of technically useless qualities, and reduced to those aspects through which they can be enrolled in a technical network. These are the qualities of primary importance to the technical subject, the qualities perceived as essential to the accomplishment of a technical program. I will therefore call them “primary qualities,” it being understood that their primacy is relative to the subject’s program. Quantification is the most complete reduction to primary qualities. “Secondary qualities” are what remains, including those dimensions of the object that may have been most significant in the course of its pretechnical history. The secondary qualities of the object contain its potential for self-development. The tree trunk, reduced to its primary quality of roundness in becoming a wheel, loses its secondary qualities as a habitat, a source of shade, and a living, growing member of its species. The Heideggerian enframing is the reduction of all of reality to such primary qualities.

Autonomization. The subject of technical action isolates itself as much as possible from the effects of its action on its objects. Metaphorically speaking, it thus violates Newton’s third law, according to which “for every action there is an equal and opposite reaction.” The actor and the object in mechanics belong to the same system, hence the reciprocity of their relations. This is not a bad description of ordinary human interactions. A friendly remark is likely to elicit a friendly reply, a rude one, a correspondingly unpleasant response. By contrast, technical action “autonomizes” the subject. This is accomplished by interrupting the feedback between the object and the actor. In an apparent exception to Newton’s law, the technical subject has a big impact on the world, but the world has only a very small return impact on the subject. The hunter experiences a slight

pressure on his shoulder as the bullet from his gun strikes the rabbit; the driver hears a faint rustling in the wind as he hurtles a ton of steel down the highway. Administrative action too, as a technical relationship between human beings, presupposes the autonomization of the manager as subject.

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

Secondary instrumentalization: Integration

The primary instrumentalization lays out in skeletal fashion the basic technical relations. Far more is necessary for those relations to yield an actual system or device: technique must be *integrated* with the natural, technical, and social environments that support its functioning. The process of integration compensates for some of the reifying effects of the primary instrumentalization. Here technical action turns back on itself and its actors as it is realized concretely. In the process, it reappropriates some of the dimensions of contextual relatedness and self-development from which abstraction was

originally made in establishing the technical relation. The underdetermination of technological development leaves room for social interests and values to participate in the process of realization. As decontextualized elements are combined, these interests and values assign functions, orient choices, and ensure congruence between technology and society at the technical level itself.

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

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

Mediation. In all societies, ethical and aesthetic mediations supply the simplified technical object with secondary qualities that seamlessly embed it into its new social context. The ornamentation of artifacts and their investment with ethical meaning are integral to production in all traditional cultures. The choice of a type of stone or feather in the making of an arrow may be motivated not only by sharpness and size, but also by various ritual considerations that yield an aesthetically and ethically expressive object. Heidegger's chalice exemplifies such expressive design. By contrast, production and aesthetics are differentiated in modern industrial societies. The goods are produced first, and then superficially styled and packaged for distribution. The social insertion of the industrial object appears as an afterthought. From this results the unfortunate separation of technique and aesthetics characteristic of our societies; unfortunate, I would argue, because no one denies the prevailing ugliness of so much of our

work and urban environment. Ethical limits too are overthrown in the breakdown of religious and craft traditions. Recently, medical advances and environmental crises have inspired new interest in the ethical limitation of technical power. These limitations are eventually embodied in modified designs that condense considerations of efficiency with ethical values. A similar condensation appears in the aesthetics of good industrial design. Thus mediations remain an essential aspect of the technical process even in modern societies.

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

Initiative. Finally, strategic control of the worker and consumer through positioning is to some extent compensated by various forms of tactical initiative on the part of the individuals submitted to technical control. Before the rise of capitalist management, cooperation was often regulated by tradition or paternal authority, and the uses of the few available devices so loosely prescribed that the line between producer programs and user appropriations was often blurred. It is capitalism that has led to the sharp split between positioning and initiative, and the marginalization of the latter. Nevertheless, a certain margin of maneuver belongs to subordinated

positions in the capitalist technical hierarchy. That margin can support conscious cooperation in the coordination of effort and creative user appropriation of devices and systems.

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

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

Capitalism and Substantive Theory of Technology

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

capitalism to its social and natural environment that frees the entrepreneur to extend technical control to the labor force, the organization of work, and aspects of the natural environment that were formerly protected from interference by custom and tradition.¹⁴ To define technology as such on these terms is ethnocentric.

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

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

Similarly, the old craft guilds with their collegial forms of organization have been replaced by capitalist management. Collegiality, like vocational investment in work, survives only in a few specialized and archaic settings such as universities. Not the essence of technology but the requirements of capitalist economics explain this outcome (Braverman 1974; Noble 1984). A different social system that restored the role of the secondary instrumentalizations would determine a different type of technical development in which it would be possible to recover these traditional technical values and organizational forms in new ways. Thus reform of this society would involve

not merely limiting the reach of the technical, but building on its intrinsic democratic potential.

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

Conclusion: The Gathering

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

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

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

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

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

Notes

- 1 See, for examples, Pinch, Hughes, and Bijker 1989.
- 2 For an exception, see Latour 1993.
- 3 In a 1949 lecture, Heidegger explained: "Agriculture is now the mechanized food industry, in essence the same as the manufacturing of corpses in gas chambers and extermination camps, the same as the blockade and starvation of nations, the same as the production of hydrogen bombs" (quoted in Rockmore 1992, 241).
- 4 I would of course be willing to revise this view if shown how Heidegger actually envisages technological change. What I have heard from his defenders is principally waffling on the attitude/device ambiguity described here. Yes, Heidegger envisages change in "technological thinking," but how is this change supposed to affect the design of actual devices? The lack of an answer to this question leaves me in some doubt as to the supposed relevance of Heidegger's work to ecology. One enthusiastic defender informed me that art and technique would merge anew in a Heideggerian future, but was unable to cite a text. That would indeed historicize Heidegger's theory, but in a way resembling Marcuse's position in *An Essay on Liberation* (1969) with its eschatological concept of an aesthetic revolution in technology. It is not clear how the case for Heidegger is fundamentally improved by this shift, which would not make much difference to the substantive arguments presented here. For an interesting defense of Heidegger's theory of technology that eschews mystification, see Dreyfus 1995.
- 5 For another interesting contemporary approach that complements Borgmann's, see Simpson 1995. Simpson denies that he is essentializing technology, and yet he works throughout his book with a minimum set of invariant characteristics of technology as though they constituted a "thing" he could talk about independent of the socio-historical context (Simpson 1995, 15–16, 182). That context is then consigned to a merely contingent level of influences, conditions, or consequences rather than being integrated to the conception of technology itself.
- 6 In the next part of this paper I will attempt to resituate this dualism within technology itself, to avoid the ontologized distinctions characteristic of essentialism.
- 7 For another critique of the computer similar to Borgmann's, see Slouka 1995.
- 8 Andrew Light has argued that I underestimate the significance of Borgmann's distinction between device and thing for an understanding of the aesthetics of everyday life. The distinction is useful for developing a critique of mass culture and could provide criteria for subversive rationalizations of the commodified environment. The story of the ALS patients told here could be interpreted in this light as an example of the creation of a meaningful community through the creative appropriation of the hyperreal technological universe Borgmann describes (Light 1996, chap. 9). I am in general agreement with this revision of Borgmann's position, but in some doubt as to whether Borgmann himself would be open to it.

- 9 Like the turtles in Feynman's famous story, the hermeneutics of technology "goes all the way down."
- 10 Compare Latour's account of a similar episode involving Heraclitus (Latour 1993, 65–66).
- 11 Many of the ideas in this section and the next were first presented in an earlier version in Feenberg (1991, chap. 8).
- 12 Thus considered as just a thing, an automobile is no better parked with its wheels on the ground than in the air. It is only insofar as it is *assigned* a function that it must be considered as a technical device and placed squarely right side up. The spontaneous confusion between these two levels is no doubt less likely in non-Western societies. One who lives in a Japanese home with both tatami mat and wooden floors is well aware that what's underfoot is not just a thing on which to walk but also a whole national tradition.
- 13 For a discussion of this theme in the context of modern production, see Hirschhorn 1984.
- 14 It is important to resist the temptation to dismiss capitalism as a factor on the grounds that Soviet communism and its imitators did no different and no better. These regimes never constituted an alternative; they followed the capitalist example in essential respects, importing technology and management methods, and in some cases, such as protection of the environment, carrying its irresponsibility even further. I have discussed this problem in more detail in Feenberg 1991, chap. 6.
- 15 For a discussion of that tradition as it shapes philosophy of technology, see Mitcham 1994.

References

- Borgmann, Albert. 1984. *Technology and the Character of Contemporary Life: A Philosophical Inquiry*. Chicago: University of Chicago Press.
- Borgmann, Albert. 1992. *Crossing the Postmodern Divide*. Chicago: University of Chicago Press.
- Braverman, Harry. 1974. *Labor and Monopoly Capital*. New York: Monthly Review.
- Cornford, Francis. 1957. *Plato and Parmenides*. New York: Liberal Arts Press.
- Dreyfus, Hubert. 1995. "Heidegger on Gaining a Free Relation to Technology." In *Technology and the Politics of Knowledge*. Ed. Andrew Feenberg and Alastair Hannay. Bloomington: Indiana University Press.
- Epstein, Steven. 1996. *Impure Science: AIDS, Activism, and the Politics of Knowledge*. Berkeley and Los Angeles: University of California Press.
- Feenberg, Andrew. 1986. *Lukács, Marx, and the Sources of Critical Theory*. New York: Oxford University Press.
- Feenberg, Andrew. 1991. *Critical Theory of Technology*. New York: Oxford University Press.
- Feenberg, Andrew. 1995. *Alternative Modernity: The Technical Turn in Philosophy and Social Theory*. Berkeley and Los Angeles: University of California Press.
- Feenberg, Andrew, J. Licht, K. Kane, K. Moran, and R. Smith. 1996. "The Online Patient Meeting." *Journal of the Neurological Sciences* 139: 129–31.
- Gras, Alain. 1994. *Grandeur et dépendence: Sociologie des macro-systèmes techniques*. Paris: Presses Universitaires de France.
- Habermas, Jürgen. 1970. "Technology and Science as Ideology." In *Toward a Rational Society*. Trans. Jeremy Shapiro. Boston: Beacon Press.
- Harasim, Linda, Star Roxanne Hiltz, Lucio Teles, and Murray Turoff. 1995. *Learning Networks: A Field Guide to Teaching and Learning Online*. Cambridge: MIT Press.
- Heidegger, Martin. 1959. *An Introduction to Metaphysics*. New York: Doubleday Anchor.
- Heidegger, Martin. 1971. "The Thing." In *Poetry, Language, and Thought*. Trans. Albert Hofstadter. New York: Harper and Row.
- Heidegger, Martin. 1977a. *The Question Concerning Technology*. Trans. William Lovitt. New York: Harper and Row.
- Heidegger, Martin. 1977b. "Only a God Can Save Us Now." Trans. D. Schendler. *Graduate Faculty Philosophy Journal* 6:5–27.
- Hirschhorn, Larry. 1984. *Beyond Mechanization: Work and Technology in a Postindustrial Age*. Cambridge: MIT Press.
- Hughes, Thomas. 1989. "The Evolution of Large Technological Systems." In *The Social Construction of Technological Systems*. Ed. Trevor Pinch, Thomas Hughes, and Wiebe Bijker. Cambridge: MIT Press.
- Latour, Bruno. 1992. "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts." In *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Ed. Wiebe Bijker and John Law. Cambridge: MIT Press.
- Latour, Bruno. 1993. *We Have Never Been Modern*. Trans. C. Porter. Cambridge: Harvard University Press.
- Light, Andrew. 1996. "Nature, Class, and the Built World: Philosophical Essays between Political Ecology and Critical Technology." Ph.D. diss., University of California, Riverside.
- Marcuse, Herbert. 1969. *An Essay on Liberation*. Boston: Beacon.
- Mitcham, Carl. 1994. *Thinking through Technology: The Path between Engineering and Philosophy*. Chicago: University of Chicago Press.
- Noble, David. 1984. *Forces of Production*. New York: Oxford University Press.
- Pinch, Trevor, Thomas Hughes, and Wiebe Bijker, eds. 1989. *The Social Construction of Technological Systems*. Cambridge: MIT Press.

- Rockmore, Tom. 1992. *On Heidegger's Nazism and Philosophy*. Berkeley and Los Angeles: University of California Press.
- Rothenberg, David. 1993. *Hand's End: Technology and the Limits of Nature*. Berkeley and Los Angeles: University of California Press.
- Simpson, Lorenzo. 1995. *Technology, Time, and the Conversations of Modernity*. New York: Routledge.
- Slouka, Mark. 1995. *War of the Worlds*. New York: Basic Books.
- Sluga, Hans. 1993. *Heidegger's Crisis: Philosophy and Politics in Nazi Germany*. Cambridge: Harvard University Press.

Part V

Technology and Human Ends

Human Beings as “Makers” or “Tool-Users”?

Introduction

What is the place of technology in human life? Is it – or at least some form of it (e.g., its premodern or its scientifically informed version) – a fundamental expression of our nature? Not all philosophers, of course, are sympathetic to the idea that we even have a “nature,” if that means some timeless essence. What we have, Ortega y Gasset famously remarked, is a history, not a nature. Nevertheless, it is probably fair to say that even for anti-essentialists like Ortega, the general question of what role(s) technology plays or ought to play in human affairs always receives some sort of answer – even if it is only silently assumed, in the form of a background understanding about how, when, and in what fashion it should or should not be employed.

The traditional conception of human nature as that of a “rational animal” already clearly figures in the thought of Socrates and Plato, and it receives its classical formulation in Aristotle. Our capacity to “know,” that is, to reason about our surroundings and to act with principled deliberation, is taken to be the primary sign of our difference from (and that often means also superiority over) other species. In one form or another, this idea dominates the Western tradition until at least the beginning of the modern period – and much farther, if one includes the instrumentalist transformations of the older, more contemplative conceptions of reason that begin with and are inspired by the rise of modern science. For some modern thinkers, however, even modeling reason more closely on scientific cognition cannot

save the traditional species-genus definition. In light of the picture of our species emerging in the new biological sciences, a more radical break appeared to be required from what is after all a metaphysically and theologically motivated definition of human beings that makes us into something cosmically special. Benjamin Franklin speaks for numerous early modern period writers in claiming that it would be better to characterize us as tool-making animals. In his essay on the role of labor in human evolution (in Chapter 8), Engels develops this claim (following his influential contemporary, Ernst Haeckel) in arguing that *first* human beings stood up and *then* they became intelligent. The erect stance freed the hands for manipulation of objects, which led to the fabrication of tools and thereafter to the enlargement of the human brain. Modern naturalistic, evolutionary conceptions of the human species thereby reverse the picture promoted by traditional theories, which typically claim that the mind or brain evolved first, followed by the evolution of the dexterous hands. In Plato, for example, we find the mythic imagery of the earliest humans as limbless heads, later given legs and arms to escape rolling into ditches. In a more serious vein, Aristotle specifically rejects Anaxagoras’ idea that the evolution of the hand led to the evolution of the mind; on the contrary, Aristotle insists that the hand must have evolved to serve the mind.

Even when it was no longer explicitly embraced, however, the influence of the traditional picture of our species’ favored status lingered long into the modern period. For example, the famous fraud of the Piltown Man (the phony fossil of a human skull connected to an

ape's skeleton, which was in fact “planted” just before World War I) gained initial acceptance in part because it appealed to many early anthropologists in suggesting that, Anaxagoras-like, the brain enlarged first in an apelike body, and then the hands evolved. Against this view, Engels insists that manual activity is the source of the evolution of brain and mind. We humans are precisely those beings that manipulate our environment through labor. Engels, of course, is especially concerned to link this priority of practical, physical activity to the Marxist view of the priority of labor, not only in human evolution but in society as well. Even language, he adds, has its origins in labor, first having developed for the purposes of social cooperation in hunting.

For quite different reasons, Lewis Mumford and Hannah Arendt both deny the priority of tool-making and labor in characterizing human nature. Arendt makes original use of the categories of the ancients to criticize Marx and to present her own understanding of human action. In contrast to the post-World War II Marxist humanists, she does not distinguish between a “true” Marx and the allegedly distorted interpretation by Marxists of humans as laboring animals. Marx himself, she argues, is simply ambivalent about the concept of labor. In some of his writings, it is a positive thing – a creative and thoroughly human activity. In other writings, it is a negative, onerous burden to be eliminated as far as possible. Arendt claims that to understand the issue properly, one must distinguish labor from both work and (communicative) action. “Labor” is the basic activity for the maintenance of life, from the labor of childbirth through the cleaning and maintenance of the household and the feeding of the family. In contrast, “work” involves the construction of artifacts – the introduction into the world of the fruits of an artisan's skill. Whereas, for example, household labor (cleaning, cooking) has no tangible, permanent, observable product, work is purposively directed toward a physical product that it creates. Finally, “action” – that is, communicative activity and in particular, political speech in the public forum – is like labor in that it produces no tangible artifact, but like work, is purposively directed toward specific goals. According to Arendt, in the modern world of mass production, divisions of labor, and the planned obsolescence of whatever is produced, work tends to collapse into mere labor, and political action disappears along with the loss of a genuine sense of the political. For Arendt, as for Plato and Aristotle, human nature

expresses its highest capacities in contemplation and communicative action, not in labor and work. But today, both contemplation and action have been expunged by the world of labor.

Mumford also opposes those who would interpret human activity primarily in terms of the use of tools and the production of artifacts, but for a different reason. He wants to emphasize the way human activity operates on and through the human body. Mumford claims that the anthropological preoccupation with tools and tool-making is in part a function of the sheer durability of the materials used to make these tools, in contrast to the relative paucity of the more fragile records of speech and ritual and non-durable objects such as clothing. Mumford urges us to remember how much human activity was (and is) directed toward the body itself, for instance in dance and in decoration. Moreover, the earliest human “machines” were in fact not physical artifacts but organized forces of huge numbers of laborers – what he calls “megamachines” – brought together for the purpose of building canals, pyramids, and other vast construction projects. Like many other twentieth-century thinkers, Mumford argues that it is language, or more generally symbolization, not tools and cooperative labor, that most clearly distinguishes humans from other animals. For us, he argues, the tool is only significant when linked with human symbolic creativity. At first glance, Mumford's conclusion may seem to have gained further plausibility in recent years from the discovery of considerable simple tool-use by animals. Not only chimps, but even insects and crabs appear to use twigs, pebbles, sponges and other tools. Upon closer consideration, however, these discoveries prove little about the relative importance of tool-use for humans. Our tool-making and tool-using – like our language – are recursive and creative in a way that is not the case with other animals. Humans typically devise tools to make tools to make more tools ...

Is there, then, *any* satisfying answer to the question of whether contemplation, or tool-using, or ... best represents what it is to be human? As Larry Hickman explains, for John Dewey the answer appears to be No. Dewey rejects the very idea of abstractly identifying and rank ordering human capacities; indeed, he argues that as long as human experience is considered beholden to some epistemic or metaphysical theory that embraces antecedent and superior certitudes about us or the world, the role of technology in human affairs will never

be properly understood. Whether it is the ancient metaphysics of contemplation, or some form of super-naturalism, or the official view of modern scientific theory as conceptually transcending all the messy particularities of its materials and instruments – all of these lofty, “foundationalist” images of knowing and being have the double effect of inflating the importance of theoretical conceptualization and denigrating material practice in a way that distorts the real character of both activities.

It is when we begin with what Dewey calls experienced “situations” rather than with a context-free theory of knowledge or of the objects of such knowledge, that we see what can properly be said about technical human activity, namely, that it is “inquiry” – something that “reflective organisms” do in order to “adapt” to or “alter” their environment to achieve satisfying conditions. When we are not behaving habitually and spontaneously, that is, when a “problem of use or enjoyment” occurs in a situation, we “intervene” and “experiment” with new ways of conceiving, materially handling, or socially organizing what we encounter. Hickman’s use of Darwinian language is deliberate. Dewey is a philosophical naturalist and instrumentalist, which means that he understands inquiry as emerging within the evolutionary development of natural organisms and (as far as we know) reaching its most sophisticated form in our species’ reflective, cognitive-experimental manipulation of ideas, tools, materials, and conditions. Of course, from this point of view, the whole idea of deciding once and for all which kind of activity is most human makes no sense. Science, engineering, and sociopolitical inquiry only gain whatever “priority” they have in our affairs in light of how they matter and affect some actual practice.

In the present selection, Hickman tries to distance himself (and Dewey) from the accusation that his very broad and amorphous evolutionary conception of inquiry seems to imply the merely empty observation that all human activity is technological, insofar as it is virtually impossible to think of situations in which we use no concepts, methods, materials, artifacts, or tools. Hickman’s response has some interesting implications. To be sure, Dewey may have come to call his theory of inquiry “technology,” but actually, Hickman explains, by Dewey’s definition most human activity is not technological. Rather, much of it is either “technical” (i.e., involves non-cognitive/habitual use of tools and artifacts), or “non-instrumental and [at least minimally]

cognitive” (e.g., drinking stream water from one’s hands or running away from something scary), or “non-instrumental and non-cognitive” (e.g., immediate perceivings and unconscious habitual responses like feeling joy at a sunrise or pain at stubbing a toe). It is clear what Hickman is trying to avoid with these classifications, and also in general how they serve his Deweyan aim of making technological activity an emergent evolutionary phenomenon with purely practical-instrumental aims. But from other angles, one might question the wisdom of describing human activity in such a way that practices that were once “technological” are now “merely technical.” Hickman is surely right to acknowledge that most of life is unthinking and habitual. Philosophers who insist (on presupposed “Cartesian” grounds) that we simply “must” think of all human behavior as rule-following even when no one can see it, or that it is a mark of ignorance not to have “solved” the skeptical problem, probably deserve to be the “big losers.” But do we want to stop thinking of “technical” behavior as “technological” just because it has become habitual? Are there not political and ontological dangers here – that one might, for example, begin to overestimate the power of later “cognitive and deliberate reflection” in the face of problematic “habits,” or ignore the conservative implications of embracing naturalism and instrumentalism in an already pervasively technoscientific and “developed” world?

Finally, in “Buddhist Economics,” E.F. Schumacher offers a provocative and starkly contrasting reconsideration of the proper place of technology in our lives by identifying and then reversing many of the rarely questioned assumptions about the nature and purpose of human life upon which familiar Western accounts of economics and work depend. Drawing upon the idea of “Right Livelihood” that forms part of the Buddhist conception of the Noble Eightfold Path to spiritual liberation, Schumacher shows that by Buddhist standards, the Western economic (specifically, capitalist) conception of work is ultimately, and not surprisingly, contradictory. It appears, he says, that for employers, the optimum condition would be to have output without employees, and for employees, income without employment. Ideally, then, there should be no work. The source of this conundrum, argues Schumacher, is precisely the basic Western conception of work as a necessary evil, a mere means, something instrumental only. For a Buddhist, however, work is only partially and secondarily

concerned with the production of goods and services. Most importantly, work offers us the chance to develop our capacities and to overcome our ego-centeredness by cooperating in common tasks. (Although he says little about the matter here, it is clear that Buddhist teaching

also has little sympathy for the Baconian idea that technoscience can give us power over our surroundings.) From this viewpoint, says Schumacher, the Western way of judging work has, unfortunately, “stood the truth on its head.”

Tool Users vs. Homo Sapiens and the Megamachine

Lewis Mumford

The last century, we all realize, has witnessed a radical transformation in the entire human environment, largely as a result of the impact of the mathematical and physical sciences upon technology. This shift from an empirical, tradition-bound technics to an experimental scientific mode has opened up such new realms as those of nuclear energy, supersonic transportation, computer intelligence, and instantaneous planetary communication.

In terms of the currently accepted picture of the relation of man to technics, our age is passing from the primeval state of man, marked by his invention of tools and weapons for the purpose of achieving mastery over the forces of nature, to a radically different condition, in which he will not only have conquered nature but detached himself completely from the organic habitat. With this new megatechnology, man will create a uniform, all-enveloping structure, designed for automatic operation. Instead of functioning actively as a tool-using animal, man will become a passive, machine-serving animal whose proper functions, if this process continues unchanged, will either be fed into a machine or strictly limited and controlled for the benefit of depersonalized collective organizations. The ultimate tendency of this development was correctly anticipated by Samuel Butler, the satirist, more than a century ago: but it is only now that his playful fantasy shows many signs of becoming a far-from-playful reality.

My purpose is to question both the assumptions and the predictions upon which our commitment to the present form of technical and scientific progress, as an end itself, has been based. In particular, I find it necessary to cast doubts upon the generally accepted theories of man's basic nature which have been implicit during the past century in our constant overrating of the role of tools and machines in the human economy. I shall suggest that not only was Karl Marx in error in giving the instruments of production a central place and a directive function in human development, but that even the seemingly benign interpretation by Teilhard de Chardin reads back into the whole story of man the narrow technological rationalism of our own age, and projects into the future a final state in which all the further possibilities of human development would come to an end, because nothing would be left of man's original nature which had not been absorbed into, if not suppressed by, the technical organization of intelligence into a universal and omnipotent layer of mind.

Since the conclusions I have reached require, for their background, a large body of evidence ... I am aware that the following summary must, by its brevity, seem superficial and unconvincing. At best, I can only hope to show that there are serious reasons for reconsidering the whole picture of both human and technical

Lewis Mumford, "Tool Users vs. Homo Sapiens and the Megamachine," from *Knowledge Among Men: Eleven Essays on Science, Culture, and Society Commemorating the 200th Anniversary of the Birth of James Smithson*, ed. Paul H. Oehser (New York: Simon & Schuster, 1966), pp. 126–141, published by Smithsonian Institution Press. Reprinted by permission of the Smithsonian Institution.

development upon which the present organization of Western society is based.

Now we cannot understand the role that technics has played in human development without a deeper insight into the nature of man: yet that insight has itself been blurred, during the last century, because it has been conditioned by a social environment in which a mass of new mechanical inventions had suddenly proliferated, sweeping away many ancient processes and institutions, and altering our very conception of both human limitations and technical possibilities.

For more than a century man has been habitually defined as a tool-using animal. This definition would have seemed strange to Plato, who attributed man's rise from a primitive state as much to Marsyas and Orpheus as to Prometheus and Hephaestos, the blacksmith-god. Yet the description of man as essentially a tool-using and tool-making animal has become so firmly accepted that the mere finding of the fragments of skulls, in association with roughly shaped pebbles, as with Dr. L. S. B. Leakey's Australopithecines, is deemed sufficient to identify the creature as a protohuman, despite marked anatomical divergences from both earlier apes and men and despite the more damaging fact that a million years later no notable improvement in stone chipping had yet been made.

By fastening attention on the surviving stone artifacts, many anthropologists have gratuitously attributed to the shaping and using of tools the enlargement of man's higher intelligence, though the motor-sensory coordinations involved in this elementary manufacture do not demand or evoke any considerable mental acuteness. Since the subhominids of South Africa had a brain capacity about a third of that of *homo sapiens*, no greater indeed than that of many apes, the capacity to make tools neither called for nor generated early man's rich cerebral equipment, as Dr. Ernst Mayr has recently pointed out.

The second error in interpreting man's nature is a less pardonable one, and that is the current tendency to read back into prehistoric times modern man's own overwhelming interest in tools, machines, technical mastery. Early man's tools and weapons were common to other primates – his own teeth, nails, fists – and it was long before he could fabricate any stone tools that were functionally more efficient than these organs. The possibility of surviving without extraneous tools gave early man, I suggest, the leeway he needed to develop those non-material parts of his culture which eventually greatly enriched his technology.

In treating toolmaking as central to the paleolithic economy from the beginning, anthropologists have underplayed or neglected a mass of devices – less dynamic but no less ingenious and adroit – in which many other species were for long far more resourceful than man. Despite the contrary evidence put forward by R. U. Sayce, C. Daryll Forde, and Leroi-Gourhan, there is still a Victorian tendency to give tools and machines a special status in technology and to completely neglect the equally important role of utensils. This practice overlooks the role of containers: hearths, storage pits, huts, pots, traps, baskets, bins, byres, and later, ditches, reservoirs, canals, cities. These static components play an important part in every technology, not least in our own day, with its high-tension transformers, its giant chemical retorts, its atomic reactors.

In any comprehensive definition of technics, it should be plain that many insects, birds, and mammals had made far more radical innovations in the fabrication of containers than man's ancestors had achieved in the making of tools until the emergence of *homo sapiens*: consider their intricate nests and bowers, their beaver dams, their geometric beehives, their urbanoid anthills and termitaries. In short, if technical proficiency were alone sufficient to identify man's active intelligence, he would for long have rated as a hopeless duffer alongside many other species. The consequences of this perception should be plain: namely, that there was nothing uniquely human in early technology until it was modified by linguistic symbols, social organization, and esthetic design. At that point symbol making leaped far ahead of tool-making and, in turn, fostered neater technical facility.

At the beginning, then, I suggest that the human race had achieved no special position by reason of its tool-using or tool-making propensities alone. Or, rather, man possessed one primary all-purpose tool that was more important than any later assemblage: namely, his own mind-activated body, every part of it, not just those sensory-motor activities that produced hand axes and wooden spears. To compensate for his extremely primitive working gear, early man had a much more important asset that widened his whole technical horizon: a body not specialized for any single activity, but, precisely because of its extraordinary lability and plasticity, more effective in using an increasing portion of both his external environment and his equally rich internal psychical resources.

Through man's overdeveloped, incessantly active brain, he had more mental energy to tap than he needed for survival at a purely animal level; and he was, accordingly,

under the necessity of canalizing that energy, not just into food getting and reproduction, but into modes of living that would convert this energy more directly and constructively into appropriate cultural – that is, symbolic – forms. Life-enhancing cultural “work” by necessity took precedence over utilitarian manual work. This wider area involved far more than the discipline of hand, muscle, and eye in making and using tools: it likewise demanded a control of all man’s biological functions, including his appetites, his organs of excretion, his upsurging emotions, his widespreading sexual activities, his tormenting and tempting dreams. Even the hand was no mere horny work tool; it stroked a lover’s body, held a baby close to the breast, made significant gestures, or expressed in ordered dance and shared ritual some otherwise inexpressible sentiment, about life or death, a remembered past, or an anxious future. Tool technics and our derivative machine technics are but specialized fragments of biotechnics: and by biotechnics one means man’s total equipment for living.

On this interpretation one may well hold it an open question whether the standardized patterns and the repetitive order which came to play such an effective part in the development of tools from an early time on, as Robert Braidwood has pointed out, derive solely from toolmaking. Do they not derive quite as much, perhaps even more, from the forms of ritual, song, and dance – forms that exist in a state of perfection among primitive peoples, often in a ‘far more exquisitely finished state than their tools. There is, in fact, widespread evidence, first noted by A. M. Hocart, that ritual exactitude in ceremony long preceded mechanical exactitude in work; and that even the rigorous division of labor came first through specialization in ceremonial offices. These facts may help to explain why simple peoples, who easily get bored by purely mechanical tasks that might improve their physical well-being, will nevertheless repeat a meaningful ritual over and over, often to the point of exhaustion. The debt of technics to play and to play toys, to myth and fantasy, to magic rite and religious rote, which I called attention to in *Technics and Civilization*, has still to be sufficiently recognized, though Johan Huizinga, in *Homo Ludens*, has gone so far as to treat play itself as the formative element in all culture.

Toolmaking in the narrow technical sense may, indeed, go back to our hominid African ancestors. But the technical equipment of Clactonian and Acheulian cultures remained extremely limited until a more richly endowed creature, with a nervous system nearer to that

of *homo sapiens* than to any primeval hominid predecessors, had come into existence, and brought into operation not alone his hands and legs, but his entire body and mind, projecting them, not just into his material equipment, but into more purely symbolic nonutilitarian forms.

In this revision of the accepted technical stereotypes, I would go even further: For I suggest that at every stage, man’s technological expansions and transformations were less for the purpose of directly increasing the food supply or controlling nature than for utilizing his own immense internal resources, and expressing his latent superorganic potentialities. When not threatened by a hostile environment, man’s lavish, hyperactive nervous organization – still often irrational and unmanageable – was possibly an embarrassment rather than an aid to his survival. If so, his control over his psycho-social environment, through the elaboration of a common symbolic culture, was a more imperious need than control over the external environment – and, as one must infer, largely predated it and outpaced it.

On this reading, the emergence of language – a laborious culmination of man’s more elementary forms of expressing and transmitting meaning – was incomparably more important to further human development than would have been the chipping of a mountain of hand axes. Beside the relatively simple coordinations required for tool using, the delicate interplay of the many organs needed for the creation of articulate speech was a far more striking advance, and must have occupied a great part of early man’s time, energy, and mental concentration, since its collective product, language, was infinitely more complex and sophisticated at the dawn of civilization than the Egyptian or Mesopotamian kit of tools. For only when knowledge and practice could be stored in symbolic forms, and passed on by word of mouth from generation to generation, was it possible to keep each fresh cultural acquisition from dissolving with the passing moment or the dying generation. Then and then only did the domestication of plants and animals become possible. Need I remind you that the latter technical transformation was achieved with no better tools than the digging stick, the ax, and the mattock? The plow, like the cart wheel, came much later as a specialized contribution to the large-scale field cultivation of grain.

To consider man as primarily a tool-making animal, then, is to skip over the main chapters of human prehistory in which a decisive development actually took place. Opposed to this tool-dominated stereotype, the present

view holds that man is preeminently a mind-using, symbol-making, and self-mastering animal; and the primary locus of all his activities lies in his own organism. Until man had made something of himself, he could make little of the world around him.

In this process of self-discovery and self-transformation, technics in the narrow sense, of course, served man well as a subsidiary instrument, but not as the main operative agent in his development; for technics was never till our own age dissociated from the larger cultural whole, still less did technics dominate all other institutions. Early man's original development was based upon what Andre Varagnac happily called "the technology of the body": the utilization of his highly plastic bodily capacities for the expression of his still unformed and uninformed mind, before that mind had yet achieved, through the development of symbols and images, its own more appropriate etherealized technical instruments. From the beginning the creation of significant modes of symbolic expression, rather than more effective tools, was the basis of *homo sapiens'* further development.

Unfortunately, so firmly were the prevailing nineteenth-century conceptions committed to the notion of man as primarily *homo faber*, the toolmaker, rather than *homo sapiens*, the mind maker, that [...] the first discovery of the art of the Altamira caves was dismissed as a hoax, because the leading paleoethnologists would not admit that the Ice Age hunters, whose weapons and tools they had recently discovered, could have had either the leisure or the mental inclination to produce art – not crude forms, but images that showed powers of observation and abstraction of a high order.

But, when we compare the carvings and paintings of the Aurignacian or Magdalenian finds with their surviving technical equipment, who shall say whether it is art or technics that shows the higher development? Even the finely finished Solutrean laurel-leaf points were a gift of esthetically sensitive artisans. The classic Greek usage for *technics* makes no distinction between industrial production and art; and for the greater part of human history these aspects were inseparable, one side respecting objective conditions and functions, the other responding to subjective needs and expressing sharable feelings and meanings.

Our age has not yet overcome the peculiar utilitarian bias that regards technical invention as primary, and esthetic expression as secondary or even superfluous; and this means that we have still to acknowledge that, until our own period, technics derived from the whole man

in his intercourse with every part of the environment, utilizing every aptitude in himself to make the most of his own biological, ecological, and psychosocial potentials.

Even at the earliest stage, trapping and foraging called less for tools than for sharp observation of animal habits and habitats, backed by a wide experimental sampling of plants and a shrewd interpretation of the effects of various foods, medicines, and poisons upon the human organism. And in those horticultural discoveries which, if Oakes Ames was right, must have preceded by many thousands of years the active domestication of plants, taste and formal beauty played a part no less than their food value; so that the earliest domesticates, other than the grains, were often valued for the color and form of their flowers, for their perfume, their texture, their spiciness, rather than merely for nourishment. Edgar Anderson has suggested that the neolithic garden, like gardens in many simpler cultures today, was probably a mixture of food plants, dye plants, medicinals, and ornamentals – all treated as equally essential for life.

Similarly, some of early man's most daring technical experiments had nothing whatever to do with the mastery of the external environment: they were concerned with the anatomical modification or the superficial decoration of the human body, for sexual emphasis, self-expression, or group identification. The Abbé Breuil found evidence of such practices as early as the Mousterian culture, which served equally in the development of ornament and surgery.

Plainly, tools and weapons, so far from always dominating man's technical equipment, as the stone artifacts too glibly suggest, constituted only a small part of the biotechnic assemblage; and the struggle for existence, though sometimes severe, did not engross the energy and vitality of early man, or divert him from his more central need to bring order and meaning into every part of his life. In that larger effort, ritual, dance, song, painting, carving, and above all discursive language must for long have played a decisive role.

At its point of origin, then, technics was related to the whole nature of man. Primitive technics was life-centered, not narrowly work-centered, still less production-centered or power-centered. As in all ecological complexes, a variety of human interests and purposes, along with organic needs, restrained the overgrowth of any single component. As for the greatest technical feat before our own age, the domestication of plants and animals, this advance owed almost nothing to new tools, though it necessarily encouraged the development of clay containers,

to hold and preserve its agricultural abundance. But neolithic domestication owed much, we now begin to realize, since Eduard Hahn and Levy, to an intense subjective concentration on sexuality in all its manifestations, expressed first in religious myth and ritual, still abundantly visible in cult objects and symbolic art. Plant selection, hybridization, fertilization, manuring, seeding, castration were the products of an imaginative cultivation of sexuality, whose first evidence one finds tens of thousands of years earlier in the emphatically sexual carvings of paleolithic woman: the so-called Venuses.

But at the point where history, in the form of the written record, becomes visible, that life-centered economy, a true polytechnics, was challenged and in part displaced in a series of radical technical and social innovations. About five thousand years ago a monotecnics, devoted to the increase of power and wealth by the systematic organization of workaday activities in a rigidly mechanical pattern, came into existence. At this moment, a new conception of the nature of man arose, and with it a new stress upon the exploitation of physical energies, cosmic and human, apart from the processes of growth and reproduction, came to the fore. In Egypt, Osiris symbolizes the older, fecund, life-oriented technics: Atum-Re, the Sun God, who characteristically created the world out of his own semen without female cooperation, stands for the machine-centered one. The expansion of power, through ruthless human coercion and mechanical organization, took precedence over the nurture and enhancement of life.

The chief mark of this change was the construction of the first complex, high-powered machines; and thereafter the beginning of a new regimen, accepted by all later civilized societies – though reluctantly by more archaic cultures – in which work at a single specialized task, segregated from other biological and social activities, not only occupied the entire day but increasingly engrossed the entire lifetime. That was the fundamental departure which, during the last few centuries, has led to the increasing mechanization and automation of all production. With the assemblage of the first collective machines, work, by its systematic dissociation from the rest of life, became a curse, a burden, a sacrifice, a form of punishment: and by reaction this new regimen soon awakened compensatory dreams of effortless affluence, emancipated not only from slavery but from work itself. These ancient dreams, first expressed in myth, but long delayed in realization, now dominate our own age.

The machine I refer to was never discovered in any archeological diggings for a simple reason: it was composed almost entirely of human parts. These parts were brought together in a hierarchical organization under the rule of an absolute monarch whose commands, supported by a coalition of the priesthood, the armed nobility, and the bureaucracy, secured a corpselike obedience from all the components of the machine. Let us call this archetypal collective machine – the human model for all later specialized machines – the *Megamachine*. This new kind of machine was far more complex than the contemporary potter's wheel or bow drill, and it remained the most advanced type of machine until the invention of the mechanical clock in the fourteenth century.

Only through the deliberate invention of such a high-powered machine could the colossal works of engineering that marked the Pyramid Age in both Egypt and Mesopotamia have been brought into existence, often in a single generation. This new technics came to an early climax in the Great Pyramid at Giza: that structure exhibited, as J. H. Breasted pointed out, a watchmaker's standard of exact measurement. By operating as a single mechanical unit of specialized, subdivided, interlocking parts, the one hundred thousand men who worked on that pyramid could generate ten thousand horsepower. This human mechanism alone made it possible to raise that colossal structure with the use of only the simplest stone and copper tools – without the aid of such otherwise indispensable machines as the wheel, the wagon, the pulley, the derrick, or the winch.

Two things must be noted about this power machine because they identify it through its whole historic course down to the present. The first is that the organizers of the machine derived their power and authority from a cosmic source. The exactitude in measurement, the abstract mechanical order, the compulsive regularity of this labor machine sprang directly from astronomical observations and abstract scientific calculations: this inflexible, predictable order, incorporated in the calendar, was then transferred to the regimentation of the human components. By a combination of divine command and ruthless military coercion, a large population was made to endure grinding poverty and forced labor at dull repetitive tasks, in order to ensure "life, prosperity, and health" for the divine or semidivine ruler and his entourage.

The second point is that the grave social defects of the human machine – then as now – were partly offset by its superb achievements in flood control, grain production, and urban building, which plainly benefited the whole

community. This laid the ground for an enlargement in every area of human culture: in monumental art, in codified law, and in systematically pursued and permanently recorded thought. Such order, such collective security and abundance as were achieved in Mesopotamia and Egypt – later, in India, China, in the Andean and Mayan cultures – were never surpassed until the Megamachine was reestablished in a new form in our own time. But, conceptually, the machine was already detached from other human functions and purposes than the increase of mechanical power and order. With mordant symbolism, the Megamachine's ultimate products in Egypt were tombs, cemeteries, and mummies, while later in Assyria and elsewhere the chief testimonial to its dehumanized efficiency was, again typically, a waste of destroyed cities and poisoned soils.

In a word, what modern economists lately termed the Machine Age had its origin, not in the eighteenth century, but at the very outset of civilization. All its salient characteristics were present from the beginning in both the means and the ends of the collective machine. So Keynes's acute prescription of "pyramid building" as an essential means of coping with the insensate productivity of a highly mechanized technology, applies both to the earliest manifestations and the present ones; for what is a space rocket but the precise dynamic equivalent, in terms of our present-day theology and cosmology, of the static Egyptian pyramid? Both are devices for securing at an extravagant cost a passage to heaven for the favored few, while incidentally maintaining equilibrium in an economic structure threatened by its own excessive productivity.

Unfortunately, though the labor machine lent itself to vast constructive enterprises, which no small-scale community could even contemplate, much less execute, the most conspicuous result has been achieved through military machines, in colossal acts of destruction and human extermination; acts that monotonously soil the pages of history, from the rape of Sumer to the blasting of Warsaw and Hiroshima. Sooner or later, I suggest, we must have the courage to ask ourselves: Is this association of inordinate power and productivity with equally inordinate violence and destruction a purely accidental one?

Now the misuse of Megamachines would have proved intolerable had they not also brought genuine benefits to the whole community by raising the ceiling of collective human effort and aspiration. Perhaps the most dubious of these advantages, humanly speaking, was the gain in efficiency derived from concentration upon rigorously repetitive motions in work, already indeed introduced in the grinding and polishing processes of neolithic

toolmaking. This inured civilized man to long spans of regular work, with possibly a higher productive efficiency per unit. But the social byproduct of this new discipline was perhaps even more significant; for some of the psychological benefits hitherto confined to religious ritual were transferred to work. The monotonous repetitive tasks imposed by the Megamachine, which in a pathological form we would associate with a compulsion neurosis, nevertheless served, I suggest, like all ritual and restrictive order, to lessen anxiety and to defend the worker himself from the often demonic promptings of the unconscious, no longer held in check by the traditions and customs of the neolithic village.

In short, mechanization and regimentation, through labor armies, military armies, and ultimately through the derivative modes of industrial and bureaucratic organization, supplemented and increasingly replaced religious ritual as a means of coping with anxiety and promoting psychical stability in mass populations. Orderly, repetitive work provided a daily means of self-control: a moralizing agent more pervasive, more effective, more universal than either ritual or law. This hitherto unnoticed psychological contribution was possibly more important than quantitative gains in productive efficiency, for the latter too often was offset by absolute losses in war and conquest. Unfortunately, the ruling classes, which claimed immunity from manual labor, were not subject to this discipline; hence, as the historic record testifies, their disordered fantasies too often found an outlet into reality through insensate acts of destruction and extermination.

Having indicated the beginnings of this process, I must regrettably pass over the actual institutional forces that have been at work during the past five thousand years and leap, all too suddenly, into the present age, in which the ancient forms of biotechnics are being either suppressed or supplanted, and in which the extravagant enlargement of the Megamachine itself has become, with increasing compulsiveness, the condition of continued scientific and technical advance. This unconditional commitment to the Megamachine is now regarded by many as the main purpose of human existence.

But if the clues I have been attempting to expose prove helpful, many aspects of the scientific and technical transformation of the last three centuries will call for reinterpretation and judicious reconsideration. For at the very least, we are now bound to explain why the whole process of technical development has become increasingly coercive, totalitarian, and – in its direct

human expression – compulsive and grimly irrational, indeed downright hostile to more spontaneous manifestations of life that cannot be fed into the machine.

Before accepting the ultimate translation of all organic processes, biological functions, and human aptitudes into an externally controllable mechanical system, increasingly automatic and self-expanding, it might be well to reexamine the ideological foundations of this whole system, with its overconcentration upon centralized power and external control. Must we not, in fact, ask ourselves if the probable destination of this system is compatible with the further development of specifically human potentialities?

Consider the alternatives now before us. If man were actually, as current theory still supposes, a creature whose manufacture and manipulation of tools played the largest formative part in his development, on what valid grounds do we now propose to strip mankind of the wide variety of autonomous activities historically associated with agriculture and manufacture, leaving the residual mass of workers with only the trivial tasks of watching buttons and dials, and responding to one-way communication and remote control? If man indeed owes his intelligence mainly to his tool-making and tool-using propensities, by what logic do we now take his tools away, so that he will become a functionless, workless being, conditioned to accept only what the Megamachine offers him: an automaton within a larger system of automation, condemned to compulsory consumption, as he was once condemned to compulsory production? What, in fact, will be left of human life, if one autonomous function after another is either taken over by the machine or else surgically removed – perhaps genetically altered – to fit the Megamachine?

But if the present analysis of human development in relation to technics proves sound, there is an even more fundamental criticism to be made. For we must then go on to question the basic soundness of the current scientific and educational ideology, which is now pressing to shift the locus of human activity from the organic environment, the social group, and the human personality to the Megamachine, considered as the ultimate expression of human intelligence – divorced from the limitations and qualifications of organic existence. That machine-centered metaphysics invites replacement: in both its ancient Pyramid Age form and its Nuclear Age form it is obsolete. For the prodigious advance of knowledge about man's biological origins and historic development made during the last century massively undermines this dubious underdimensioned ideology, with its specious

social assumptions and “moral” imperatives, upon which the imposing fabric of science and technics, since the seventeenth century, has been based.

From our present vantage point, we can see that the inventors and controllers of the Megamachine, from the Pyramid Age onward, have in fact been haunted by delusions of omniscience and omnipotence – immediate or prospective. Those original delusions have not become less irrational, now that they have at their disposal the formidable resources of exact science and a high-energy technology. The Nuclear Age conceptions of absolute power, infallible computerized intelligence, limitless expanding productivity, all culminating in a system of total control exercised by a military-scientific-industrial elite, correspond to the Bronze Age conception of Divine Kingship. Such power, to succeed on its own terms, must destroy the symbiotic cooperations between all species and communities essential to man's survival and development. Both ideologies belong to the same infantile magico-religious scheme as ritual human sacrifice. As with Captain Ahab's pursuit of *Moby Dick*, the scientific and technical means are entirely rational, but the ultimate ends are mad.

Living organisms, we now know, can use only limited amounts of energy, as living personalities can utilize only limited quantities of knowledge and experience. “Too much” or “too little” is equally fatal to organic existence. Even too much sophisticated abstract knowledge, insulated from feeling, from moral evaluation, from historic experience, from responsible, purposeful action, can produce a serious unbalance in both the personality and the community. Organisms, societies, human persons are nothing less than delicate devices for regulating energy and putting it at the service of life.

To the extent that our Megatechnics ignores these fundamental insights into the nature of all living organisms, it is actually prescientific, even when not actively irrational: a dynamic agent of arrest and regression. When the implications of this weakness are taken in, a deliberate, large-scale dismantling of the Megamachine, in all its institutional forms, must surely take place, with a redistribution of power and authority to smaller units, more open to direct human control.

If technics is to be brought back again into the service of human development, the path of advance will lead, not to the further expansion of the Megamachine, but to the deliberate cultivation of all those parts of the organic environment and the human personality that have been suppressed in order to magnify the offices of the Megamachine.

The deliberate expression and fulfillment of human potentialities requires a quite different approach from that bent solely on the control of natural forces and the modification of human capabilities in order to facilitate and expand the system of control. We know now that play and sport and ritual and dream fantasy, no less than organized work, have exercised a formative influence upon human culture, and not least upon technics. But make-believe cannot for long be a sufficient substitute for productive work: only when play and work form part of an organic cultural whole, as in Tolstoy's picture of the mowers in *Anna Karenina*, can the many-sided requirements for full human growth be satisfied. Without serious responsible work, man progressively loses his grip on reality.

Instead of liberation *from* work being the chief contribution of mechanization and automation, I would suggest that liberation *for* work, for more educative, mind-forming, self-rewarding work, on a voluntary basis, may become the most salutary contribution of a life-centered technology. This may prove an indispensable counterbalance to universal automation: partly by protecting the displaced worker from boredom and suicidal desperation, only temporarily relievable by anesthetics, sedatives, and narcotics, partly by giving wider play to constructive impulses, autonomous functions, meaningful activities.

Relieved from abject dependence upon the Megamachine, the whole world of biotechnics would then once more become open to man; and those parts of his

personality that have been crippled or paralyzed by insufficient use should again come into play, with fuller energy than ever before. Automation is indeed the proper end of a purely mechanical system; and, once in its place, subordinate to other human purposes, these cunning mechanisms will serve the human community no less effectively than the reflexes, the hormones, and the autonomic nervous system – nature's earliest experiment in automation – serve the human body. But autonomy, self-direction, and self-fulfillment are the proper ends of organisms; and further technical development must aim at reestablishing this vital harmony at every stage of human growth by giving play to every part of the human personality, not merely to those functions that serve the scientific and technical requirements of the Megamachine.

I realize that in opening up these difficult questions I am not in a position to provide ready-made answers, nor do I suggest that such answers will be easy to fabricate. But it is time that our present wholesale commitment to the machine, which arises largely out of our one-sided interpretation of man's early technical development, should be replaced by a fuller picture of both human nature and the technical milieu, as both have evolved together. That is the first step toward a many-sided transformation of man's self and his work and his habitat – it will probably take many centuries to effect, even after the inertia of the forces now dominant has been overcome.

The “Vita Activa” and the Modern Age

Hannah Arendt

1 *Vita Activa* and the Human Condition

With the term *vita activa*, I propose to designate three fundamental human activities: labor, work, and action. They are fundamental because each corresponds to one of the basic conditions under which life on earth has been given to man.

Labor is the activity which corresponds to the biological process of the human body, whose spontaneous growth, metabolism, and eventual decay are bound to the vital necessities produced and fed into the life process by labor. The human condition of labor is life itself.

Work is the activity which corresponds to the unnaturalness of human existence, which is not imbedded in, and whose mortality is not compensated by, the species' ever-recurring life cycle. Work provides an “artificial” world of things, distinctly different from all natural surroundings. Within its borders each individual life is housed, while this world itself is meant to outlast and transcend them all. The human condition of work is worldliness.

Action, the only activity that goes on directly between men without the intermediary of things or matter, corresponds to the human condition of plurality, to the fact that men, not Man, live on the earth and inhabit the world. While all aspects of the human condition are

somehow related to politics, this plurality is specifically the condition – not only the *conditio sine qua non*, but the *conditio per quam* – of all political life. Thus the language of the Romans, perhaps the most political people we have known, used the words “to live” and “to be among men” (*inter homines esse*) or “to die” and “to cease to be among men” (*inter homines esse desinere*) as synonyms. But in its most elementary form, the human condition of action is implicit even in Genesis (“Male and female created He *them*”), if we understand that this story of man’s creation is distinguished in principle from the one according to which God originally created Man (*adam*), “him” and not “them,” so that the multitude of human beings becomes the result of multiplication. Action would be an unnecessary luxury, a capricious interference with general laws of behavior, if men were endlessly reproducible repetitions of the same model, whose nature or essence was the same for all and as predictable as the nature or essence of any other thing. Plurality is the condition of human action because we are all the same, that is, human, in such a way that nobody is ever the same as anyone else who ever lived, lives, or will live.

All three activities and their corresponding conditions are intimately connected with the most general condition of human existence: birth and death, natality and mortality. Labor assures not only individual survival, but the life of the species. Work and its product, the human

Hannah Arendt, “The ‘Vita Activa’ and the Modern Age,” from Hannah Arendt, *The Human Condition*, 2nd edn. (Chicago: University of Chicago Press, 1998), pp. 7–11, 280–313, some notes abridged or omitted. Reprinted by permission of the University of Chicago Press.

artifact, bestow a measure of permanence and durability upon the futility of mortal life and the fleeting character of human time. Action, in so far as it engages in founding and preserving political bodies, creates the condition for remembrance, that is, for history.

Labor and work, as well as action, are also rooted in natality in so far as they have the task to provide and preserve the world for, to foresee and reckon with, the constant influx of newcomers who are born into the world as strangers. However, of the three, action has the closest connection with the human condition of natality; the new beginning inherent in birth can make itself felt in the world only because the newcomer possesses the capacity of beginning something anew, that is, of acting. In this sense of initiative, an element of action, and therefore of natality, is inherent in all human activities. Moreover, since action is the political activity par excellence, natality, and not mortality, may be the central category of political, as distinguished from metaphysical, thought.

The human condition comprehends more than the conditions under which life has been given to man. Men are conditioned beings because everything they come in contact with turns immediately into a condition of their existence. The world in which the *vita activa* spends itself consists of things produced by human activities; but the things that owe their existence exclusively to men nevertheless constantly condition their human makers. In addition to the conditions under which life is given to man on earth, and partly out of them, men constantly create their own, self-made conditions, which, their human origin and their variability notwithstanding, possess the same conditioning power as natural things. Whatever touches or enters into a sustained relationship with human life immediately assumes the character of a condition of human existence. This is why men, no matter what they do, are always conditioned beings. Whatever enters the human world of its own accord or is drawn into it by human effort becomes part of the human condition. The impact of the world's reality upon human existence is felt and received as a conditioning force. The objectivity of the world – its object- or thing-character – and the human condition supplement each other; because human existence is conditioned existence, it would be impossible without things, and things would be a heap of unrelated articles, a non-world, if they were not the conditioners of human existence.

To avoid misunderstanding: the human condition is not the same as human nature, and the sum total of human activities and capabilities which correspond to the human condition does not constitute anything like

human nature. For neither those we discuss here nor those we leave out, like thought and reason, and not even the most meticulous enumeration of them all, constitute essential characteristics of human existence in the sense that without them this existence would no longer be human. The most radical change in the human condition we can imagine would be an emigration of men from the earth to some other planet. Such an event, no longer totally impossible, would imply that man would have to live under man-made conditions, radically different from those the earth offers him. Neither labor nor work nor action nor, indeed, thought as we know it would then make sense any longer. Yet even these hypothetical wanderers from the earth would still be human; but the only statement we could make regarding their “nature” is that they still are conditioned beings, even though their condition is now self-made to a considerable extent.

The problem of human nature, the Augustinian *quaestio mihi factus sum* (“a question have I become for myself”), seems unanswerable in both its individual psychological sense and its general philosophical sense. It is highly unlikely that we, who can know, determine, and define the natural essences of all things surrounding us, which we are not, should ever be able to do the same for ourselves — this would be like jumping over our own shadows. Moreover, nothing entitles us to assume that man has a nature or essence in the same sense as other things. In other words, if we have a nature or essence, then surely only a god could know and define it, and the first prerequisite would be that he be able to speak about a “who” as though it were a “what.”¹ The perplexity is that the modes of human cognition applicable to things with “natural” qualities, including ourselves to the limited extent that we are specimens of the most highly developed species of organic life, fail us when we raise the question: And *who* are we? This is why attempts to define human nature almost invariably end with some construction of a deity, that is, with the god of the philosophers, who, since Plato, has revealed himself upon closer inspection to be a kind of Platonic idea of man. Of course, to demask such philosophic concepts of the divine as conceptualizations of human capabilities and qualities is not a demonstration of, not even an argument for, the non-existence of God; but the fact that attempts to define the nature of man lead so easily into an idea which definitely strikes us as “superhuman” and therefore is identified with the divine may cast suspicion upon the very concept of “human nature.”

On the other hand, the conditions of human existence – life itself, natality and mortality, worldliness, plurality,

and the earth – can never “explain” what we are or answer the question of who we are for the simple reason that they never condition us absolutely. This has always been the opinion of philosophy, in distinction from the sciences – anthropology, psychology, biology, etc. – which also concern themselves with man. But today we may almost say that we have demonstrated even scientifically that, though we live now, and probably always will, under the earth’s conditions, we are not mere earth-bound creatures. Modern natural science owes its great triumphs to having looked upon and treated earth-bound nature from a truly universal viewpoint, that is, from an Archimedean standpoint taken, wilfully and explicitly, outside the earth.

39 Introspection and the Loss of Common Sense

Introspection, as a matter of fact, not the reflection of man’s mind on the state of his soul or body but the sheer cognitive concern of consciousness with its own content (and this is the essence of the Cartesian *cogitatio*, where *cogito* always means *cogito me cogitare*) must yield certainty, because here nothing is involved except what the mind has produced itself; nobody is interfering but the producer of the product, man is confronted with nothing and nobody but himself. Long before the natural and physical sciences began to wonder if man is capable of encountering, knowing, and comprehending anything except himself, modern philosophy had made sure in introspection that man concerns himself only with himself. Descartes believed that the certainty yielded by his new method of introspection is the certainty of the I-am.² Man, in other words, carries his certainty, the certainty of his existence, within himself; the sheer functioning of consciousness, though it cannot possibly assure a worldly reality given to the senses and to reason, confirms beyond doubt the reality of sensations and of reasoning, that is, the reality of processes which go on in the mind. These are not unlike the biological processes that go on in the body and which, when one becomes aware of them, can also convince one of its working reality. In so far as even dreams are real, since they presuppose a dreamer and a dream, the world of consciousness is real enough. The trouble is only that just as it would be impossible to infer from the awareness of bodily processes the actual shape of any body, including one’s own, so it is impossible to reach out from the mere consciousness of sensations, in which one senses his senses and in which even the sensed object becomes part of sensation, into reality with its shapes, forms, colors, and

constellations. The seen tree may be real enough for the sensation of vision, just as the dreamed tree is real enough for the dreamer as long as the dream lasts, but neither can ever become a real tree.

It is out of these perplexities that Descartes and Leibniz needed to prove, not the existence of God, but his goodness, the one demonstrating that no evil spirit rules the world and mocks man and the other that this world, including man, is the best of all possible worlds. The point about these exclusively modern justifications, known since Leibniz as theodicies, is that the doubt does not concern the existence of a highest being, which, on the contrary, is taken for granted, but concerns his revelation, as given in biblical tradition, and his intentions with respect to man and world, or rather the adequateness of the relationship between man and world. Of these two, the doubt that the Bible or nature contains divine revelation is a matter of course, once it has been shown that revelation as such, the disclosure of reality to the senses and of truth to reason, is no guaranty for either. Doubt of the goodness of God, however, the notion of a *Dieu trompeur*, arose out of the very experience of deception inherent in the acceptance of the new world view, a deception whose poignancy lies in its irremediable repetitiveness, for no knowledge about the heliocentric nature of our planetary system can change the fact that every day the sun is seen circling the earth, rising and setting at its preordained location. Only now, when it appeared as though man, if it had not been for the accident of the telescope, might have been deceived forever, did the ways of God really become wholly inscrutable; the more man learned about the universe, the less he could understand the intentions and purposes for which he should have been created. The goodness of the God of the theodicies, therefore, is strictly the quality of a *deus ex machina*; inexplicable goodness is ultimately the only thing that saves reality in Descartes’ philosophy (the coexistence of mind and extension, *res cogitans* and *res extensa*), as it saves the pre-stabilized harmony between man and world in Leibniz.

The very ingenuity of Cartesian introspection, and hence the reason why this philosophy became so all-important to the spiritual and intellectual development of the modern age, lies first in that it had used the nightmare of non-reality as a means of submerging all worldly objects into the stream of consciousness and its processes. The “seen tree” found in consciousness through introspection is no longer the tree given in sight and touch, an entity in itself with an unalterable identical shape of its own. By being processed into an object of consciousness

on the same level with a merely remembered or entirely imaginary thing, it becomes part and parcel of this process itself, of that consciousness, that is, which one knows only as an ever-moving stream. Nothing perhaps could prepare our minds better for the eventual dissolution of matter into energy, of objects into a whirl of atomic occurrences, than this dissolution of objective reality into subjective states of mind or, rather, into subjective mental processes. Second, and this was of even greater relevance to the initial stages of the modern age, the Cartesian method of securing certainty against universal doubt corresponded most precisely to the most obvious conclusion to be drawn from the new physical science: though one cannot know truth as something given and disclosed, man can at least know what he makes himself. This, indeed, became the most general and most generally accepted attitude of the modern age, and it is this conviction, rather than the doubt underlying it, that propelled one generation after another for more than three hundred years into an ever-quickenning pace of discovery and development.

Cartesian reason is entirely based “on the implicit assumption that the mind can only know that which it has itself produced and retains in some sense within itself.” Its highest ideal must therefore be mathematical knowledge as the modern age understands it, that is, not the knowledge of ideal forms given outside the mind but of forms produced by a mind which in this particular instance does not even need the stimulation – or, rather, the irritation – of the senses by objects other than itself. This theory is certainly what Whitehead calls it, “the outcome of common-sense in retreat.” For common sense, which once had been the one by which all other senses, with their intimately private sensations, were fitted into the common world, just as vision fitted man into the visible world, now became an inner faculty without any world relationship. This sense now was called common merely because it happened to be common to all. What men now have in common is not the world but the structure of their minds, and this they cannot have in common, strictly speaking; their faculty of reasoning can only happen to be the same in everybody.³ The fact that, given the problem of two plus two we all will come out with the same answer, four, is henceforth the very model of common-sense reasoning.

Reason, in Descartes no less than in Hobbes, becomes “reckoning with consequences,” the faculty of deducing and concluding, that is, of a process which man at any moment can let loose within himself. The mind of this

man – to remain in the sphere of mathematics – no longer looks upon “two-and-two-are-four” as an equation in which two sides balance in a self-evident harmony, but understands the equation as the expression of a process in which two and two *become* four in order to generate further processes of addition which eventually will lead into the infinite. This faculty the modern age calls common-sense reasoning; it is the playing of the mind with itself, which comes to pass when the mind is shut off from all reality and “senses” only itself. The results of this play are compelling “truths” because the structure of one man’s mind is supposed to differ no more from that of another than the shape of his body. Whatever difference there may be is a difference of mental power, which can be tested and measured like horsepower. Here the old definition of man as an *animal rationale* acquires a terrible precision: deprived of the sense through which man’s five animal senses are fitted into a world common to all men, human beings are indeed no more than animals who are able to reason, “to reckon with consequences.”

The perplexity inherent in the discovery of the Archimedean point was and still is that the point outside the earth was found by an earth-bound creature, who found that he himself lived not only in a different but in a topsy-turvy world the moment he tried to apply his universal world view to his actual surroundings. The Cartesian solution of this perplexity was to move the Archimedean point into man himself, to choose as ultimate point of reference the pattern of the human mind itself, which assures itself of reality and certainty within a framework of mathematical formulas which are its own products. Here the famous *reductio scientiae ad mathematicam* permits replacement of what is sensuously given by a system of mathematical equations where all real relationships are dissolved into logical relations between man-made symbols. It is this replacement which permits modern science to fulfil its “task of *producing*” the phenomena and objects it wishes to observe. And the assumption is that neither God nor an evil spirit can change the fact that two and two equal four.

40 Thought and the Modern World View

The Cartesian removal of the Archimedean point into the mind of man, while it enabled man to carry it, as it were, within himself wherever he went and thus freed

him from given reality altogether – that is, from the human condition of being an inhabitant of the earth – has perhaps never been as convincing as the universal doubt from which it sprang and which it was supposed to dispel. Today, at any rate, we find in the perplexities confronting natural scientists in the midst of their greatest triumphs the same nightmares which have haunted the philosophers from the beginning of the modern age. This nightmare is present in the fact that a mathematical equation, such as of mass and energy – which originally was destined only to save the phenomena, to be in agreement with observable facts that could also be explained differently, just as the Ptolemaic and Copernican systems originally differed only in simplicity and harmony – actually lends itself to a very real conversion of mass into energy and vice versa, so that the mathematical "conversion" implicit in every equation corresponds to convertibility in reality; it is present in the weird phenomenon that the systems of non-Euclidean mathematics were found without any forethought of applicability or even empirical meaning before they gained their surprising validity in Einstein's theory; and it is even more troubling in the inevitable conclusion that "the possibility of such an application must be held open for all, even the most remote constructions of pure mathematics." If it should be true that a whole universe, or rather any number of utterly different universes will spring into existence and "prove" whatever over-all pattern the human mind has constructed, then man may indeed, for a moment, rejoice in a reassertion of the "pre-established harmony between pure mathematics and physics,"⁴ between mind and matter, between man and the universe. But it will be difficult to ward off the suspicion that this mathematically preconceived world may be a dream world where every dreamed vision man himself produces has the character of reality only as long as the dream lasts. And his suspicions will be enforced when he must discover that the events and occurrences in the infinitely small, the atom, follow the same laws and regularities as in the infinitely large, the planetary systems.⁵ What this seems to indicate is that if we inquire into nature from the standpoint of astronomy we receive planetary systems, while if we carry out our astronomical inquiries from the standpoint of the earth we receive geocentric, terrestrial systems.

In any event, wherever we try to transcend appearance beyond all sensual experience, even instrument-aided, in order to catch the ultimate secrets of Being, which according to our physical world view is so secretive that it never appears and still so tremendously powerful that

it produces all appearance, we find that the same patterns rule the macrocosm and the microcosm alike, that we receive the same instrument readings. Here again, we may for a moment rejoice in a refund unity of the universe, only to fall prey to the suspicion that what we have found may have nothing to do with either the macrocosmos or the microcosmos, that we deal only with the patterns of our own mind, the mind which designed the instruments and put nature under its conditions in the experiment – prescribed its laws to nature, in Kant's phrase – in which case it is really as though we were in the hands of an evil spirit who mocks us and frustrates our thirst for knowledge, so that wherever we search for that which we are not, we encounter only the patterns of our own minds.

Cartesian doubt, logically the most plausible and chronologically the most immediate consequence of Galileo's discovery, was assuaged for centuries through the ingenious removal of the Archimedean point into man himself, at least so far as natural science was concerned. But the mathematization of physics, by which the absolute renunciation of the senses for the purpose of knowing was carried through, had in its last stages the unexpected and yet plausible consequence that every question man puts to nature is answered in terms of mathematical patterns to which no model can ever be adequate, since one would have to be shaped after our sense experiences.⁶ At this point, the connection between thought and sense experience, inherent in the human condition, seems to take its revenge: while technology demonstrates the "truth" of modern science's most abstract concepts, it demonstrates no more than that man can always apply the results of his mind, that no matter which system he uses for the explanation of natural phenomena he will always be able to adopt it as a guiding principle for making and acting. This possibility was latent even in the beginnings of modern mathematics, when it turned out that numerical truths can be fully translated into spatial relationships. If, therefore, present-day science in its perplexity points to technical achievements to "prove" that we deal with an "authentic order" given in nature,⁷ it seems it has fallen into a vicious circle, which can be formulated as follows: scientists formulate their hypotheses to arrange their experiments and then use these experiments to verify their hypotheses; during this whole enterprise, they obviously deal with a hypothetical nature.

In other words, the world of the experiment seems always capable of becoming a man-made reality, and this, while it may increase man's power of making and acting,

even of creating a world, far beyond what any previous age dared to imagine in dream and phantasy, unfortunately puts man back once more – and now even more forcefully – into the prison of his own mind, into the limitations of patterns he himself created. The moment he wants what all ages before him were capable of achieving, that is, to experience the reality of what he himself is not, he will find that nature and the universe “escape him” and that a universe construed according to the behavior of nature in the experiment and in accordance with the very principles which man can translate technically into a working reality lacks all possible representation. What is new here is not that things exist of which we cannot form an image – such “things” were always known and among them, for instance, belonged the “soul” – but that the material things we see and represent and against which we had measured immaterial things for which we can form no images should likewise be “unimaginable.” With the disappearance of the sensually given world, the transcendent world disappears as well, and with it the possibility of transcending the material world in concept and thought. It is therefore not surprising that the new universe is not only “practically inaccessible but not even thinkable,” for “however we think it, it is wrong; not perhaps quite as meaningless as a ‘triangular circle,’ but much more so than a ‘winged lion.’”⁸

Cartesian universal doubt has now reached the heart of physical science itself; for the escape into the mind of man himself is closed if it turns out that the modern physical universe is not only beyond presentation, which is a matter of course under the assumption that nature and Being do not reveal themselves to the senses, but is inconceivable, unthinkable in terms of pure reasoning as well.

41 The Reversal of Contemplation and Action

Perhaps the most momentous of the spiritual consequences of the discoveries of the modern age and, at the same time, the only one that could not have been avoided, since it followed closely upon the discovery of the Archimedean point and the concomitant rise of Cartesian doubt, has been the reversal of the hierarchical order between the *vita contemplativa* and the *vita activa*.

In order to understand how compelling the motives for this reversal were, it is first of all necessary to rid ourselves of the current prejudice which ascribes the development

of modern science, because of its applicability, to a pragmatic desire to improve conditions and better human life on earth. It is a matter of historical record that modern technology has its origins not in the evolution of those tools man had always devised for the twofold purpose of easing his labors and erecting the human artifice, but exclusively in an altogether non-practical search for useless knowledge. Thus, the watch, one of the first modern instruments, was not invented for purposes of practical life, but exclusively for the highly “theoretical” purpose of conducting certain experiments with nature. This invention, to be sure, once its practical usefulness became apparent, changed the whole rhythm and the very physiognomy of human life; but from the standpoint of the inventors, this was a mere incident. If we had to rely only on men’s so-called practical instincts, there would never have been any technology to speak of, and although today the already existing technical inventions carry a certain momentum which will probably generate improvements up to a certain point, it is not likely that our technically conditioned world could survive, let alone develop further, if we ever succeeded in convincing ourselves that man is primarily a practical being.

However that may be, the fundamental experience behind the reversal of contemplation and action was precisely that man’s thirst for knowledge could be assuaged only after he had put his trust into the ingenuity of his hands. The point was not that truth and knowledge were no longer important, but that they could be won only by “action” and not by contemplation. It was an instrument, the telescope, a work of man’s hands, which finally forced nature, or rather the universe, to yield its secrets. The reasons for trusting *doing* and for distrusting *contemplation* or *observation* became even more cogent after the results of the first active inquiries. After being and appearance had parted company and truth was no longer supposed to appear, to reveal and disclose itself to the mental eye of a beholder, there arose a veritable necessity to hunt for truth behind deceptive appearances. Nothing indeed could be less trustworthy for acquiring knowledge and approaching truth than passive observation or mere contemplation. In order to be certain one had to *make sure*, and in order to know one had to do. Certainty of knowledge could be reached only under a twofold condition: first, that knowledge concerned only what one had done himself – so that its ideal became mathematical knowledge, where we deal only with self-made entities of the mind – and second, that knowledge was of such a nature that it could be tested only through more doing.

Since then, scientific and philosophic truth have parted company; scientific truth not only need not be eternal, it need not even be comprehensible or adequate to human reason. It took many generations of scientists before the human mind grew bold enough to fully face this implication of modernity. If nature and the universe are products of a divine maker, and if the human mind is incapable of understanding what man has not made himself, then man cannot possibly expect to learn anything about nature that he can understand. He may be able, through ingenuity, to find out and even to imitate the devices of natural processes, but that does not mean these devices will ever make sense to him – they do not have to be intelligible. As a matter of fact, no supposedly suprarational divine revelation and no supposedly abstruse philosophic truth has ever offended human reason so glaringly as certain results of modern science. One can indeed say with Whitehead: "Heaven knows what seeming nonsense may not to-morrow be demonstrated truth."⁹

Actually, the change that took place in the seventeenth century was more radical than what a simple reversal of the established traditional order between contemplation and doing is apt to indicate. The reversal, strictly speaking, concerned only the relationship between thinking and doing, whereas contemplation, in the original sense of beholding the truth, was altogether eliminated. For thought and contemplation are not the same. Traditionally, thought was conceived as the most direct and important way to lead to the contemplation of truth. Since Plato, and probably since Socrates, thinking was understood as the inner dialogue in which one speaks with himself (*eme emautō*, to recall the idiom current in Plato's dialogues); and although this dialogue lacks all outward manifestation and even requires a more or less complete cessation of all other activities, it constitutes in itself a highly active state. Its outward inactivity is clearly separated from the passivity, the complete stillness, in which truth is finally revealed to man. If medieval scholasticism looked upon philosophy as the handmaiden of theology, it could very well have appealed to Plato and Aristotle themselves; both, albeit in a very different context, considered this diaogical thought process to be the way to prepare the soul and lead the mind to a beholding of truth beyond thought and beyond speech – a truth that is *arrhēton*, incapable of being communicated through words, as Plato put it,¹⁰ or beyond speech, as in Aristotle.¹¹

The reversal of the modern age consisted then not in raising doing to the rank of contemplating as the highest state of which human beings are capable, as though

henceforth doing was the ultimate meaning for the sake of which contemplation was to be performed, just as, up to that time, all activities of the *vita activa* had been judged and justified to the extent that they made the *vita contemplation* possible. The reversal concerned only thinking, which from then on was the handmaiden of doing as it had been the *ancilla theologiae*, the handmaiden of contemplating divine truth in medieval philosophy and the handmaiden of contemplating the truth of Being in ancient philosophy. Contemplation itself became altogether meaningless.

The radicality of this reversal is somehow obscured by another kind of reversal, with which it is frequently identified and which, since Plato, has dominated the history of Western thought. Whoever reads the Cave allegory in Plato's *Republic* in the light of Greek history will soon be aware that the *periagōgē*, the turning-about that Plato demands of the philosopher, actually amounts to a reversal of the Homeric world order. Not life after death, as in the Homeric Hades, but ordinary life on earth, is located in a "cave," in an underworld; the soul is not the shadow of the body, but the body the shadow of the soul; and the senseless, ghostlike motion ascribed by Homer to the lifeless existence of the soul after death in Hades is now ascribed to the senseless doings of men who do not leave the cave of human existence to behold the eternal ideas visible in the sky.

In this context, I am concerned only with the fact that the Platonic tradition of philosophical as well as political thought started with a reversal, and that this original reversal determined to a large extent the thought patterns into which Western philosophy almost automatically fell wherever it was not animated by a great and original philosophical impetus. Academic philosophy, as a matter of fact, has ever since been dominated by the never-ending reversals of idealism and materialism, of transcendentalism and immanentism, of realism and nominalism, of hedonism and asceticism, and so on. What matters here is the reversibility of all these systems, that they can be turned "upside down" or "downside up" at any moment in history without requiring for such reversal either historical events or changes in the structural elements involved. The concepts themselves remain the same no matter where they are placed in the various systematic orders. Once Plato had succeeded in making these structural elements and concepts reversible, reversals within the course of intellectual history no longer needed more than purely intellectual experience, and experience within the framework of conceptual thinking itself.

These reversals already began with the philosophical schools in late antiquity and have remained part of the Western tradition. It is still the same tradition, the same intellectual game with paired antitheses that rules, to an extent, the famous modern reversals of spiritual hierarchies, such as Marx's turning Hegelian dialectic upside down or Nietzsche's revaluation of the sensual and natural as against the supersensual and supernatural.

The reversal we deal with here, the spiritual consequence of Galileo's discoveries, although it has frequently been interpreted in terms of the traditional reversals and hence as integral to the Western history of ideas, is of an altogether different nature. The conviction that objective truth is not given to man but that he can know only what he makes himself is not the result of skepticism but of a demonstrable discovery, and therefore does not lead to resignation but either to redoubled activity or to despair. The world loss of modern philosophy, whose introspection discovered consciousness as the inner sense with which one senses his senses and found it to be the only guaranty of reality, is different not only in degree from the age-old suspicion of the philosophers toward the world and toward the others with whom they shared the world; the philosopher no longer turns from the world of deceptive perishability to another world of eternal truth, but turns away from both and withdraws into himself. What he discovers in the region of the inner self is, again, not an image whose permanence can be beheld and contemplated, but, on the contrary, the constant movement of sensual perceptions and the no less constantly moving activity of the mind. Since the seventeenth century, philosophy has produced the best and least disputed results when it has investigated, through a supreme effort of self-inspection, the processes of the senses and of the mind. In this aspect, most of modern philosophy is indeed theory of cognition and psychology, and in the few instances where the potentialities of the Cartesian method of introspection were fully realized by men like Pascal, Kierkegaard, and Nietzsche, one is tempted to say that philosophers have experimented with their own selves no less radically and perhaps even more fearlessly than the scientists experimented with nature.

Much as we may admire the courage and respect the extraordinary ingenuity of philosophers throughout the modern age, it can hardly be denied that their influence and importance decreased as never before. It was not in the Middle Ages but in modern thinking that philosophy came to play second and even third fiddle. After Descartes based his own philosophy upon the discoveries

of Galileo, philosophy has seemed condemned to be always one step behind the scientists and their ever more amazing discoveries, whose principles it has strived ardently to discover *ex post facto* and to fit into some over-all interpretation of the nature of human knowledge. As such, however, philosophy was not needed by the scientists, who – up to our time, at least – believed that they had no use for a handmaiden, let alone one who would “carry the torch in front of her gracious lady” (Kant). The philosophers became either epistemologists, worrying about an over-all theory of science which the scientists did not need, or they became, indeed, what Hegel wanted them to be, the organs of the *Zeitgeist*, the mouthpieces in which the general mood of the time was expressed with conceptual clarity. In both instances, whether they looked upon nature or upon history, they tried to understand and come to terms with what happened without them. Obviously, philosophy suffered more from modernity than any other field of human endeavor; and it is difficult to say whether it suffered more from the almost automatic rise of activity to an altogether unexpected and unprecedented dignity or from the loss of traditional truth, that is, of the concept of truth underlying our whole tradition.

42 The Reversal within the *Vita Activa* and the Victory of *Homo Faber*

First among the activities within the *vita activa* to rise to the position formerly occupied by contemplation were the activities of making and fabricating – the prerogatives of *homo faber*. This was natural enough, since it had been an instrument and therefore man in so far as he is a toolmaker that led to the modern revolution. From then on, all scientific progress has been most intimately tied up with the ever more refined development in the manufacture of new tools and instruments. While, for instance, Galileo's experiments with the fall of heavy bodies could have been made at any time in history if men had been inclined to seek truth through experiments, Michelson's experiment with the interferometer at the end of the nineteenth century relied not merely on his “experimental genius” but “required the general advance in technology,” and therefore “could not have been made earlier than it was.”¹²

It is not only the paraphernalia of instruments and hence the help man had to enlist from *homo faber* to

acquire knowledge that caused these activities to rise from their former humble place in the hierarchy of human capacities. Even more decisive was the element of making and fabricating present in the experiment itself, which produces its own phenomena of observation and therefore depends from the very outset upon man's productive capacities. The use of the experiment for the purpose of knowledge was already the consequence of the conviction that one can know only what he has made himself, for this conviction meant that one might learn about those things man did not make by figuring out and imitating the processes through which they had come into being. The much discussed shift of emphasis in the history of science from the old questions of "what" or "why" something is to the new question of "how" it came into being is a direct consequence of this conviction, and its answer can only be found in the experiment. The experiment repeats the natural process as though man himself were about to make nature's objects, and although in the early stages of the modern age no responsible scientist would have dreamt of the extent to which man actually is capable of "making" nature, he nevertheless from the onset approached it from the standpoint of the One who made it, and this not for practical reasons of technical applicability but exclusively for the "theoretical" reason that certainty in knowledge could not be gained otherwise: "Give me matter and I will build a world from it, that is, give me matter and I will show you how a world developed from it." These words of Kant show in a nutshell the modern blending of making and knowing, whereby it is as though a few centuries of knowing in the mode of making were needed as the apprenticeship to prepare modern man for making what he wanted to know.

Productivity and creativity, which were to become the highest ideals and even the idols of the modern age in its initial stages, are inherent standards of *homo faber*, of man as a builder and fabricator. However, there is another and perhaps even more significant element noticeable in the modern version of these faculties. The shift from the "why" and "what" to the "how" implies that the actual objects of knowledge can no longer be things or eternal motions but must be processes, and that the object of science therefore is no longer nature or the universe but the history, the story of the coming into being, of nature or life or the universe. Long before the modern age developed its unprecedented historical consciousness and the concept of history became dominant in modern philosophy, the natural sciences had developed into

historical disciplines, until in the nineteenth century they added to the older disciplines of physics and chemistry, of zoology and botany, the new natural sciences of geology or history of the earth, biology or the history of life, anthropology or the history of human life, and, generally, natural history. In all these instances, development, the key concept of the historical sciences, became the central concept of the physical sciences as well. Nature, because it could be known only in processes which human ingenuity, the ingeniousness of *homo faber*, could repeat and remake in the experiment, became a process, and all particular natural things derived their significance and meaning solely from their functions in the over-all process. In the place of the concept of Being we now find the concept of Process. And whereas it is in the nature of Being to appear and thus disclose itself, it is in the nature of Process to remain invisible, to be something whose existence can only be inferred from the presence of certain phenomena. This process was originally the fabrication process which "disappears in the product," and it was based on the experience of *homo faber*, who knew that a production process necessarily precedes the actual existence of every object.

Yet while this insistence on the process of making or the insistence upon considering everything as the result of a fabrication process is highly characteristic of *homo faber* and his sphere of experience, the exclusive emphasis the modern age placed on it at the expense of all interest in the things, the products themselves, is quite new. It actually transcends the mentality of man as a tool-maker and fabricator, for whom, on the contrary, the production process was a mere means to an end. Here, from the standpoint of *homo faber*, it was as though the means, the production process or development, was more important than the end, the finished product. The reason for this shift of emphasis is obvious: the scientist made only in order to know, not in order to produce things, and the product was a mere by-product, a side effect. Even today all true scientists will agree that the technical applicability of what they are doing is a mere by-product of their endeavor.

The full significance of this reversal of means and ends remained latent as long as the mechanistic world view, the world view of *homo faber* par excellence, was predominant. This view found its most plausible theory in the famous analogy of the relationship between nature and God with the relationship between the watch and the watchmaker. The point in our context is not so much that the eighteenth-century idea of God was obviously

formed in the image of *homo faber* as that in this instance the process character of nature was still limited. Although all particular natural things had already been engulfed in the process from which they had come into being, nature as a whole was not yet a process but the more or less stable end product of a divine maker. The image of watch and watchmaker is so strikingly apposite precisely because it contains both the notion of a process character of nature in the image of the movements of the watch and the notion of its still intact object character in the image of the watch itself and its maker.

It is important at this point to remember that the specifically modern suspicion toward man's truth-receiving capacities, the mistrust of the given, and hence the new confidence in making and introspection which was inspired by the hope that in human consciousness there was a realm where knowing and producing would coincide, did not arise directly from the discovery of the Archimedean point outside the earth in the universe. They were, rather, the necessary consequences of this discovery for the discoverer himself, in so far as he was and remained an earth-bound creature. This close relationship of the modern mentality with philosophical reflection naturally implies that the victory of *homo faber* could not remain restricted to the employment of new methods in the natural sciences, the experiment and the mathematization of scientific inquiry. One of the most plausible consequences to be drawn from Cartesian doubt was to abandon the attempt to understand nature and generally to know about things not produced by man, and to turn instead exclusively to things that owed their existence to man. This kind of argument, in fact, made Vico turn his attention from natural science to history, which he thought to be the only sphere where man could obtain certain knowledge, precisely because he dealt here only with the products of human activity. The modern discovery of history and historical consciousness owed one of its greatest impulses neither to a new enthusiasm for the greatness of man, his doings and suffering, nor to the belief that the meaning of human existence can be found in the story of mankind, but to the despair of human reason, which seemed adequate only when confronted with man-made objects.

Prior to the modern discovery of history but closely connected with it in its impulses are the seventeenth-century attempts to formulate new political philosophies or, rather, to invent the means and instruments with which to "make an artificial animal ... called a Commonwealth, or State."¹³ With Hobbes as with Descartes "the prime

mover was doubt,"¹⁴ and the chosen method to establish the "art of man," by which he would make and rule his own world as "God hath made and governs the world" by the art of nature, is also introspection, "to read in himself," since this reading will show him "the similitude of the thoughts and passions of one man to the thoughts and passions of another." Here, too, the rules and standards by which to build and judge this most human of human "works of art"¹⁵ do not lie outside of men, are not something men have in common in a worldly reality perceived by the senses or by the mind. They are, rather, inclosed in the inwardness of man, open only to introspection, so that their very validity rests on the assumption that "not ... the objects of the passions" but the passions themselves are the same in every specimen of the species man-kind. Here again we find the image of the watch, this time applied to the human body and then used for the movements of the passions. The establishment of the Commonwealth, the human creation of "an artificial man," amounts to the building of an "automaton [an engine] that moves [itself] by springs and wheels as doth a watch."

In other words, the process which, as we saw, invaded the natural sciences through the experiment, through the attempt to imitate under artificial conditions the process of "making" by which a natural thing came into existence, serves as well or even better as the principle for doing in the realm of human affairs. For here the processes of inner life, found in the passions through introspection, can become the standards and rules for the creation of the "automatic" life of that "artificial man" who is "the great Leviathan." The results yielded by introspection, the only method likely to deliver certain knowledge, are in the nature of movements: only the objects of the senses remain as they are and endure, precede and survive, the act of sensation; only the objects of the passions are permanent and fixed to the extent that they are not devoured by the attainment of some passionate desire; only the objects of thoughts, but never thinking itself, are beyond motion and perishability. Processes, therefore, and not ideas, the models and shapes of the things to be, become the guide for the making and fabricating activities of *homo faber* in the modern age.

Hobbes's attempt to introduce the new concepts of making and reckoning into political philosophy – or, rather, his attempt to apply the newly discovered aptitudes of making to the realm of human affairs – was of the greatest importance; modern rationalism as it is currently known, with the assumed antagonism of reason

and passion as its stock-in-trade, has never found a clearer and more uncompromising representative. Yet it was precisely the realm of human affairs where the new philosophy was first found wanting, because by its very nature it could not understand or even believe in reality. The idea that only what I am going to make will be real – perfectly true and legitimate in the realm of fabrication – is forever defeated by the actual course of events, where nothing happens more frequently than the totally unexpected. To act in the form of making, to reason in the form of "reckoning with consequences," means to leave out the unexpected, the event itself, since it would be unreasonable or irrational to expect what is no more than an "infinite improbability." Since, however, the event constitutes the very texture of reality within the realm of human affairs, where the "wholly improbable happens regularly," it is highly unrealistic not to reckon with it, that is, not to reckon with something with which nobody can safely reckon. The political philosophy of the modern age, whose greatest representative is still Hobbes, founders on the perplexity that modern rationalism is unreal and modern realism is irrational – which is only another way of saying that reality and human reason have parted company. Hegel's gigantic enterprise to reconcile spirit with reality (*den Geist mit der Wirklichkeit zu versöhnen*), a reconciliation that is the deepest concern of all modern theories of history, rested on the insight that modern reason foundered on the rock of reality.

The fact that modern world alienation was radical enough to extend even to the most worldly of human activities, to work and reification, the making of things and the building of a world, distinguishes modern attitudes and evaluations even more sharply from those of tradition than a mere reversal of contemplation and action, of thinking and doing, would indicate. The break with contemplation was consummated not with the elevation of man the maker to the position formerly held by man the contemplator, but with the introduction of the concept of process into making. Compared with this, the striking new arrangement of hierarchical order within the *vita activa*, where fabrication now came to occupy a rank formerly held by political action, is of minor importance. We saw before that this hierarchy had in fact, though not expressly, already been overruled in the very beginnings of political philosophy by the philosophers' deep-rooted suspicion of politics in general and action in particular.

The matter is somewhat confused because Greek political philosophy still follows the order laid down by the *polis* even when it turns against it; but in their strictly

philosophical writings (to which, of course, one must turn if he wants to know their innermost thoughts), Plato as well as Aristotle tends to invert the relationship between work and action in favor of work. Thus Aristotle, in a discussion of the different kinds of cognition in his *Metaphysics*, places *dianoia* and *epistēmē praktikē*, practical insight and political science, at the lowest rank of his order, and puts above them the science of fabrication, *epistēmē poiētikē*, which immediately precedes and leads to *theōria*, the contemplation of truth.¹⁶ And the reason for this predilection in philosophy is by no means the politically inspired suspicion of action which we mentioned before, but the philosophically much more compelling one that contemplation and fabrication (*theōria* and *poiēsis*) have an inner affinity and do not stand in the same unequivocal opposition to each other as contemplation and action. The decisive point of similarity, at least in Greek philosophy, was that contemplation, the beholding of something, was considered to be an inherent element in fabrication as well, inasmuch as the work of the craftsman was guided by the "idea," the model beheld by him before the fabrication process had started as well as after it had ended, first to tell him what to make and then to enable him to judge the finished product.

Historically, the source of this contemplation, which we find for the first time described in the Socratic school, is at least twofold. On one hand, it stands in obvious and consistent connection with the famous contention of Plato, quoted by Aristotle, that *thaumazein*, the shocked wonder at the miracle of Being, is the beginning of all philosophy.¹⁷ It seems to me highly probable that this Platonic contention is the immediate result of an experience, perhaps the most striking one, that Socrates offered his disciples: the sight of him time and again suddenly overcome by his thoughts and thrown into a state of absorption to the point of perfect motionlessness for many hours. It seems no less plausible that this shocked wonder should be essentially speechless, that is, that its actual content should be untranslatable into words. This, at least, would explain why Plato and Aristotle, who held *thaumazein* to be the beginning of philosophy, should also agree – despite so many and such decisive disagreements – that some state of speechlessness, the essentially speechless state of contemplation, was the end of philosophy. *Theōria*, in fact, is only another word for *thaumazein*; the contemplation of truth at which the philosopher ultimately arrives is the philosophically purified speechless wonder with which he began.

There is, however, another side to this matter, which shows itself most articulately in Plato's doctrine of ideas, in

its content as well as in its terminology and exemplifications. These reside in the experiences of the craftsman, who sees before his inner eye the shape of the model according to which he fabricates his object. To Plato, this model, which craftsmanship can only imitate but not create, is no product of the human mind but given to it. As such it possesses a degree of permanence and excellence which is not actualized but on the contrary spoiled in its materialization through the work of human hands. Work makes perishable and spoils the excellence of what remained eternal so long as it was the object of mere contemplation. Therefore, the proper attitude toward the models which guide work and fabrication, that is, toward Platonic ideas, is to leave them as they are and appear to the inner eye of the mind. If man only renounces his capacity for work and does not do anything, he can behold them and thus participate in their eternity. Contemplation, in this respect, is quite unlike the enraptured state of wonder with which man responds to the miracle of Being as a whole. It is and remains part and parcel of a fabrication process even though it has divorced itself from all work and all doing; in it, the beholding of the model, which now no longer is to guide any doing, is prolonged and enjoyed for its own sake.

In the tradition of philosophy, it is this second kind of contemplation that became the predominant one. Therefore the motionlessness which in the state of speechless wonder is no more than an incidental, unintended result of absorption, becomes now the condition and hence the outstanding characteristic of the *vita contemplativa*. It is not wonder that overcomes and throws man into motionlessness, but it is through the conscious cessation of activity, the activity of making, that the contemplative state is reached. If one reads medieval sources on the joys and delights of contemplation, it is as though the philosophers wanted to make sure that *homo faber* would heed the call and let his arms drop, finally realizing that his greatest desire, the desire for permanence and immortality, cannot be fulfilled by his doings, but only when he realizes that the beautiful and eternal cannot be made. In Plato's philosophy, speechless wonder, the beginning and the end of philosophy, together with the philosopher's love for the eternal and the craftsman's desire for permanence and immortality, permeate each other until they are almost indistinguishable. Yet the very fact that the philosophers' speechless wonder seemed to be an experience reserved for the few, while the craftsmen's contemplative glance was known by many, weighed heavily in favor of a contemplation primarily derived

from the experiences of *homo faber*. It already weighed heavily with Plato, who drew his examples from the realm of making because they were closer to a more general human experience, and it weighed even more heavily where some kind of contemplation and meditation was required of everybody, as in medieval Christianity.

Thus it was not primarily the philosopher and philosophic speechless wonder that molded the concept and practice of contemplation and the *vita contemplativa*, but rather *homo faber* in disguise; it was man the maker and fabricator, whose job it is to do violence to nature in order to build a permanent home for himself, and who now was persuaded to renounce violence together with all activity, to leave things as they are, and to find his home in the contemplative dwelling in the neighborhood of the imperishable and eternal. *Homo faber* could be persuaded to this change of attitude because he knew contemplation and some of its delights from his own experience; he did not need a complete change of heart, a true *periagōgē*, a radical turnabout. All he had to do was let his arms drop and prolong indefinitely the act of beholding the *eidos*, the eternal shape and model he had formerly wanted to imitate and whose excellence and beauty he now knew he could only spoil through any attempt at reification.

If, therefore, the modern challenge to the priority of contemplation over every kind of activity had done no more than turn upside down the established order between making and beholding, it would still have remained in the traditional framework. This framework was forced wide open, however, when in the understanding of fabrication itself the emphasis shifted entirely away from the product and from the permanent, guiding model to the fabrication process, away from the question of what a thing is and what kind of thing was to be produced to the question of how and through which means and processes it had come into being and could be reproduced. For this implied both that contemplation was no longer believed to yield truth and that it had lost its position in the *vita activa* itself and hence within the range of ordinary human experience.

43 The Defeat of *Homo Faber* and the Principle of Happiness

If one considers only the events that led into the modern age and reflects solely upon the immediate consequences of Galileo's discovery, which must have struck the great

minds of the seventeenth century with the compelling force of self-evident truth, the reversal of contemplation and fabrication, or rather the elimination of contemplation from the range of meaningful human capacities, is almost a matter of course. It seems equally plausible that this reversal should have elevated *homo faber*, the maker and fabricator, rather than man the actor or man as *animal laborans*, to the highest range of human possibilities.

And, indeed, among the outstanding characteristics of the modern age from its beginning to our own time we find the typical attitudes of *homo faber*: his instrumentalization of the world, his confidence in tools and in the productivity of the maker of artificial objects; his trust in the all-comprehensive range of the means-end category, his conviction that every issue can be solved and every human motivation reduced to the principle of utility; his sovereignty, which regards everything given as material and thinks of the whole of nature as of "an immense fabric from which we can cut out whatever we want to resew it however we like";¹⁸ his equation of intelligence with ingenuity, that is, his contempt for all thought which cannot be considered to be "the first step ... for the fabrication of artificial objects, particularly of tools to make tools, and to vary their fabrication indefinitely";¹⁹ finally, his matter-of-course identification of fabrication with action.

It would lead us too far afield to follow the ramifications of this mentality, and it is not necessary, for they are easily detected in the natural sciences, where the purely theoretical effort is understood to spring from the desire to create order out of "mere disorder," the "wild variety of nature," and where therefore *homo faber's* predilection for patterns for things to be produced replaces the older notions of harmony and simplicity. It can be found in classical economics, whose highest standard is productivity and whose prejudice against non-productive activities is so strong that even Marx could justify his plea for justice for laborers only by misrepresenting the laboring, non-productive activity in terms of work and fabrication. It is most articulate, of course, in the pragmatic trends of modern philosophy, which are not only characterized by Cartesian world alienation but also by the unanimity with which English philosophy from the seventeenth century onward and French philosophy in the eighteenth century adopted the principle of utility as the key which would open all doors to the explanation of human motivation and behavior. Generally speaking, the oldest conviction of *homo faber* – that "man is the measure of all things" – advanced to the rank of a universally accepted commonplace.

What needs explanation is not the modern esteem of *homo faber* but the fact that this esteem was so quickly followed by the elevation of laboring to the highest position in the hierarchical order of the *vita activa*. This second reversal of hierarchy within the *vita activa* came about more gradually and less dramatically than either the reversal of contemplation and action in general or the reversal of action and fabrication in particular. The elevation of laboring was preceded by certain deviations and variations from the traditional mentality of *homo faber* which were highly characteristic of the modern age and which, indeed, arose almost automatically from the very nature of the events that ushered it in. What changed the mentality of *homo faber* was the central position of the concept of process in modernity. As far as *homo faber* was concerned, the modern shift of emphasis from the "what" to the "how," from the thing itself to its fabrication process, was by no means an unmixed blessing. It deprived man as maker and builder of those fixed and permanent standards and measurements which, prior to the modern age, have always served him as guides for his doing and criteria for his judgment. It is not only and perhaps not even primarily the development of commercial society that, with the triumphal victory of exchange value over use value, first introduced the principle of interchangeability, then the relativization, and finally the devaluation, of all values. For the mentality of modern man, as it was determined by the development of modern science and the concomitant unfolding of modern philosophy, it was at least as decisive that man began to consider himself part and parcel of the two superhuman, all-encompassing processes of nature and history, both of which seemed doomed to an infinite progress without ever reaching any inherent *telos* or approaching any preordained idea.

Homo faber, in other words, as he arose from the great revolution of modernity, though he was to acquire an undreamed-of ingenuity in devising instruments to measure the infinitely large and the infinitely small, was deprived of those permanent measures that precede and outlast the fabrication process and form an authentic and reliable absolute with respect to the fabricating activity. Certainly, none of the activities of the *vita activa* stood to lose as much through the elimination of contemplation from the range of meaningful human capacities as fabrication. For unlike action, which partly consists in the unchaining of processes, and unlike laboring, which follows closely the metabolic process of biological life, fabrication experiences processes, if it is aware of them at all, as mere means toward an end, that is, as something

secondary and derivative. No other capacity, moreover, stood to lose as much through modern world alienation and the elevation of introspection into an omnipotent device to conquer nature as those facilities which are primarily directed toward the building of the world and the production of worldly things.

Nothing perhaps indicates clearer the ultimate failure of *homo faber* to assert himself than the rapidity with which the principle of utility, the very quintessence of his world view, was found wanting and was superseded by the principle of “the greatest happiness of the greatest number.” When this happened it was manifest that the conviction of the age that man can know only what he makes himself – which seemingly was so eminently propitious to a full victor of *homo faber* – would be overruled and eventually destroyed by the even more modern principle of process, whose concepts and categories are altogether alien to the needs and ideals of *homo faber*. For the principle of utility, though its point of reference is clearly man, who uses matter to produce things, still presupposes a world of use objects by which man is surrounded and in which he moves. If this relationship between man and world is no longer secure, if worldly things are no longer primarily considered in their usefulness but as more or less incidental results of the production process which brought them into being, so that the end product of the production process is no longer a true end and the produced thing is valued not for the sake of its predetermined usage but “for its production of something else,” then, obviously, the objection can be “raised that ... its value is secondary only, and a world that contains no primary values can contain no secondary ones either.” This radical loss of values within the restricted frame of reference of *homo faber* himself occurs almost automatically as soon as he defines himself not as the maker of objects and the builder of the human artifice who incidentally invents tools, but considers himself primarily a toolmaker and “particularly [a maker] of tools to make tools” who only incidentally also produces things. If one applies the principle of utility in this context at all, then it refers primarily not to use objects and not to usage but to the production process. Now what helps stimulate productivity and lessens pain and effort is useful. In other words, the ultimate standard of measurement is not utility and usage at all, but “happiness,” that is, the amount of pain and pleasure experienced in the production or in the consumption of things.

Bentham’s invention of the “pain and pleasure calculus” combined the advantage of seemingly introducing

the mathematical method into the moral sciences with the even greater attraction of having found a principle which resided entirely on introspection. His “happiness,” the sum total of pleasures minus pains, is as much an inner sense which senses sensations and remains unrelated to worldly objects as the Cartesian consciousness that is conscious of its own activity. Moreover, Bentham’s basic assumption that what all men have in common is not the world but the sameness of their own nature, which manifests itself in the sameness of calculation and the sameness of being affected by pain and pleasure, is directly derived from the earlier philosophers of the modern age. For this philosophy, “hedonism” is even more of a misnomer than for the epicureanism of late antiquity, to which modern hedonism is only superficially related. The principle of all hedonism, as we saw before, is not pleasure but avoidance of pain, and Hume, who in contradistinction to Bentham was still a philosopher, knew quite well that he who wants to make pleasure the ultimate end of all human action is driven to admit that not pleasure but pain, not desire but fear, are his true guides. “If you ... inquire, why [somebody] desires health, he will readily reply, because sickness is painful. If you push your inquiries further and desire a reason why he hates pain, it is impossible he can ever give any. This is an ultimate end, and is never referred to by any other object.” The reason for this impossibility is that only pain is completely independent of any object, that only one who is in pain really senses nothing but himself; pleasure does not enjoy itself but something besides itself. Pain is the only inner sense found by introspection which can rival in independence from experienced objects the self-evident certainty of logical and arithmetical reasoning.

While this ultimate foundation of hedonism in the experience of pain is true for both its ancient and modern varieties, in the modern age it acquires an altogether different and much stronger emphasis. For here it is by no means the world, as in antiquity, that drives man into himself to escape the pains it may inflict, under which circumstance both pain and pleasure still retain a good deal of their worldly significance. Ancient world alienation in all its varieties – from stoicism to epicureanism down to hedonism and cynicism – had been inspired by a deep mistrust of the world and moved by a vehement impulse to withdraw from worldly involvement, from the trouble and pain it inflicts, into the security of an inward realm in which the self is exposed to nothing but itself. Their modern counterparts – puritanism, sensualism, and Bentham’s hedonism – on the contrary, were

inspired by an equally deep mistrust of man as such; they were moved by doubt of the adequacy of the human senses to receive reality, the adequacy of human reason to receive truth, and hence by the conviction of the deficiency or even depravity of human nature.

This depravity is not Christian or biblical either in origin or in content, although it was of course interpreted in terms of original sin, and it is difficult to say whether it is more harmful and repulsive when puritans denounce man's corruptness or when Benthamites brazenly hail as virtues what men always have known to be vices. While the ancients had relied upon imagination and memory, the imagination of pains from which they were free or the memory of past pleasures in situations of acute painfulness, to convince themselves of their happiness, the moderns needed the calculus of pleasure or the puritan moral bookkeeping of merits and transgressions to arrive at some illusory mathematical certainty of happiness or salvation. (These moral arithmetics are, of course, quite alien to the spirit pervading the philosophic schools of late antiquity. Moreover, one need only reflect on the rigidity of self-imposed discipline and the concomitant nobility of character, so manifest in those who had been formed by ancient stoicism or epicureanism, to become aware of the gulf by which these versions of hedonism are separated from modern puritanism, sensualism, and hedonism. For this difference, it is almost irrelevant whether the modern character is still formed by the older narrow-minded, fanatic self-righteousness or has yielded to the more recent self-centered and self-indulgent egotism with its infinite variety of futile miseries.) It seems more than doubtful that the "greatest happiness principle" would have achieved its intellectual triumphs in the English-speaking world if no more had been involved than the questionable discovery that "nature has placed mankind under the governance of two sovereign masters, pain and pleasure,"²⁰ or the absurd idea of establishing morals as an exact science by isolating "in the human soul that feeling which seems to be the most easily measurable."

Hidden behind this as behind other, less interesting variations of the sacredness of egoism and the all-pervasive power of self-interest, which were current to the point of being commonplace in the eighteenth and early nineteenth centuries, we find another point of reference which indeed forms a much more potent principle than any pain-pleasure calculus could ever offer, and that is the principle of life itself. What pain and pleasure, fear and desire, are actually supposed to achieve in all these

systems is not happiness at all but the promotion of individual life or a guaranty of the survival of mankind. If modern egoism were the ruthless search for pleasure (called happiness) it pretends to be, it would not lack what in all truly hedonistic systems is an indispensable element of argumentation – a radical justification of suicide. This lack alone indicates that in fact we deal here with life philosophy in its most vulgar and least critical form. In the last resort, it is always life itself which is the supreme standard to which everything else is referred, and the interests of the individual as well as the interests of mankind are always equated with individual life or the life of the species as though it were a matter of course that life is the highest good.

The curious failure of *homo faber* to assert himself under conditions seemingly so extraordinarily propitious could also have been illustrated by another, philosophically even more relevant, revision of basic traditional beliefs. Hume's radical criticism of the causality principle, which prepared the way for the later adoption of the principle of evolution, has often been considered one of the origins of modern philosophy. The causality principle with its twofold central axiom – that everything that is must have a cause (*nihil sine causa*) and that the cause must be more perfect than its most perfect effect – obviously relies entirely on experiences in the realm of fabrication, where the maker is superior to his products. Seen in this context, the turning point in the intellectual history of the modern age came when the image of organic life development – where the evolution of a lower being, for instance the ape, can cause the appearance of a higher being, for instance man – appeared in the place of the image of the watchmaker who must be superior to all watches whose cause he is.

Much more is implied in this change than the mere denial of the lifeless rigidity of a mechanistic world view. It is as though in the latent seventeenth-century conflict between the two possible methods to be derived from the Galilean discovery, the method of the experiment and of making on one hand and the method of introspection on the other, the latter was to achieve a somewhat belated victory. For the only tangible object introspection yields, if it is to yield more than an entirely empty consciousness of itself, is indeed the biological process. And since this biological life, accessible in self-observation, is at the same time a metabolic process between man and nature, it is as though introspection no longer needs to get lost in the ramifications of a consciousness without reality, but has found within man – not in his mind but

in his bodily processes – enough outside matter to connect him again with the outer world. The split between subject and object, inherent in human consciousness and irremediable in the Cartesian opposition of man as a *res cogitans* to a surrounding world of *res extensae*, disappears altogether in the case of a living organism,

whose very survival depends upon the incorporation, the consumption, of outside matter. Naturalism, the nineteenth-century version of materialism, seemed to find in life the way to solve the problems of Cartesian philosophy and at the same time to bridge the ever-widening chasm between philosophy and science.²¹

Notes

- 1 Augustine, who is usually credited with having been the first to raise the so-called anthropological question in philosophy, knew this quite well. He distinguishes between the questions of “Who am I?” and “What am I?” the first being directed by man at himself (“And I directed myself at myself and said to me: You, who are you? And I answered: A man” – *tu, quis es?* [*Confessiones* x. 6]) and the second being addressed to God (“What then am I, my God? What is my nature?” – *Quid ergo sum, Deus meus? Quae uatura sum?* [x. 17]). For in the “great mystery,” the *grande profundum*, which man is (iv. 14), there is “something of man [*aliquid hominis*] which the spirit of man which is in him itself knoweth not. But Thou, Lord, who has made him [*fecisti eum*] knowest every thing of him [*eius omnia*]” (x. 5). Thus, the most familiar of these phrases which I quoted in the text, the *quaestio mihi factus sum*, is a question raised in the presence of God, “in whose eyes I have become a question for myself” (x. 33). In brief, the answer to the question “Who am I?” is simply: “You are a man – whatever that may be”; and the answer to the question “What am I?” can be given only by God who made man. The question about the nature of man is no less a theological question than the question about the nature of God; both can be settled only within the framework of a divinely revealed answer.
- 2 That the *cogito ergo sum* contains a logical error, that, as Nietzsche pointed out, it should read: *cogito, ergo cogitationes sunt*, and that therefore the mental awareness expressed in the *cogito* does not prove that I am, but only that consciousness is, is another matter and need not interest us here (see Nietzsche, *Wille zur Macht*, No. 484).
- 3 This transformation of common sense into an inner sense is characteristic of the whole modern age; in the German language it is indicated by the difference between the older German word *Gemeinsinn* and the more recent expression *gesunder Menschen-verstand* which replaced it.
- 4 Hermann Minkowski, “Raum und Zeit,” in Lorentz, Einstein, and Minkowski, *Das Relativitätsprinzip* (1913).
- 5 And this doubt is not assuaged if another coincidence is added, the coincidence between logic and reality. Logically, it seems evident indeed that “the electrons if they were to explain the sensory qualities of matter could not very well possess these sensory qualities, since in that case the question for the cause of these qualities would simply have been removed one step farther, but not solved” (Heisenberg, *Wandlungen in den Grundlagen der Naturwissenschaft* [1935], p. 66). The reason why we become suspicious is that only when “in the course of time” the scientists became aware of this logical necessity did they discover that “matter” had no qualities and therefore could no longer be called matter.
- 6 In the words of Erwin Schrödinger. “As our mental eye penetrates into smaller and smaller distances and shorter and shorter times, we find nature behaving so entirely differently from what we observe in visible and palpable bodies of our surrounding that no model shaped after our large-scale experiences can ever be ‘true’” (*Science and Humanism* [1952], p. 25).
- 7 Heisenberg, *Wandlungen in den Grundlagen*, p. 64.
- 8 Schrödinger, *op. cit.*, p. 26.
- 9 *Science and the Modern World* [1925], p. 116.
- 10 In the *Seventh letter* 341C: *rhēton gar oudamōs estin hōs alla mathēmata* (“for it is never to be expressed by words like other things we learn”).
- 11 See esp. *Nicomachean Ethics* 1142a25 ff. and 1143a 36 ff. The current English translation distorts the meaning because it renders *logos* as “reason” or “argument.”
- 12 Whitehead, *Science and the Modern World*, pp. 116–17.
- 13 Hobbes’s Introduction to the *Leviathan*.
- 14 See Michael Oakeshott’s excellent Introduction to the *Leviathan* [1651] (Blackwell’s Political Texts), p. xiv.
- 15 *Ibid.*, p. lxiv.
- 16 *Metaphysics* 1025b25 ff., 1064a 17 ff.
- 17 For Plato see *Theaetetus* 155: *Mala gar philosophou touto to pathos, to thaumazein; ou gar allē archē philosophias ē hautē* (“For wonder is what the philosopher endures most; for there is no other beginning of philosophy than this”). Aristotle, who at the beginning of the *Metaphysics* (982b12ff.) seems to repeat Plato almost verbatim – “For it is owing to their wonder that men both now begin and at first began to philosophize” – actually uses this wonder in an altogether different way; to him, the actual impulse to philosophize lies in the desire “to escape ignorance.”
- 18 Henri Bergson, *Évolution créatrice* (1948) p. 157.
- 19 *Ibid.*, p. 140.

- 20 This, of course, is the first sentence of the *Principles of Morals and Legislation* [1789].
- 21 The greatest representatives of modern life philosophy are Marx, Nietzsche, and Bergson, inasmuch as all three equate Life and Being. For this equation, they rely on introspection, and life is indeed the only “being” man can possibly be aware of by looking merely into himself. The difference between these and the earlier philosophers of the modern age is that life appears to be more active and more productive than consciousness, which seems to be still too closely related to contemplation and the old ideal of truth. This last stage of modern philosophy is perhaps best described as the

rebellion of the philosophers against philosophy, a rebellion which, beginning with Kierkegaard and ending in existentialism, appears at first glance to emphasize action as against contemplation. Upon closer inspection, however, none of these philosophers is actually concerned with action as such. We may leave aside here Kierkegaard and his non-worldly, inward-directed acting. Nietzsche and Bergson describe action in terms of fabrication – *homo faber* instead of *homo sapiens* – just as Marx thinks of acting in terms of making and describes labor in terms of work. But their ultimate point of reference is not work and worldliness any more than action; it is life and life’s fertility.

Putting Pragmatism (especially Dewey's) to Work

Larry Hickman

“Technology” signifies all the intelligent techniques by which the energies of nature and man are directed and used in satisfaction of human needs; it cannot be limited to a few outer and comparatively mechanical forms. In the face of its possibilities, the traditional conception of experience is obsolete.

John Dewey, “What I Believe”¹

[...]

II. Naturalizing Technology

[...]

My theme in this section is naturalizing technology – locating technology within the evolutionary history of human development. It is also, incidentally, an attempt to clear up some misunderstandings that were occasioned by my treatment of technology in *John Dewey's Pragmatic Technology*.² Carl Mitcham, for example, took my claim to be that all activity is in some sense technological. He responded that “if virtually all knowing, and indeed all human activity, is or ought to be at its core technological, this raises the specter of reductionism.” He quite reasonably concluded that “if all life is technological then the concept of technology becomes vacuous.”³

A responsible reply to his objection calls for a brief account of four interrelated but functionally separate types or phases of human activity, and this in order to

demonstrate that in fact vast areas of human activity lie outside the domain of what I have characterized as technological.

Some activity, for example, involves the use of tools and artifacts and some does not. Activity that *does* involve the use of tools and artifacts can be divided into two types. What is *technological* involves cognitive or deliberate inferential activity,⁴ whereas what is merely *technical* is generally and for the most part habitual. It is non-cognitive or non-inferential. Activity that *does not* involve tools and artifacts may likewise be divided into two types. First, there is activity that is *non-instrumental but at least minimally cognitive*. Second, there is activity that is *non-instrumental as well as non-cognitive*. Activity of this last type usually involves little more than immediate perception or habitual “knee-jerk” responses.

Activities that are *technological* include much of what engineers, computer programmers, musicians, architects, and historians do, as well as what each of us does when we utilize tools and artifacts, whether they be concrete or abstract, to address some perceived problem. Such

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activities are characterized by organized and deliberate transformations of existing situations in ways that generate new outcomes, or products.

In certain cases of this type of activity we may wish to distinguish concrete or tangible tools from those that are abstract or intangible. When such a distinction is made, however, it is itself a tool used within a particular sequence of inquiry.

There is, for example, a difference between the work of an architect and the work of a novelist, or between the work of an engineer and the work of a politician, or even between the work of a sculptor and a person who is planning a vacation. In each of these pairs, the first project emphasizes the material and tangible over the abstract and intangible. The second project in each pair emphasizes the abstract and intangible over the material and tangible. A sculptor is likely to use a mallet and chisel, acquired woodworking skills, a block of oak, and perhaps even some previously constructed ornamental detail that she has in her workshop. A person planning a vacation might use a computer, skill at using the Internet, a list of schedules and fares she finds there, and perhaps an address or phone number of a restaurant or hotel that she has in her files or remembers from a previous trip.

In terms of basic activities, however, each of these examples involves a basic pattern of cognition, or productive problem-solving. Considered in terms of the pattern of inquiry involved, the question of whether the tools involved are tangible or intangible simply dissolves into the background. In the event that such activities were examined from another angle, however, such as how much work space is required to accomplish a task, the distinction between tangible and intangible might well return to the foreground. A sculptor, for example, usually requires more work space than a person planning a vacation.

In the case of a mathematician, hardly any space is required. Nevertheless we must count her tools and artifacts, such as pi and the square root of minus one, as more or less on the same footing as the tools and artifacts of any other profession. This is a point that Dewey made and elaborated in his 1916 essay "Logical Objects" (MW.10.89–97).

Examples of merely *technical* activities include most of what assembly line workers do, what carpenters do when they drive nails, what most of us (except student drivers) do when driving a car, what engineers do when they look up data for load factors, and in fact what most of us do most of the time when we employ tools and artifacts, regardless of whether such tools be counted as

tangible or intangible. If this category of behavior were not very large, creativity and innovation that is a part of technological activity would be stifled. We would drown in a sea of details.

If the technical activity of driving a car were not for the most part habitual, for example, then it would not leave room for the cognitive work that must also be done while driving. To take another example, if the technical activities of airline pilots did not involve standardized, habitualized, practical skills, there would be no space left in which to deal with in-flight anomalies or emergencies that demand immediate creative – technological – attention.

The category of *non-instrumental cognitive*, activities is extremely difficult to characterize. In cases of this sort a need is identified and then satisfied by the use of something non-artifactual that is immediately at hand – perhaps even by the hand itself. This might involve deciding that the water in a mountain stream is safe, and then cupping a hand and drinking. Or it might involve deciding that a wild animal constitutes a threat and then running away. Simply deciding to pick a flower and enjoy its scent is an uncomplicated example of this type of experience. Since we do not normally talk of hands and feet as tools, it does not seem quite right to identify these activities as instrumental. But there is cognition at a very low level. Each of the examples involves the solution of a fairly simple problem.

What makes these examples so slippery is that in an extended or analogous sense each of them might be said to involve tool-use because it involves low-level inference. This is because inference generally involves the use of conclusions that have proven to be of value in the past and that have become the inferential stock parts we term "premises," as well as the type of tools that we call "transformation rules," when they reach the level of conscious and deliberate use. William James, John Dewey, and Marshall McLuhan, among others, had some of the same difficulties with this category of activity that I am now experiencing as a part of my attempt to characterize it. To call it technological without qualification would be to create confusion with activities that are unambiguously instrumental and cognitive. But not to recognize that there is at least a low level of cognition present would be to deny the obvious.

A part of the problem is attributable to certain vestigial structures that continue to affect – one might even say infect – our language. It is almost impossible, for example, to ignore the influence of mind-body dualism on linguistic usage. Some major industries even have a

vested interest in maintaining these linguistic fossils. If the mind and body are separate, for example, insurance companies can continue to offer health plans for “physical” diseases but avoid paying for “mental” ones. Of course I have avoided talk of minds and bodies altogether because such talk relies on assumptions that are empirically suspect. I have instead talked about the empirically obvious fact that human beings are biological organisms with an evolutionary history and multiple ways of interacting with their environments. It is in this context that it is possible to point to the existence of a grey or fuzzy area between “tools” that are extra-organic and those that are intra-organic. The difference between what is not cognitive in the activities of non-human animals and what is cognitive in the activities of human beings is a matter of degree.

Activities that are *non-instrumental and non-cognitive* include immediate perceptions and unconscious habitual responses. They include the immediate delight associated with viewing a sunrise or walking on the beach, and the immediate pain involved in stubbing a toe or straining a muscle. They also include the expression of organic habits such as particular ways of smiling, standing, or walking. If there is any inference at all, it is usually below the level of consciousness.

[. . .]

Philosophers, especially since the time of Descartes, have spent an inordinate amount of time and energy attempting to deal with experiences that are non-instrumental and non-cognitive, but by and large they have not been very successful. They have debated the status of things such as hallucinations, mirages, sticks that appear bent in water, and so on, as if there were matters of deep metaphysical importance at stake. Most of these debates could probably have been cut short, however, if it had been recognized that experiences of this type do not have any role whatsoever in inquiry unless they are called upon to serve some representative function, that is, unless they are required to point beyond themselves as a result of their being involved in some doubtful situation that requires inquiry.

This is a point that Dewey made in his 1927 essay “Appearing and Appearance” (LW.3.55–72). His account inverted the standard epistemological story. Knowing, he argued, is not the sole and only legitimate method of experiencing, nor is it the criteria of experience. Most of our experiences are not anything cognized, but they do offer a possibility of being an occasion for cognitive activity.

More needs to be said about what Dewey told us about this type of experience, since his account helps to

clarify what my analysis of these four types of activity has to do with the theme of this section, namely “naturalizing technology.”

In his 1938 *Logic*, Dewey devoted a section to what he called “common sense and scientific inquiry.” He began by calling attention to what he termed a “situation.” A situation is a contextual whole that is experienced as prior to any object or event or set of objects or events that might eventually be found in it or abstracted from it. A situation, then, is some part of an enviroing experienced world that has a certain dominant character or quality. A singular object or event may stand out from the complex whole or situation, however, when the situation presents what Dewey called “some problem of use or enjoyment” (LW.132.72). The object or event is then abstracted or isolated with a view to determining the nature of the problem at hand and carrying forward some course of action that will lead to its satisfactory reconstruction.

It is at this point that the cognitive enters in. “When the act and object of perception are isolated from their place and function in promoting and directing a successful course of activities in behalf of use-enjoyment, they are taken to be exclusively cognitive (LW.12.73). To be cognitive in this sense means that what has been isolated from a situation will be used to prolong enjoyment or avoid suffering. In short, the cognitive alters the enviroing situation of the organism. The new situation is artificial and a product of the type of manufacture we term cognitive. It is the product of an activity that is best termed technological.

At this point I need to recur to what I said earlier about the purpose of offering this fourfold analysis of human activity. *Its aim is to naturalize technology, that is, to locate technology as a cognitive activity within the evolutionary history of complex organisms.* Once this has been done, I hope that it will be apparent that my account does not advance the unsupportable claim that “all life is technological.”

This evolutionary history can be fleshed out by saying something more about the relations between and among the four types of activities I have just described. Immediate perception and habitual non-instrumental response are just that: immediate. Upon reflection, however, elements that are found in such experiences or abstracted from them may be analyzed as either something to be avoided or something to be sustained.

Humans, and even less complex organisms, tend to intervene in such situations – either to adapt themselves to the situation or to alter it in some way. Some animals,

for example, such as rabbits, adapt passively to perceived danger by freezing in their tracks or hiding. Other animals are more active; they alter their environing situation. An alarmed squid, for example, alters the visibility of the water in its vicinity. Taken together, processes of adaptation and alteration constitute what Dewey calls “adjustment.”

The adjustive activities of humans, when they reach a certain level of organizational complexity, may be called “cognitive” or “inferential.” As I use these terms, they refer to choice that is purposive, deliberate, and productive of new outcomes designed to resolve perceived problems.

[. . .]

Although Dewey did not address the matter of the intelligence of non-human animals in any detail, he was quite interested in the issue that Peirce had raised. “From [a] biological point of view,” he wrote, “deliberate or conscious behavior is just a way of doing more effectively and economically what unconscious life adaptations do in a relatively wasteful and uncontrolled way, namely, modifying the environment so as to make it a more varied and more stable or secure stimulus for the exercise of functions” (MW.6.439).

Unconscious “inference” may thus be said to utilize “tools” such as “premises” in a sense that is parasitic on tools such as premises that are used in conscious inference. But such a characterization is analogical at best. It can be made only by conscious inference and only in retrospect. By placing the issue in the context of “behavior,” Dewey was able to bridge the gap between what is unconscious and what is conscious in much the same way that Peirce had done. Both Peirce and Dewey emphasized the continuity of processes.

In any event, at least since *Homo habilis* some two million years ago, conscious choice or cognition has involved the augmentation of organic responses by the use of tools and artifacts. In addition to the voluminous anthropological literature, a considerable philosophical literature is also dedicated to this subject. John Dewey, Martin Heidegger, Maurice Merleau-Ponty, Marshall McLuhan, Don Ihde, among others, have discussed the interface between organic responses, such as those involving arms, legs, and fingers, and extra-organic tools by means of which arms, legs, and fingers are extended. Merleau-Ponty, for example, discussed cases in which the use of a blind person’s cane becomes an extension of arms and fingers. McLuhan wrote about extensions as different as money and automobiles. Ihde has written a phenomenology of dental picks.

Do we then call the cane and the dental pick “organic,” or not? Is the voice of a singer or actor her “instrument”? It is indisputable that the blind person feels the sidewalk with her cane and that the dentist feels the tooth with his dental pick in ways that extend their respective central nervous systems. It is also indisputable that the singer or actor trains her voice as if it were a finely wrought tool. As McLuhan put it, media are the extensions of man. The many examples offered by Merleau-Ponty and Ihde support the view, which had been adumbrated some years earlier by Dewey, that the dividing line between body and not-body, between intra-organic and extra-organic, is both vague and shifting. Moreover, it is a boundary that is probably capable of being determined only on a case-by-case basis. There are thus borderline examples, such as the one I just mentioned, that might be counted as either *technological* or *cognitive-intra-organic*, and there are habitual responses that might be counted as either *technical* or *immediately experienced*. Our decision would depend on the precise question being asked and the assumptions involved. When language doubles back on itself, such decisions become even more interesting.

The fact that the boundaries between such cases are fuzzy, however, hardly constitutes an adequate reason to reject the picture I am presenting. On the contrary, it serves to underscore my general point that techniques and technology are evolutionary products. They have evolved from non-instrumental, non-artifactual behavior in ways that appear continuous when seen in retrospect, even though there were probably cases of saltation along the way.

Cognition that involves the use of tools and artifacts that are relatively external to the organism is what I have termed “technology.” But once technological work has been done, that is, once problematic situations have been resolved with the help of those tools and artifacts, their solutions tend to be habitualized or routinized. Techniques are then stored as habits and used as needed. When habitualized techniques are applied to problematic situations but fail to resolve them, then more technology – more deliberate inquiry into techniques – is called for.

In the world in which most of us live there is continual reciprocal movement between the technical and the technological. In other words, the technical and the technological are *phases* of our experience. Technology is what we use to tune up the way we experience the world, and the way we experience the world is increasingly technical.

[. . .]

IV. John Dewey as a Philosopher of Technology

The reigning historian of the philosophy of technology, Carl Mitcham, has written that the first publication in the field was Friedrich Dessauer's *Philosophie der Technik*, published in 1927.⁵ That year also marked the appearance of Martin Heidegger's *Sein und Zeit (Being and Time)*, which is widely accepted as the first major contribution to the field. Works on the subject by Ernst Juenger in 1932 and by José Ortega y Gasset in 1939 quickly followed.

Until recently, however, no one seemed to notice that American philosophy, or more specifically classical American pragmatism, had also made a solid contribution to the field.⁶ I have argued that John Dewey's treatments of education, aesthetics, social and political philosophy, logic, and the philosophy of nature should also be read as contributions to a cultural critique of technology.⁷ Some twenty years prior to the publication of the works of Dessauer and Heidegger, Dewey was already writing about a whole range of topics that today are considered central concerns within the philosophy of technology. Later, Dewey's books *Essays in Experimental Logic* (1916), *Experience and Nature* (1925), and *Art as Experience* (1934) all contained incisive critiques of technological culture.

To put this matter in perspective, it may help to recall that Dewey was born in 1859, the year of America's first successful oil well in Titusville, Pennsylvania, and the publication of Darwin's *Origin of Species*. He died in 1952, the year of the first hydrogen bomb test and the first mass marketing of the birth control pill. Dewey's ninety-two years thus spanned two major technological revolutions in America. At the time of his birth, America's economy was based to a great extent on wind, water, and wood. As he grew to maturity, he observed the shift to an economy of steel, coal, and steam. At the time of his death, America had entered the age of synthetics, electronics, and nuclear energy. The post-industrial society in which we now live was already present in rudimentary form.

I draw attention to these details because Dewey's work as philosopher of technology is of more than just, historical interest. His analysis of human experience as transactional with, and within, its various overlapping contexts holds the promise of stimulating new ways of thinking about many of the concerns – especially the ones that involve our environment – that have only recently received the attention of professional philosophers.

The key to understanding Dewey's work as a contribution to the philosophy of technology is, I suggest, an appreciation of his contention that all inquiry or deliberation that involves tools and artifacts, whether those tools and artifacts be abstract or concrete, tangible or intangible, should be viewed as instrumental: in other words, as a form of technology. In short, he understood that technology involves more than just tangible tools, machines, and factories. It also involves the abstract thought and cultural practices that provide the contexts for such things and make them possible. His view of this matter was based upon his broad characterization of technology, which served as the basis for the functional taxonomy of types of activity that I developed earlier in this essay, and that may also be formulated as the *invention, development, and cognitive deployment of tools and other artifacts, brought to bear on raw materials and intermediate stock parts, with a view to the resolution of perceived problems*.⁸

This is my gloss on thousands of words that Dewey devoted to his characterization of technology. It is also quite close to his statement, provided as the epigraph to this chapter, that 'Technology' signifies all the intelligent techniques by which the energies of nature and man are directed and used in satisfaction of human needs; it cannot be limited to a few outer and comparatively mechanical forms. In the face of its possibilities, the traditional conception of experience is obsolete" (LW.5.270).

It might be objected that this characterization begs the question by identifying technology with "intelligent techniques." But what Dewey in fact accomplished by putting matters as he did was the very distinction between technology and technique that I attempted to work out earlier in this chapter. He was also distinguishing between cases in which it appears that technology is being done but in which in fact something else, such as economic self-interest, has intervened. On this radical view, when such interventions occur, it is intelligence itself that suffers. [...]

Dewey's view of these matters constitutes a radical departure from the epistemology of the modern period of philosophy. At least since Descartes it had been generally accepted that the central problem of epistemology was the problem of skepticism: how is it that we can have certain or reliable knowledge of the world? Although the story of modern epistemology is long and complex, certain of its features stand out in high profile. As Descartes and other modern philosophers attempted to move out

from under the influence of medieval scholastic thought, they faced the difficulty of constructing a foundation for science that offered the same level of certitude that scholasticism had claimed. Since their move was toward naturalism, however, they were obligated to locate certitude within nature, as opposed to the supernatural.

The best recourse seemed to Descartes and others to treat certainty as knowledge possessed by an *individual thinking mind*. Modern theories of knowledge and belief were thus designed to find ways of depicting states of affairs in a world that was assumed to exist separately from a thinking mind, and this in a way that would ensure that such depictions were reliable.

Like the late nineteenth-century photographers who attempted to get ever better emulsions for ever more accurate photographs of a world outside and independent of their cameras, these epistemologists were attempting to get ever more accurate mental representations of a world that they thought was outside and independent of their minds. They characterized that world not just as independent of mind, but also as whatever it was without respect to whether or not it would ever be known by an individual mind. Now, some 350 years later, some epistemologists and philosophers of science are still doing this.

Dewey thought that this “picture theory” or “spectator theory” of knowledge was deeply flawed. He reasoned that knowing is not just the capturing of a picture or impression, but an active and experimental involvement of an entire organism (not just a “thinking substance” or even a brain) with the raw materials of its experience in such a manner that tools – including habits and concepts, for example – are brought to bear on those materials and new products are formed. And he thought that the point of making these new products was not to take a more accurate picture representation of what was or had been the case (an external “state of affairs”), but rather to deal with felt problems and difficulties in ways that effected their resolution. He thought that inquiry is always launched for the sake of resolving some specific felt difficulty. When inquiry is successful, he argued, it produces a new product – a new outcome.

For Dewey there is no such thing as knowledge in general, but the production of new knowledge in specific cases, ranging from the most quotidian to the most abstract, involves technology just as surely as cases of problem-solving in chemical engineering. This is because we live forward in time in a world that is perilous at best and in continual need of being “tuned up.” We have to

keep turning out new knowledge-products, including new tools and methods, if we are to convert conditions that range all the way from what is merely irritating to what is life-threatening into situations that are stable, harmonious, and more nearly what we wish them to be.

For Dewey, therefore, one of the most important concerns of philosophy was not so much epistemology, or the attempt to deal with the problem of skepticism, but logic, or the theory of inquiry. Inquiry, he once wrote, is not so much a matter of “grasping antecedently given sureties” as it is a matter of experimentation, or “making sure” (LW.1.123).

Unlike modernist epistemology, Dewey’s notion of inquiry emphasizes the use of raw materials and the tools that have been designed for the refinement of those materials. It also involves other tools whose purpose it is to refine and reconstruct tools that already exist, but that are simpler and more primitive. Inquiry also requires the production and stockpiling of intermediate parts, among which are relatively secure concepts and objects. The end or goal of inquiry is products that can be said to be finished in a relative sense of that term, that is, satisfactory until they are challenged by further experience and demonstrated to be in need of reworking or reconstruction.

It was by means of this view of the instrumental or productive role and function of inquiry in human experience that Dewey avoided the problems that had vitiated the work of many of his predecessors. His view avoids the problems of the empiricism advanced by John Locke, for example, since the central place that his instrumentalism gives to production allows it to undercut both the sensory atomism and the associationism on which such empiricism depends. The problem with putative sensory atoms, Dewey argued, is that they are not primitive at all, they are the products of reflection. And the problem with associationism is that its associations tend to be arbitrary if they are based on nothing more than an arrangement of sensory atoms.

His view avoids the difficulties of Cartesian rationalism, moreover, by treating productive inquiry as a public, observable enterprise that takes place within a community, and not as something that takes place within private, non-extended, albeit reified mind. Dewey called inquiry “an outdoor fact,” and thought it no less natural and observable than activities such as chewing or walking.

It also avoids the pitfalls generated by the Kantian treatment of knowledge, especially the view that perceptual and conceptual contents have different origins, by treating perceptual and conceptual materials as

functional aspects of ongoing inquiry, even as different portions or aspects of judgments. In Dewey's view, the perceptual is concerned with marking out and locating a problem in inquiry, whereas the conceptual is concerned with setting out possible methods of solution. That both types of materials function correlatively within organized inquiry is apparent from the structure of judgments, whose subjects, Dewey pointed out, tend to be perceptual and whose predicates tend to be conceptual.

Dewey worked out his extended technological metaphor for inquiry at great length in the introduction to his 1916 *Essays in Experimental Logic*. That essay is pervaded by technological figures. Here is a typical example:

Hence, while all meanings are derived from things which antedate suggestion or thinking or "consciousness"—not all qualities are equally fitted to be meanings of a wide efficiency, and it is a work of art to select the proper qualities for doing the work. This corresponds to the working over of raw material into an effective tool. A spade or a watch-spring is made out of antecedent material, but does not pre-exist as a ready-made tool; and, the more delicate and complicated the work which it has to do, the more art intervenes. (MW.10.354)

In the same essay Dewey asserted that "there is no problem of why and how the plow fits, or applies to, the garden, or the watch-spring to time-keeping. They were made for those respective purposes; the question is how well they do their work, and how they can be reshaped to do it better" (MW.10.354–55).

This passage contains several points that are important to the issue at hand, namely the relevance of philosophy as a tool for tuning up technological culture.

First, Dewey wanted to demystify those entities traditionally called "logical objects," "essences," and "ideals," by taking them out of the psychical or metaphysical realms they had occupied in the works of Plato and Frege, for example, and by treating them as so many tools in a toolbox. These tools include logical connectives and numbers, abstract terms such as "democracy," and essences such as "the family." When it is understood that these entities are tools and the products of tools, then it will also be understood that they are open to reconstruction and reconfiguration. They will not be honored as essences that are deemed to be fixed and finished for all time.

Since Dewey's program is radical, its application would involve certain casualties. Among the big losers, to name just a few examples, would be Platonism in mathematics and the doctrine of original intent in constitutional law.

This is because each of these positions, as it is usually articulated, depends upon the premise that its respective essence or ideal is absolute and fixed, and not instrumental and consequently in need of continuing reconstruction as circumstances dictate.

So Dewey argued that essences and ideals should be treated not as absolute and fixed, but instead as just more artifacts, constructed not so much *by* inquiry as arising *from* inquiry. They are not found within a chain of inference, but are instead the by-products of inference. In this way they are like agricultural implements that are developed and improved not as a direct consequence of farming but incidentally, as the by-products of tilling, planting, and harvesting.

In all this Dewey was developing a metaphor that would allow him to bring the various types of inquiry we term "successful" under one general formula. He worked out what was already implicit in the work of his fellow pragmatists Charles Sanders Peirce and William James. For those philosophers, all successful inquiry is productive of new outcomes that are more secure than the situations that occasioned the inquiry that produced them. This is true in the sciences, in the arts, in engineering, in agriculture, and in quotidian or everyday enterprises as well.

As Dewey argued in his 1938 *Logic*, the subject matter and the specific tactical methods of inquiry may be, and most likely are, different from one of these enterprises to the next; but each enterprise nevertheless participates within a more general strategic form of inquiry that he called the "general method of intelligence." Because his root metaphor was technological, however, Dewey was able to do explicitly what Peirce and James had done only implicitly. He was able, for example, to reconstruct the important categories of human activity traditionally termed "theory," "practice," and "production."

He did this by reconstructing the Aristotelian hierarchy of types of knowledge. Aristotle had lived in a world in which science was still only empirical and not yet experimental. In other words, Aristotle's science was observational, and not yet instrumental. Instrumentation was not yet viewed as an essential ingredient in science, nor as a source of insights into the pattern of successful inquiry. Aristotle therefore held theory, or contemplation, to be the highest form of knowledge and as such he regarded it as superior to practice, which he in turn regarded superior to production.

But because Dewey's emphasis was on the production of successful outcomes as the end of Inquiry, he treated theory and practice as component parts within inquiry

and as instruments for further production. He did not completely invert the Aristotelian schema, however, since he regarded theory and practice as phases of inquiry, whose outcome is the production of something new. In Dewey's view, theory and practice must cooperate if there is to be success in the production of new knowledge.

V. Three Objections

In talking to people about Dewey's program for tuning up our technological culture as I have sought to articulate it, several objections have been raised. I believe that they are based on misunderstandings not just of Dewey's critique of technology, but also of the problems and possibilities of our technological culture.

1. Some have claimed that it is an exaggeration to say that philosophical inquiry is a form of technology – an instrumentality – for the transformation of our technological culture. This objection seems to reflect the traditional view that philosophy has its own areas of interest, that technology has its own concrete areas of interest, and that despite some occasional areas of overlap, the two activities are fundamentally separate. What has philosophy got to do with the space program or the construction of bridges? The former has to do with human values, and the latter has to do with instrumental rationality.

A version of this view has been advanced by Jürgen Habermas, for example, who has tended to drive a wedge between what he has called the “knowledge constitutive interests” of science and technology on the one hand and the “communicative” and “emancipatory” interests of the human sciences on the other. Put more simply, this is the old “fact–value” split that was lamented by C. P. Snow in *The Two Cultures*.¹⁰

There are three things I want to say in response to this. First, one of Dewey's great insights was that philosophy has a special kind of productive function, since philosophy is a kind of general “liaison officer,” as he put it, “making reciprocally intelligible voices speaking provincial tongues, and thereby enlarging as well as rectifying the meanings with which they are charged” (LW.1.306). In other words, philosophy can serve as a kind of translator that helps the various arts, sciences, engineering, and agriculture continue their discussions with one another. Just as philosophers of science help scientists within different disciplines talk to one another and learn from one another's methods, philosophers as critics of

technological culture are in a position to perform this function on a more inclusive scale.

There are several very good reasons why it is up to philosophy to perform this task. As I have already indicated, philosophy contains as one of its parts logic, or the theory of the most general patterns of inquiry. And whereas inquiry within computer aesthetics and inquiry within materials science have different subject matters and different tactical methods, each contributes to and in turn receives the contributions of more general strategic methods of inquiry. Logic, as the theory of this general method of inquiry, serves as a facilitator.

Second, philosophy also involves metaphysics, which Dewey reconstructed as “a statement of the generic traits manifested by existences of all kinds without regard to their differentiation into physical and mental” (LW.1.308). “Any theory,” he wrote, “that detects and defines these traits is therefore but a ground-map of the province of criticism, establishing base lines to be employed in more intricate triangulations” (LW.1.309). For Dewey, metaphysics is anything but arcane: it has a connection to the objective world. The importance of the generic traits, he wrote, “lies in their application in the conduct of life: that is, in their *moral* bearing provided *moral* be taken in its basic broad human sense” (LW.16.389). In short, philosophers at their best are not only involved in a criticism of culture, but, because the process is self-correcting, they are also involved in a criticism of criticisms of culture as well.

The material just quoted comes from well-known passages from Dewey's great book *Experience and Nature*. I therefore find it remarkable that several generations of philosophers could have read them without grasping their implications for technological culture.

Third, as I have already indicated, philosophy as a critique of technology does not honor the traditional dualisms of body and mind, tangible and intangible, concrete and abstract, except as they are required as tools of inquiry. The general pattern of inquiry, as laid out by Dewey in his numerous books and essays on logic, is a technological enterprise precisely because it utilizes raw materials upon which tools are brought to bear in a cognitive fashion in order to produce novel artifacts, namely situations that are determined to be more desirable than the ones with which it started.

But this general pattern applies to inquiry of all types, whether the primary focus is that part of our experience we call tangible or that other portion we call the intangible. In other words, this general pattern of inquiry fits cases that involve what we would call hardware, and it

also fits cases that are patently conceptual. It applies to descriptions of how manufacturers proceed from iron ore and coal to intermediate and finished steel products, and it applies to descriptions of how writers move from the raw materials of their experiences and research interests to working drafts and thence to finished works of fiction and nonfiction. It applies to the construction of logical and mathematical proofs, and it applies in social and political inquiry.

This concern with the means and ends involved in the production of novel artifacts seems to me to be one of the most important of Dewey's insights about technology. Whenever and wherever techniques of production and construction are utilized, no matter whether the sphere is conceptual or material, there is, in Dewey's view, productive work being done. This is why Dewey regarded the public, or better yet, the many publics that make up what we normally call "the public," as products. They are created as responses to issues of common interest, and their members seek to secure the ends-in-view that they hold in common. It is hardly a secret that billions of dollars are spent each year, from Madison Avenue to Pennsylvania Avenue, to create, manage, and reconstruct such publics precisely as artifacts.

2. A second objection comes from people who are interested in the arts. A colleague once objected that it is a mistake to say that a writer at work on a novel is doing anything "technological." There is in back of this second objection, I think, just the same confusion of terms that plagued Dewey during his long career. When I call writing a novel a problem-solving or technological activity I mean only that there is inquiry going forward and that it is technological because just as in other types of inquiry there are raw materials, there are tools that are deliberately or cognitively deployed and further refined for tasks at hand, there are artifacts produced, and those artifacts are the responses to perceived goals as those goals are themselves developed and refined during the course of inquiry.

Applied to the work of the novelist the pattern is clear. The raw materials are the experiences of the novelist and the experiences of others that she has at second hand. But the novelist doesn't utilize *all* her experiences, and so there is involved a process of abstraction, selection, and reconfiguration. Dewey thought that this happens in all types of inquiry. As a goal or procedure is set up to solve some problem, in this case the writing of a novel, some things are taken as the facts of the case. Then they are weighed, tested, tried, and refined, all with respect to the task at hand. During this process, the task itself is usually

modified. This calls for a reevaluation of what have been taken as the facts of the case. Some formerly pertinent data are discarded; other data are seen for the first time to be relevant.

In the case of writing a novel, characters emerge and are developed, plots thicken and then thin again, and there is the production of a new artifact: a novel. (Beyond that, the novel takes its place as an artifact that is used in the construction of further products or artifacts: various publics that will be motivated to purchase the novel, as well as the lives that will be altered as a consequence of reading it.)

Although there is a confusion of terms present in this objection, I believe that there is something else as well. The objection betrays a concern that the "fine" arts be held in higher esteem – or at least a different kind of esteem – than those that are "merely technological." But to treat the fine arts in this manner is to cut short their full reach as instrumental to an enhanced appreciation of the materials with which they are concerned.

Another variety of this type of objection might take the following form: if writing a novel in fact falls under the definition of technology as it has been advanced (namely, *the invention, development, and cognitive deployment of tools and artifacts brought to bear on raw materials and intermediate stock parts, with a view to the resolution of perceived problems*), then why shouldn't the editors of a journal of automotive engineering accept for publication an essay on literary criticism? Writing novels and designing automobiles are, after all, both forms of technology.

This objection misses the point on two counts. First, even if we were to employ the popular and uncritical notion of technology as having exclusively to do with material culture, we still would not expect the editors of the journal of automotive engineering to publish essays on hydrology or coal research. Although both disciplines fit the common definition of technology, their practitioners have different interests and ends-in-view. Second, it might in fact be appropriate under certain circumstances for the editors of the automotive engineering journal to publish a literary essay that explores some aspect of auto-mobiled life in a way that would inform and expand the horizon of automotive engineers. To deny this would be to honor the "fact-value" split about which Dewey continually complained, and which has retarded the resolution of many of our most pressing social problems.

Dewey took a significant risk when he reconstructed the term "technology" in the way that I have described. He took the risk that he would be labeled an uncritical follower of what some have termed "Enlightenment

rationality.” He also took the risk that he would be thought to have attempted a reduction of all human cognitive activity to one grey, amorphous discipline. [...] But he seems to have thought the risk worth taking since the perceived benefits were so great. Repairing the old fact–value, technology–culture split was one such benefit and naturalizing technology was another.

3. A third and related objection is that if we treat technology as inclusive of conceptual tools and artifacts as well as those that are tangible and material, then we have just taken technology so broadly that *everything* is included. This is the objection that I discussed in the section on naturalizing technology. Drawing the net of this objection somewhat more tightly than Carl Mitcham’s articulation of it, however, the intuition is that we must reserve the term technology for operation with hardware, or perhaps also for the kind of software that can be held in the hand, or put on a bookshelf, or loaded in a computer, so that we can differentiate what happens in those regions from what happens in religion or poetry, for example. The idea behind this objection is that religion and poetry are “spiritual,” whereas technology is not.

As I hope to have demonstrated, what is strictly technological – what involves inquiry into technique, tools, and artifacts – constitutes but a small part of the experience of most people. That portion or phase of experience that I called “technical” is a much larger part, to be sure; but the most prevalent feature of experience is what is immediate, that is *non-cognitive and non-instrumental organic*. This is a far cry from “just turning everything into technology.”¹¹ But because the misunderstanding has been so profound, perhaps more needs to be said.

First, I believe that this objection rests on an explicit ontological dualism that is itself untenable. If what is “spiritual” is of value, then it would seem worthwhile to find ways of allowing it to penetrate all of our experiences. And if “technology” fails to be “spiritual,” then its development has somehow been cut short. Dewey rejected dualities of this type because he thought that they “formulated recognition of an impasse in life; an impotence in interaction, inability to make effective transition, limitation of power to regulate and thereby to understand” (LW.1.186).

Second, we cannot identify the technological with the cognitive *as such*, since there is cognitive work that does not involve tools except in a highly attenuated and analogous sense of the term. In retrospect, anthropologists may wish to speak metaphorically of the opposed thumb

as a tool that the higher primates used to make the transition from savanna to forest. But the notion of an organic structure as tool is parasitic on the notion of extra-organic structure as tool. To reverse the relation would be anachronistic.

Nevertheless, once we begin to reflect on the ways in which tools are invented, developed, and utilized, it is possible to read the script forward in such a way that mathematical and logical objects, for example, are accepted as legitimate cases of tools. When this occurs, then the last nail goes into the coffin of Platonism. These, are more or less the conclusions that Dewey reached during his decade at the University of Chicago, 1894–1904, and that formed the core of his productive pragmatism.¹²

Third, whether or not we use the term “spiritual” to designate religious practice, the undeniable fact is that religions, too, utilize tools, instruments, and artifacts of various types to effect their chosen ends. The leaders of the Roman Catholic Church long ago understood the importance of relics, the bread and wine of the Eucharist, incense, gilded altars, and other material artifacts, together with certain techniques such as the confession, as tools that could be used for the maintenance and enlargement of a believing public. Moreover, the cases in which the Church has retarded or rejected the advances of science in the name of what is “spiritual” have represented some of its greatest embarrassments. The case of Galileo, who was finally pardoned in 1992, some 359 years after being condemned as a heretic, is but one example of this phenomenon.

VI. Four Advantages

I believe that there are several advantages of thinking about philosophy in the sense in which Dewey understood it, and as I have tried to expand upon that understanding, that is, as a tool for tuning up technology. I shall discuss four of these advantages. The first is what I shall call the *felicities of genetic analysis*; the second is the enormous *ecological power* gained by treating human technological activity as continuous with other natural activities; the third is that we get *off the foundationalist hook*; and the fourth is that we are able to generate *stable platforms for social action*.

1. First, this broad view of philosophy as criticism of technology opens up a whole new area of inquiry, namely the genetic analysis of conceptual tools. Just as there is a vestige in the modern plow of the bent stick, there is a vestige in the square root of minus one of the

marks made on the wall of an ancient shepherd's fold in order to compare the number of outgoing sheep in the morning to the number of incoming sheep in the evening. And it is hardly surprising that organisms with ten fingers, counting thumbs, would operate in much of the world with number systems of base ten.¹³

This genetic approach to technology rejects the claims of scientific realism, namely that there is a prefigured reality "out there" waiting to be discovered, just as it is, in and of itself, apart from any contribution on the part of inquiry. It argues instead that the conceptual tools of science, including those we call scientific laws, are constructed, but not that they are constructed out of nothing. When they are sophisticated and complex, they are constructed out of tools and intermediate stock parts that are already on hand. In some cases, such as in mathematics, they are primarily relations of relations, or abstractions of abstractions. And the most primitive of such tools are constructed out of the rawest of raw empirical materials, namely, felt needs and desires and flashes of insight or accident.

Why is this felicitous? Because it helps get philosophy out of the box it has often found itself in during its long career and out into the world of human affairs where it can do the work of criticism and reconstruction. It helps philosophy to link up with disciplines such as sociology, anthropology, archeology, and paleontology and thereby to focus its considerable energies upon real problems. It is also felicitous because it helps us get out from under the positivist-scientific burden, the one that claims that the methods of the physical sciences provide "master narratives" that are somehow independent of such histories.

2. A second advantage of the view I am advancing is that it leads us to look for continuities between the adjustive activities of human beings and the adjustive activities of other natural organisms. This has profound consequences for environmental philosophy. Technology "naturalized" as I have described it, as inquiry into the techniques that human beings utilize to accommodate themselves to their environments and to alter those environments to their needs, functions as a kind of linkage or bridge to similar activities undertaken by higher primates, and even by "lower" non-human animals. It is not something above or apart from nature, but rather the cutting edge of evolutionary development.

I wish I could report that this last point is a minor one and that it has little import for the future of technoscientific education. James Moore, one of the team that worked with Martin Marty and R. Scott Appleby on the

"Fundamentalisms" project, reported that by 1984 the Institute for Creation Research had a mailing list of some 75,000, an annual budget of \$1.2 million, and a publication list of some fifty-five books that together had sold over one million copies.¹⁴ As late as 1993, one of the largest technical universities in the United States, on whose faculty I was employed for two decades, still had engineering faculty who publicly defended "creation science," thus denying the type of continuity thesis that I have just put forward. In its place they argued for a strong version of supernaturalism that cuts technology off from its roots in the evolution of non-human nature. It is difficult to determine how successful these engineers were in moving their students to accept their arguments, but when the campus newspaper polled students regarding which one book they would choose to have with them in the event of a major disaster that destroyed their civilization, the majority of those polled chose the Bible over other presumably more practical tomes such as *The Foxfire Book*.¹⁵

This point directly addresses a different sort of objection, namely that if we treat philosophy as a tool for tuning up technological culture, as Dewey recommended that we do, then we have thereby become too preoccupied with one kind of philosophical activity, namely the type that is designed to alter the physical environment, at the expense of another kind of philosophical activity, namely the one by means of which we accommodate ourselves to our environments by means of certain "spiritual" exercises. This is similar to a charge that was brought against Dewey by first-generation critical theorists and others during his lifetime, and it is a charge that is still advanced against him during our own time. Put succinctly, it is that Dewey was a latter-day proponent of "Enlightenment rationality" who urged the domination of nature, and who ignored "spiritual" values or thought them nothing more than impediments to greater levels of efficiency.

It is correct to say that an awareness of this split between what have been called "technologies of environmental domination" and what some have called "technologies of the self" is important for understanding the history of technology, as well as the history of the philosophy of technology. But this is also a point on which Dewey's critics have profoundly misunderstood his work.

The fact is that we can identify two poles or dimensions *within* human experience. One is concerned with the alteration of circumstances that are relatively external to us, organically speaking. Another is the pole that is

primarily concerned with the accommodation of ourselves as organisms to such circumstances. Although the first of these poles has sometimes been characterized as the domination of nature, it has also been characterized in some technophobic circles as “technology” *simpliciter*. Because Dewey lived in the wake of Darwin, however, and because he was interested in constructing a new form of naturalism that would take into account continuities within nature, he looked for a way to define technology with sufficient breadth that it could include this second pole of experience. This second pole has been the concern of thinkers such as Max Scheler and Michel Foucault, and it has been advanced in some strains of Buddhism. It also had an important place in Dewey’s thinking.

In the first few pages of his 1934 book, *A Common Faith*, Dewey made this point clear. It is significant that such a clear statement of the matter appears in Dewey’s only book on the philosophy of religious experience. Here is Dewey’s remark:

While the words “accommodation,” “adaptation,” and “adjustment” are frequently employed as synonyms, attitudes exist that are so different that for the sake of clear thought they should be discriminated. There are conditions we meet that cannot be changed. If they are particular and limited, we modify our own particular attitudes in accordance with them. Thus we accommodate ourselves to changes in weather, to alterations in income when we have no other recourse.

When the external conditions are lasting we become inured, habituated The two main traits of this attitude, which I should like to call accommodation, are that it affects *particular* modes of conduct, not the entire self, and that the process is mainly *passive*. It may, however, become general and then it becomes fatalistic resignation or submission. There are other attitudes toward the environment that are also particular but that are more active. . . . Instead of accommodating ourselves to conditions, we modify conditions so that they will be accommodated to our wants and purposes. This process may be called adaptation.

Now both of these processes are often called by the more general name of adjustment. But there are also changes in ourselves in relation to the world in which we live that are much more inclusive and deep seated. They relate not to this and that want in relation to this and that condition of our surroundings, but pertain to our being in its entirety. Because of their scope, this modification of ourselves is enduring. . . . It is a change of will conceived as the organic plenitude of our being, rather than any special change *in* will. (LW9.12–13)

In this passage Dewey deftly undercuts the traditional philosophical problem of the inner and the outer, the mental and the physical, by locating it in the context of his critique of technology. Viewed as a part of a larger picture, habits are tools of adjustment. A habit is something that has a certain generality of application. It is something that has been tried out and found to be capable of serving certain purposes. Viewed from this perspective, as habits of a sort, hammers and saws become continuous with the other habits developed over millennia by higher order primates, for example, in their attempts to adjust to changing environmental conditions. Viewed in this perspective, to say that human beings are uniquely technological animals is not to place them outside and above nature, but within nature and a part of it. Our activities differ from those of our non-human relatives and ancestors not in kind, but only in level of complexity.

Habits are found throughout nature, but only human beings have reached the level of complexity that allows such a high level of self-control with respect to their deliberate formation, development, retention, and modification. It is for this reason – our ability to engage in the self-controlled manipulation of habits – that we human beings are able to reach very high levels of efficiency. We not only accommodate ourselves to environing conditions, but we also adapt environing conditions to our needs. These two activities taken together Dewey calls *adjustment* or *growth*, and he identifies the inquiry that is involved with such adjustment with technology in his broad sense of the term.

3. Here is a third advantage of Dewey’s view of philosophy as a tool for tuning up technology. If knowing is a technological activity, then we are off the foundationalist hook. “Certainty” becomes an honorific term that is restricted to narrow non-existential domains. The laws of mathematical addition and subtraction are “certain” in this honorific sense not because they correspond to “the furniture of the world,” to use Bertrand Russell’s infelicitous phrase, but because a great deal of work has been focused on a very narrow area of inquiry, that is, one that is so narrow as to exclude actual existence. As for the remaining domains of inquiry, which constitute the vast majority of the locations where technoscientific work is done, reconstruction continues to be done on the assumption that further improvements can be made in existential affairs and in the laws that are developed and employed to characterize them. “Fallibilism” and “probability” replace “certainty” as key operational terms.

4. Fourth, this view has the advantage of providing secure and steady platforms for the improvement of

situations that are not as we wish them to be. It is not that we “look for” solutions in the sense of keeping our eyes open, or even that we wait for them to appear, as Heidegger told us that a “*Holzweg*” or clearing in a forest might just appear. If we are to flourish, we must construct hypotheses in a deliberate and intelligent fashion. Knowing is not so much a matter of “finding out” as it is a matter of “making sure.” On this view, the kind of inquiry that leads to greater control of problematic social and political situations is also a type of technological undertaking, since it involves an active construction of desirable outcomes through the use of the tools and artifacts that are proper to that domain of knowledge-getting. Not only science itself, but the philosophy, sociology, and politics of science become important technological undertakings.

It is instructive to note the ways in which Dewey’s view on this matter contrasts with that of Heidegger. Heidegger writes of a waiting readiness for a clearing to appear in the forest. Dewey writes of sharpening our tools in order to engage conditions that are not what we wish them to be. In one case we get a kind of watchfulness before the incomprehensibility of Being. In the other we get active management of problematic situations.

Critics of technology, such as Heidegger and his followers, have often said that it is technology that constitutes the major human problem. But what they have usually meant is that there are too many techniques, tools, and artifacts and that those things prevent our involvement in more proper occupations such as those that are religious, or “spiritual” in a broad sense, that is, that are concerned with what Heidegger termed “the shepherding of Being.” I believe that Dewey would have agreed that technology constitutes the major human problem, but for reasons that are radically different from the ones just given. He thought of technology as inquiry into techniques, tools, and artifacts. And he thought that techniques are among the habits that are necessary to the continuance and growth of human life. He therefore thought that the major human problem was improving intelligence, which he identified with technology. And this means no more or less than developing better and more productive methods of inquiry into our techniques, our tools, and our artifacts.

Following Dewey’s lead, I have characterized technology as *the invention, development, and cognitive deployment of tools and other artifacts, brought to bear on raw materials and intermediate stock parts, to resolve perceived problems*. I have also argued that philosophy is one of the most effective tools we have for tuning up technology.

In addition, I have argued that what are commonly called the “theoretical sciences” such as chemistry and biology are no less cases of this type of activity than what are commonly called “material technologies” such as mechanical engineering and crop science. Theoretical knowing, such as that involved in mathematics, is no less a case of technological activity than is the type of knowing that is involved with concrete, practical outcomes such as building bridges. Because the theoretical is also artifactual, even what is sometimes called “pure research” is a type of technology.

So whereas the narrow characterizations of technology often tend to draw a line between material artifacts and everything else, which is commonly called science or even culture, and whereas some phenomenological accounts often tend to draw a line between what is practical and what is theoretical, I want to draw a line between what is involved in and a conscious result of intelligent, reconstructive activity, on the one side, and what is merely passive, rote, and uncritically accepted on the other. It seems to me that by dividing things up as I have, we achieve a kind of continuity within the domain of human enterprises that increases our power to effect meaningful adaptive change, that we are able to develop a wider appreciation for the ways that human beings function in and as a part of nature, and that we are able to see the relevance and make more sense out of genetic or historical studies.

If the program that I have outlined is a viable one, then philosophy is indeed an important and effective instrument for tuning up our technological culture. [...]

VII. Addendum: “Technoscience”

One more thing. The cumbersome term “technoscience” is now employed in a variety of ways by philosophers, sociologists, and historians who write about technology, science, and technical artifacts. In his book *Postphenomenology*, for example, Don Ihde writes that “[t]he claim of technoscience – as it is now increasingly called – put in phenomenological terms, is that it reveals a world which, perceptually identified, is both a microworld and a macroworld which could not be experienced except through the mediations of instruments.”¹⁶ Raphael Sassower even uses the term in the title of his book *Technoscientific Angst*.¹⁷ After citing a text in which Jean-François Lyotard employs the term,¹⁸ he informs us that he will use the term to denote “a dynamic relationship among instruments and people within a cultural context

that brings about conceptual and practical changes.” He further tells us that technoscience is “the constellation of science, technology, and engineering.”¹⁹

In general, I applaud the manner in which Ihde, Lyotard, or Sassower use this term. Even though I will not use it as freely as they do, I nevertheless need to triangulate it within the context of the distinctions I have attempted to draw [...] and that will be the basis of the ones that follow.

As I have indicated, I shall use the term “technology” to mean *the invention, development, and cognitive deployment of tools and other artifacts, brought to bear on raw materials and intermediate stock parts, with a, view to the resolution of perceived problems.* Prior to the seventeenth century, technology was intermittent. Since that time, it has been increasingly systematic. As such, technology is more or less inter-definable with what Dewey meant by “inquiry” in his *Logic. The Theory of Inquiry* (1938) and by what he meant by “the general method of intelligence.” It is thus a general term under which fall various disciplines that employ their own particular inquiring tools and methods, such as the physical sciences, engineering, the arts, the humanities, jurisprudence and so on. But as I have indicated, it *excludes* the other categories of activity that I explicated in this chapter. Given the objections raised by some of the critics of this definition of technology that it is reductionist, or that it is so vague that it becomes vapid, this is a crucial point.

Some of the disciplines I just mentioned – the physical sciences, engineering, the arts, and so on, can of course be grouped in various ways, just as they themselves can be used to group various sub-disciplines. It is in this sense that “the humanities,” for example, is a term that we can use to group philosophy and historiography. I shall use

the term “technoscience” to refer to disciplines that include the natural sciences, the various types of engineering, agriculture, and so on. In addition to the other uses that I have described, I shall use the adjective “technological” to refer to our milieu – a milieu that is characterized (but not yet quite dominated) by the methods and products of technology in the sense in which I have characterized it in much the same manner that the milieu we call “medieval” was characterized (though also not quite dominated) by institutionalized religion.

The term “technology” looks backward to the broad activities of making and doing once designated by the term “*technè*,” including the observational science of Aristotle as well as the magnificent work of the Greek shipbuilders and architects. The term “technoscience” signals the fact that the “scientific revolution” of the seventeenth century initiated the systematic use of instrumentation for experimental purposes, thus forever conflating putatively “pure” theory and putatively “applied” instrumental practice. In the seventeenth century, science transcended its role as “knowledge” and became forever “technoscience” or *instrumentally experimental* knowledge. It is in this sense that the history of the craftsmen, builders, and architects of antiquity is a chapter in the history of technology, as is the history of technoscience.

The order in which I have placed the parts “techno” and “science” in “technoscience” is therefore not accidental. It indicates my view, which follows the lead provided by Dewey, that what we now call science is in fact a type or branch of technology since it involves *the invention, development, and cognitive deployment of tools and other artifacts, brought to bear on raw materials and intermediate stock parts, to resolve perceived problems.*

Notes

- 1 *The Collected Works of John Dewey* [Early Works (EW) 1892–1895, 5 vols.; Middle Works (MW) 1899–1924, 15 vols.; Later Works (LW) 1925–1953, 17 vols.], ed. Jo Ann Boydston (Carbondale: Southern Illinois University Press, 1969–91), LW5.270 [eds.]
- 2 Larry A. Hickman, *John Dewey's Pragmatic Technology* (Bloomington: Indiana University Press, 1990).
- 3 Carl Mitcham, *Thinking through Technology* (Chicago: University of Chicago Press, 1994), 74–75.
- 4 I use the qualifier “deliberate” here, even though it may appear redundant, out of respect for the claim made by C. S. Peirce that organic life also exhibits inference below the level of conscious awareness.
- 5 Mitcham points out that two earlier works had “philosophy of technology” in their titles, but their aims were really quite restricted. These were Ernst Kapp's book *Grundliniener Philosophie der Technik* (1877) and Eberhard Zschimmer's *Philosophie der Technik* (1913). See *Philosophy and Technology*, ed. Carl Mitcham and Robert Mackey (New York: Free Press, 1972), 22.
- 6 Some very recent monographs on the philosophy of technology still ignore Dewey's contribution to the field. As I was writing this chapter, for example, I received a copy of Joseph C. Pitt's *Thinking about Technology: Foundations of the Philosophy of Technology* (New York: Seven Bridges Press, 2000), which contains no mention of Dewey.

7 Hickman, *Dewey's Pragmatic Technology*.

8 This characterization has certain advantages, over some of its alternatives. In *Thinking about Technology*, for example, Joseph C. Pitt defines technology as "humanity at work." (p. xi) Pitt's definition does, of course, have the advantage of generality. Further, as he indicates, it also obviates the problems that Jacques Ellul generated when he treated technology as a thing with an essence. On the downside, however, Pitt's definition does not appear on its face to preserve the distinction between technology and technique. In other words, it does not preserve the distinction between cognitive and non-cognitive deployment of tools and other, artifacts.

On pages 10 and 11, Pitt criticizes the definition advanced by Emmanuel Mesthene. Curiously Pitt objects to Mesthene's notion that technology is "the organization of knowledge for the achievement of practical purposes" (Emmanuel 6. Mesthene, *Technological change: Its Impact on Man and Society* (New York: New American Library 1970, 25) on the grounds that the phrase "organized knowledge" is redundant. Given the fact that our culture is currently suffering the splintering effects of increased specialization, this is a remarkable claim. One of the great needs of our milieu is precisely that what currently counts as knowledge be not only expanded, but better organized as well. Pitt then repeats with emphasis his definition, "technology is humanity at work" (p. 11). The idea, he writes, is that technology must involve the activity of humans, as opposed to organisms such as beavers or aliens, and that it must also involve "their deliberate and purposeful use of tools, taken in the general sense" (p. 11.).

Two things about Pitt's gloss on his own definition are striking. First, his gloss seems to amplify what is in the definition to the point of significant revision. It adds the terms "deliberate" and "purposeful," for example. Nevertheless, the amplified definition still fails to capture the distinction I made between what is technological (cognitive) and what is technical (habitual), since it is quite possible to work mechanically in ways that are both deliberate and purposeful. Assembly line workers and farm laborers must do this daily. Of course play can be purposeful and deliberate as well.

Second, there is no acknowledgment that technology is involved not just in the use of tools but also in their invention and development; that tools must be applied in certain ways and not others; and that the problem that initiates inquiry is a function of a situation that involves inquiry with a particular perspective.

David Rothenberg, in an interview published in *A Parliament of Minds: Philosophy for a New Millennium*, ed. Michael Tobias, J. Patrick Fitzgerald, and David Rothenberg (Albany: SUNY Press, 2000), does not provide much help in this regard. "What is technology? It's really the whole history of tools that human beings have used to live in the world." (p. 169). This definition, if it is intended to be one, provides scant guidance concerning how to sort out the

underlying differences, for example, between Greek warships and contemporary spacecraft.

- 9 See Larry A. Hickman, "Making the Family Functional: The Case for Legalized Same-Sex Domestic Partnerships," *Philosophy of the Social Sciences* 29, no.2. (June 1999): 231–47; a revised and enlarged version of "Making the Family Functional: The Case for Same-Sex Marriage," in *Same-Sex Marriage: The Moral and Legal Debate*, ed. Robert M. Baird and Stuart E. Rosenbaum (Amherst, N.Y.: Prometheus Books, 1997), 192–202.
- 10 C. P. Snow, *The Two Cultures* (Cambridge: Cambridge University Press, 1993).
- 11 Carl Mitcham has noted that one response to my interpretation of Dewey's critique of technology in *John Dewey's Pragmatic Technology* involved the claim of reductionism. He thinks that "[my] reply to one possible formulation of the charge of reductionism does not consider the possibility that if all life is technological then the concept of technology becomes vacuous." See Mitcham, *Thinking through Technology*, 75. I hope to have put that objection to rest with the fourfold taxonomy I have developed in this chapter.
- 12 Mathematical objects have been developed within the sphere of the philosophy of mathematics. See Philip J. Davis and Reuben Hersh, *The Mathematical Experience* (New York: Houghton Mifflin, 1981).
- 13 See John D. Barrow, *Pi in the Sky: Counting, Thinking, and Being* (Oxford: Clarendon Press, 1992). See especially chapter 2, "The Counter Culture." This is an excellent introduction to the history of counting.
- 14 James Moore, "The Creationist Cosmos of Protestant Fundamentalism," in *Fundamentalisms and Society: Reclaiming the Sciences, the Family, and Education*, ed. Martin E. Marty and R. Scott Appleby (Chicago: University of Chicago Press, 1993), 2:49.
- 15 See Eliot Wigginton, ed., *The Foxfire Book* (New York: Doubleday, 1972). This is a back-to-basics guide to making it on the land. See also David E. Noble, *The Religion of Technology* (New York: Knopf, 1997).
- 16 Don Ihde, *Postphenomenology: Essays in the Postmodern Context* (Evanston, Ill.: Northwestern University Press, 1993), 3.
- 17 Raphael Sassower, *Technoscientific Angst* (Minneapolis: University of Minnesota Press, 1997).
- 18 "In the present epoch, science and technology combine to form contemporary technoscience. In technoscience, technology plays the role of furnishing the proof of scientific arguments: it allows one to say of a scientific utterance that claims to be true, here is a case of it.' The result of this is a profound transformation in the nature of knowledge. Truth is subjected to more and more sophisticated means of 'falsifying' scientific utterances." Jean-François Lyotard, "New Technologies," in *Political Writings*, trans. Geoff Bennington and Brian Massumi (Minneapolis: University of Minnesota Press, 1979), 14–15.
- 19 Sassower, *Technoscientific*, 3.

Buddhist Economics

E. F. Schumacher

“Right Livelihood” is one of the requirements of the Buddha’s Noble Eightfold Path. It is clear, therefore, that there must be such a thing as Buddhist economics.

Buddhist countries have often stated that they wish to remain faithful to their heritage. So Burma: “The New Burma sees no conflict between religious values and economic progress. Spiritual health and material well-being are not enemies: they are natural allies.”¹ Or: “We can blend successfully the religious and spiritual values of our heritage with the benefits of modern technology.”² Or: “We Burmans have a sacred duty to conform both our dreams and our acts to our faith. This we shall ever do.”³

All the same, such countries invariably assume that they can model their economic development plans in accordance with modern economics, and they call upon modern economists from so-called advanced countries to advise them, to formulate the policies to be pursued, and to construct the grand design for development, the Five-Year Plan or whatever it may be called. No one seems to think that a Buddhist way of life would call for Buddhist economics, just as the modern materialist way of life has brought forth modern economics.

Economists themselves, like most specialists, normally suffer from a kind of metaphysical blindness, assuming that theirs is a science of absolute and invariable truths, without any presuppositions. Some go as far as to claim that economic laws are as free from “metaphysics” or “values” as the law of gravitation. We need not, however, get involved in arguments of methodology. Instead, let us take some

fundamentals and see what they look like when viewed by a modern economist and a Buddhist economist.

There is universal agreement that a fundamental source of wealth is human labour. Now, the modern economist has been brought up to consider “labour” or work as little more than a necessary evil. From the point of view of the employer, it is in any case simply an item of cost, to be reduced to a minimum if it cannot be eliminated altogether, say, by automation. From the point of view of the workman, it is a “disutility”; to work is to make a sacrifice of one’s leisure and comfort, and wages are a kind of compensation for the sacrifice. Hence the ideal from the point of view of the employer is to have output without employees, and the ideal from the point of view of the employee is to have income without employment.

The consequences of these attitudes both in theory and in practice are, of course, extremely far-reaching. If the ideal with regard to work is to get rid of it, every method that “reduces the work load” is a good thing. The most potent method, short of automation, is the so-called “division of labour” and the classical example is the pin factory eulogised in Adam Smith’s *Wealth of Nations*. Here it is not a matter of ordinary specialisation, which mankind has practised from time immemorial, but of dividing up every complete process of production into minute parts, so that the final product can be produced at great speed without anyone having had to contribute more than a totally insignificant and, in most cases, unskilled movement of his limbs.

E.F. Schumacher, from *Small Is Beautiful: Economics as if People Mattered* (New York: Harper Trade, 1989), pp. 50–59.

The Buddhist point of view takes the function of work to be at least threefold: to give a man a chance to utilise and develop his faculties; to enable him to overcome his egocentricity by joining with other people in a common task; and to bring forth the goods and services needed for a becoming existence. Again, the consequences that flow from this view are endless. To organise work in such a manner that it becomes meaningless, boring, stultifying, or nerve-racking for the worker would be little short of criminal; it would indicate a greater concern with goods than with people, an evil lack of compassion and a soul-destroying degree of attachment to the most primitive side of this worldly existence. Equally, to strive for leisure as an alternative to work would be considered a complete misunderstanding of one of the basic truths of human existence, namely that work and leisure are complementary parts of the same living process and cannot be separated without destroying the joy of work and the bliss of leisure.

From the Buddhist point of view, there are therefore two types of mechanisation which must be clearly distinguished: one that enhances a man's skill and power and one that turns the work of man over to a mechanical slave, leaving man in a position of having to serve the slave. How to tell the one from the other? "The craftsman himself," says Ananda Coomaraswamy, a man equally competent to talk about the modern west as the ancient east, "can always, if allowed to, draw the delicate distinction between the machine and the tool. The carpet loom is a tool, a contrivance for holding warp threads at a stretch for the pile to be woven round them by the craftsmen's fingers; but the power loom is a machine, and its significance as a destroyer of culture lies in the fact that it does the essentially human part of the work."⁴ It is clear, therefore, that Buddhist economics must be very different from the economics of modern materialism, since the Buddhist sees the essence of civilisation not in a multiplication of wants but in the purification of human character. Character, at the same time, is formed primarily by a man's work. And work, properly conducted in conditions of human dignity and freedom, blesses those who do it and equally their products. The Indian philosopher and economist J. C. Kumarappa sums the matter up as follows:

"If the nature of the work is properly appreciated and applied, it will stand in the same relation to the higher faculties as food is to the physical body. It nourishes and enlivens the higher man and urges him to produce the best he is capable of. It directs his free will along the

proper course and disciplines the animal in him into progressive channels. It furnishes an excellent background for man to display his scale of values and develop his personality."⁵

If a man has no chance of obtaining work he is in a desperate position, not simply because he lacks an income but because he lacks this nourishing and enlivening factor of disciplined work which nothing can replace. A modern economist may engage in highly sophisticated calculations on whether full employment "pays" or whether it might be more "economic" to run an economy at less than full employment so as to ensure a greater mobility of labour, a better stability of wages, and so forth. His fundamental criterion of success is simply the total quantity of goods produced during a given period of time. "If the marginal urgency of goods is low," says Professor Galbraith in *The Affluent Society*, "then so is the urgency of employing the last man or the last million men in the labour force."⁶ And again: "If... we can afford some unemployment in the interest of stability – a proposition, incidentally, of impeccably conservative antecedents – then we can afford to give those who are unemployed the goods that enable them to sustain their accustomed standard of living."

From a Buddhist point of view, this is standing the truth on its head by considering goods as more important than people and consumption as more important than creative activity. It means shifting the emphasis from the worker to the product of work, that is, from the human to the subhuman, a surrender to the forces of evil. The very start of Buddhist economic planning would be a planning for full employment, and the primary purpose of this would in fact be employment for everyone who needs an "outside" job: it would not be the maximisation of employment nor the maximisation of production. Women, on the whole, do not need an "outside" job, and the large-scale employment of women in offices or factories would be considered a sign of serious economic failure. In particular, to let mothers of young children work in factories while the children run wild would be as uneconomic in the eyes of a Buddhist economist as the employment of a skilled worker as a soldier in the eyes of a modern economist.

While the materialist is mainly interested in goods, the Buddhist is mainly interested in liberation. But Buddhism is "The Middle Way" and therefore in no way antagonistic to physical well-being. It is not wealth that stands in the way of liberation but the attachment

to wealth; not the enjoyment of pleasurable things but the craving for them. The keynote of Buddhist economics, therefore, is simplicity and non-violence. From an economist's point of view, the marvel of the Buddhist way of life is the utter rationality of its pattern – amazingly small means leading to extraordinarily satisfactory results.

For the modern economist this is very difficult to understand. He is used to measuring the "standard of living" by the amount of annual consumption, assuming all the time that a man who consumes more is "better off" than a man who consumes less. A Buddhist economist would consider this approach excessively irrational: since consumption is merely a means to human well-being, the aim should be to obtain the maximum of well-being, with the minimum of consumption. Thus, if the purpose of clothing is a certain amount of temperature comfort and an attractive appearance, the task is to attain this purpose with the smallest possible effort, that is, with the smallest annual destruction of cloth and with the help of designs that involve the smallest possible input of toil. The less toil there is, the more time and strength is left for artistic creativity. It would be highly uneconomic, for instance, to go in for complicated tailoring, like the modern west, when a much more beautiful effect can be achieved by the skilful draping of uncut material. It would be the height of folly to make material so that it should wear out quickly and the height of barbarity to make anything ugly, shabby or mean. What has just been said about clothing applies equally to all other human requirements. The ownership and the consumption of goods is a means to an end, and Buddhist economics is the systematic study of how to attain given ends with the minimum means.

Modern economics, on the other hand, considers consumption to be the sole end and purpose of all economic activity, taking the factors of production – land, labour, and capital – as the means. The former, in short, tries to maximise human satisfactions by the optimal pattern of consumption, while the latter tries to maximise consumption by the optimal pattern of productive effort. It is easy to see that the effort needed to sustain a way of life which seeks to attain the optimal pattern of consumption is likely to be much smaller than the effort needed to sustain a drive for maximum consumption. We need not be surprised, therefore, that the pressure and strain of living is very much less in, say, Burma than it is in the United States, in spite of the fact that the amount of labour-saving machinery used in

the former country is only a minute fraction of the amount used in the latter.

Simplicity and non-violence are obviously closely related. The optimal pattern of consumption, producing a high degree of human satisfaction by means of a relatively low rate of consumption, allows people to live without great pressure and strain and to fulfill the primary injunction of Buddhist teaching: "Cease to do evil; try to do good." As physical resources are everywhere limited, people satisfying their needs by means of a modest use of resources are obviously less likely to be at each other's throats than people depending upon a high rate of use. Equally, people who live in highly self-sufficient local communities are less likely to get involved in large-scale violence than people whose existence depends on world-wide systems of trade.

From the point of view of Buddhist economics, therefore, production from local resources for local needs is the most rational way of economic life, while dependence on imports from afar and the consequent need to produce for export to unknown and distant peoples is highly uneconomic and justifiable only in exceptional cases and on a small scale. Just as the modern economist would admit that a high rate of consumption of transport services between a man's home and his place of work signifies a misfortune and not a high standard of life, so the Buddhist economist would hold that to satisfy human wants from faraway sources rather than from sources nearby signifies failure rather than success. The former tends to take statistics showing an increase in the number of ton/miles per head of the population carried by a country's transport system as proof of economic progress, while to the latter – the Buddhist economist – the same statistics would indicate a highly undesirable deterioration in the *pattern* of consumption.

Another striking difference between modern economics and Buddhist economics arises over the use of natural resources. Bertrand de Jouvenel, the eminent French political philosopher, has characterised "western man" in words which may be taken as a fair description of the modern economist:

"He tends to count nothing as an expenditure, other than human effort; he does not seem to mind how much mineral matter he wastes and, far worse, how much living matter he destroys. He does not seem to realise at all that human life is a dependent part of an ecosystem of many different forms of life. As the world is ruled from towns where men are cut off from any form of life other than

human, the feeling of belonging to an ecosystem is not revived. This results in a harsh and improvident treatment of things upon which we ultimately depend, such as water and trees.”⁷

The teaching of the Buddha, on the other hand, enjoins a reverent and non-violent attitude not only to all sentient beings but also, with great emphasis, to trees. Every follower of the Buddha ought to plant a tree every few years and look after it until it is safely established, and the Buddhist economist can demonstrate without difficulty that the universal observation of this rule would result in a high rate of genuine economic development independent of any foreign aid. Much of the economic decay of south-east Asia (as of many other parts of the world) is undoubtedly due to a heedless and shameful neglect of trees.

Modern economics does not distinguish between renewable and non-renewable materials, as its very method is to equalise and quantify everything by means of a money price. Thus, taking various alternative fuels, like coal, oil, wood, or water-power: the only difference between them recognised by modern economics is relative cost per equivalent unit. The cheapest is automatically the one to be preferred, as to do otherwise would be irrational and “uneconomic”. From a Buddhist point of view, of course, this will not do; the essential difference between non-renewable fuels like coal and oil on the one hand and renewable fuels like wood and water-power on the other cannot be simply overlooked. Non-renewable goods must be used only if they are indispensable, and then only with the greatest care and the most meticulous concern for conservation. To use them heedlessly or extravagantly is an act of violence, and while complete non-violence may not be attainable on this earth, there is nonetheless an ineluctable duty on man to aim at the ideal of non-violence in all he does.

Just as a modern European economist would not consider it a great economic achievement if all European art treasures were sold to America at attractive prices, so the Buddhist economist would insist that a population basing its economic life on non-renewable fuels is living parasitically, on capital instead of income. Such a way of life could have no permanence and could therefore be justified only as a purely temporary expedient. As the world’s resources of non-renewable fuels – coal, oil and natural gas – are exceedingly unevenly distributed over

the globe and undoubtedly limited in quantity, it is clear that their exploitation at an ever-increasing rate is an act of violence against nature which must almost inevitably lead to violence between men.

This fact alone might give food for thought even to those people in Buddhist countries who care nothing for the religious and spiritual values of their heritage and ardently desire to embrace the materialism of modern economics at the fastest possible speed. Before they dismiss Buddhist economics as nothing better than a nostalgic dream, they might wish to consider whether the path of economic development outlined by modern economics is likely to lead them to places where they really want to be. Towards the end of his courageous book *The Challenge of Man’s Future*, Professor Harrison Brown of the California Institute of Technology gives the following appraisal:

“Thus we see that, just as industrial society is fundamentally unstable and subject to reversion to agrarian existence, so within it the conditions which offer individual freedom are unstable in their ability to avoid the conditions which impose rigid organisation and totalitarian control. Indeed, when we examine all of the foreseeable difficulties which threaten the survival of industrial civilisation, it is difficult to see how the achievement of stability and the maintenance of individual liberty can be made compatible.”⁸

Even if this were dismissed as a long-term view there is the immediate question of whether “modernisation”, as currently practised without regard to religious and spiritual values, is actually producing agreeable results. As far as the masses are concerned, the results appear to be disastrous – a collapse of the rural economy, a rising tide of unemployment in town and country, and the growth of a city proletariat without nourishment for either body or soul.

It is in the light of both immediate experience and long-term prospects that the study of Buddhist economics could be recommended even to those who believe that economic growth is more important than any spiritual or religious values. For it is not a question of choosing between “modern growth” and “traditional stagnation”. It is a question of finding the right path of development, the Middle Way between materialist heedlessness and traditionalist immobility, in short, of finding “Right Livelihood”.

Notes

- 1 *The New Burma* (Economics and Social Board, Government of the Union of Burma, 1954).
- 2 Ibid.
- 3 Ibid.
- 4 Ananda K. Coomaraswamy, *Art and Swadeshi* (Madras: Ganesh & Co. [n.d.]).
- 5 J. C. Kumarappa, *Economy of Permanence* (Sarva-Seva Sangh Publication, Rajghat, Kashi, 4th ed., 1958).
- 6 John Kenneth Galbraith, *The Affluent Society* (London: Penguin Books Ltd., 1962).
- 7 Richard B. Gregg, *A Philosophy of Indian Economic Development* (Ahmedabad: Navajivan Publishing House, 1954).
- 8 Harrison Brown, *The Challenge of Man's Future* (New York: The Viking Press, 1954).

Is Technology Autonomous?

Introduction

From the perspective of inquiries that emphasize technology's global reach and pervasive influence, the question naturally arises whether technology constitutes a power or force of its own, beyond the control of its human creators. In other words, is technology *autonomous*? Does it *determine* rather than serve our intentions and purposes? Does technology possess a logic or (more metaphorically) a will of its own?

Jacques Ellul is perhaps the most famous proponent of the autonomy thesis. In his view, the fact that people finance, invent, consume, and even seem to regulate technology – all of this is more appearance than reality. Ellul never refers to Max Weber as a source of inspiration, but his position resembles Weber's in two important respects. First, his notion of "technique" closely resembles Weber's conception of the "rationalization" of social practice. According to Weber, in our eagerness to bring everything from scientific research to daily human relations under rules and explicit organization, we tend increasingly to transform reason entirely into something "instrumental" and means-oriented, and we thereby cease to think about the question of the ultimate ends of our practices. Moreover, with this instrumentalist focus comes a certain pervasive blindness to, as Weber puts it, the unintended consequences of human action.

Ellul's critique begins, Weber-like, with a refusal to accept the idea that technology is in fact just the total collection of instrumental means. A close look at how

"the technological phenomenon" actually functions demonstrates that all of the human activities we "grandly presume" are independent from and thus empowered to direct and control technology are in fact bound up with and beholden to it. Science, the political order, economics, our (vastly overestimated) mental powers – all of these are repeatedly put in service of "the technological demand" for more invention, more development, more control – all the more so at the very moment when we display the greatest vanity in assuming we can decide when and where invention, development, and control are desirable and valuable. Ellul identifies several of the factors that account for our blindness to all of this. For one thing, it is characteristic of those who claim possession of the ability to control the direction of technological development to overestimate their skills. Scientists and engineers display embarrassing naïveté and shallowness in dealing with the social impact of technology. Politicians are driven by ideological assumptions rather than knowledge in their efforts to direct or regulate technical practices. And ordinary citizens and consumers are seriously uninformed about both the technical practices and the social realities that dominate everyday life. Moreover, the technological system itself entrances us all – technologists, politicians, and consumers alike. Advertising and propaganda successfully channel our desires. Admired as endlessly innovative, scientifically informed (and informing), and progress-oriented, technology comes to be taken as the primary "creative force" in our lives, and its values displace traditional morality, which is then regarded as merely something lingering

“inside” our minds that has already disappeared from the “outside” world of real affairs.

Ellul's arguments seem to imply technological determinism. In simple terms, determinism is the thesis that all things and events are caused by some previous things and events. The most popular models for this thesis derive their persuasiveness from the evidence of the predictive success of classical physics, particularly Newtonian mechanics. Persuasive or not, however, determinism is never advocated for very long without evoking serious opposition from all those for whom our experience of free will is too real to be explained away. Philosophers have offered various gambits that attempt either to reconcile determinism and free will (e.g., as characterizing the physical and mental realms, respectively) or to identify equally legitimate standpoints (e.g., the scientific and the ethical, respectively) from which human action can be regarded as determined or free. Determinism, of course, comes in numerous forms. Put in very general terms, biological or genetic determinism claims that who we are is simply a function of our genetic makeup – that we are, in effect, robots guided by our genes. Economic determinism holds that all our activities are ultimately intelligible in terms of the influence of market forces. Technological determinism, then, is the thesis that technology somehow causes all other aspects of society and culture, and hence that changes in technology dictate changes in society.

Marx's Preface to *The Critique of Political Economy* (see Chapter 8) has often been read as espousing technological determinism. The interpretation is difficult to sustain, however, given Marx's descriptions of the role of class struggle in shaping the direction of technological development. In fact, it is many of the Cold War era anti-Marxist defenders of a post-industrial society (e.g., Daniel Bell, Zbigniew Brzezinski, and others mentioned by Mesthene and in McDermott's critique of him, Chapter 57; but also Wyatt's selection below) that speak the language of the single-minded technological determinist better than Marx; for they claim – and urge that we find political satisfaction in the claim – that the replacement of machine technology by information technology simply generates new classes of technocrats and service workers in a unilateral and unavoidable manner.

Robert Heilbroner's examination of technological determinism in “Do Machines Make History?” has become something of a classic. According to Heilbroner, the deterministic thesis has two parts that are often run together. About both parts he claims to be “softly”

deterministic. First, there is the question of whether there has in fact been a determinate pattern, or “fixed sequence” of technological evolution. On this question, he offers a somewhat qualified Yes. He acknowledges that the linear, logical, ostensibly automatic progress of science, especially when conceived with the aid of an interpretation of technology as applied science, makes technological progress appear inevitable. Even apparently “premature” technological inventions (Heilbroner mentions Hero's depiction of a steam engine in ancient Greece and Charles Babbage's nineteenth-century calculator) are not really counterexamples, for upon closer inspection these devices were not really feasible in their day because of limitations in other technology (here, a lack of “material competence” in metal-working). On the second question, whether technology “imposes a determinate pattern” on society, Heilbroner offers a still more heavily qualified Yes. There is no doubt, he says, that the composition of the labor force and the organization of work are “influenced” by technology. Yet this influence can only seem like the operation of a full-blown causality when one looks at the effect of machines on society but fails to do the reverse. Thus to Heilbroner, who begins with Marx's famous claim in the *Poverty of Philosophy* – that “the hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist” – this seems like a serious overstatement. In a manner suggesting a preference for softly economic rather than technological determinism, Heilbroner closes his discussion with a list of several ways in which capitalism (or even a socialism “based on maximizing profits and minimizing costs”) stimulates the development and expansion of both modern science and technology.

Critical theorists like Herbert Marcuse (in this section) and Andrew Feenberg (in Chapter 58) resist the pull of technological determinism by arguing that a certain pervasive ideology of technocracy – that is, a seriously inflated picture of the social and political importance of those who have expertise in the sciences and in technology – plays a major role in making technological autonomy appear plausible. Like Ellul, Marcuse describes the way advertising and political propaganda are utilized to control citizen-consumers; and like Weber, he stresses the tendency in contemporary society toward the complete “rationalization” of all its practices. Unlike Weber, however, Marcuse does not accept this process with what in others seems to him like Stoic resignation. Instead, he argues that the so-called rationalization of society and culture (Marcuse is

drawing here on Freud's idea of "rationalization") can be quite irrational. The key, argues Marcuse, is to recognize that science and technology are both part of a "one-dimensional" universe of discourse whose moral and political agenda is set by the needs of a particular industrial (i.e., capitalist) social order. However illogical (e.g., "free" means acceptable to Free World capitalists and "socialist" means everything that fails to serve the interests of private enterprise), the inner logic of this order will continue to dominate our lives until the very success it is currently achieving through the technoscientific domination of nature and human life makes the continuing struggle to contain this success within outmoded institutions intolerable. Today, Marcuse argues, the whole sociopolitical order merely facilitates more productivity while suppressing the free actualization of "new dimensions of human realization" that this very productivity now makes possible. Genuine rationalization would involve a very different, utopian, social arrangement; and it would have to be achieved by means of an alternative and genuinely emancipatory technology. For behind technology as presently understood, there is only the impetus for more control of human beings for the sake of more production for the greater benefit of those who are already getting the most benefit from the present social order.

In her much-cited review of the whole debate, Sally Wyatt begins, not by defending or criticizing technological determinism, but by considering how and why, in spite of all its apparent flaws as a thesis, the idea continues to be accepted by so many social *actors* as well as by many *analysts* of technological activity, including those in the Science, Technology, and Society (STS) movement with which she identifies. Her conclusion is that, for both actors and analysts, technological determinism is often not really taken as a rational principle to be justified by argument; rather, it functions as a basically plausible means of making sense out of what they experience (or study) and what they can or should do (or empirically report) about it.

To follow Wyatt's arguments, one must recognize the point of her change in perspective. Where philosophers quarrel over the objective truth, essential usefulness, genuine reality, or axiological rightness of technological determinism as a thesis, Wyatt speaks for social science, explaining that STS researchers simply want to understand technology's role in human history and social life. Like Pinch and Bijker (Chapter 24), Wyatt embraces a somewhat expanded version of David Bloor's "principle

of symmetry." If the aim is to understand, for example, what people think is true, or what they use because they think it works, then truth and utility must be interpreted as socially constructed ideas internal to the culture in which they develop – that is, ideas that are "symmetrical" in importance with any other such ideas developed elsewhere, and independently of any later "objective" judgments about the superiority or inferiority of these ideas. Thus, to cite a case made famous by Pinch and Bijker (discussed by Feenberg in Chapter 58), it might be tempting to come to the study of the history of the bicycle with our present appreciation for the greater "efficiency" of chain-driven bicycles with equal-sized wheels; but to do so would guarantee our failure to understand all those who rode for sport and thus preferred the other available kind of bicycle (with a high front wheel and pedals attached directly its axle) because it was, for the time and for the purpose, the most "efficiently" designed for risk and speed.

What Wyatt adds to the mix is the idea of the symmetry of beliefs and theories, not just among social actors, but between actors and those, like STS researchers, who analyze the actors. Only with this expansion of the principle, she argues, are researchers able to fully acknowledge all of the ways that human beings "construct" their ideas about technological determinism without secretly evaluating them by privileging either the researchers' own ideas or those of the most visible actors. Favoring the former reinforces the old idea of scientists as omniscient observers, and favoring the latter encourages researchers to simply "follow the [primary] actors" and thus overlook the less visible users and the effect of their beliefs on sociotechnological relations. Wyatt cites with approval Anthony Giddens' notion of a "double hermeneutic," for its fostering of symmetrical treatment of both actors' and researchers' identification of other actors and their interests.

Using this expanded version of the principle of symmetry, says Wyatt, we can see that for both social actors and STS researchers, the idea of technological determinism actually functions in four different ways. First, there is its "justificatory" use, which is important primarily to actors – especially in relation to social policy issues, where government and corporate leaders appeal to it to defend the "necessity" of their political or economic decisions. Second, there is a "descriptive" use, important primarily to researchers in their characterizations of the actual historical and social record. Third, there is what Wyatt calls a "methodological" use

(allegedly, e.g., Heilbroner's version), which she seems to think of as also accepted by STS researchers in their non-traditional decision to place special emphasis on the role of technology in human affairs. Finally, there is a "normative" use, exemplified by Langdon Winner's insistence on the idea that technology has become so complex and ubiquitous that we must now admit that it displays an autonomy beyond social control.

Wyatt concludes by acknowledging what she sees as STS's "guilty secret," namely, that to a certain degree all technology researchers are and have to be technological determinists. Whatever we might ourselves think about the thesis, she says, it is obvious not only that technology

does in fact centrally affect society in many ways, but also that some species of technological determinism is widely employed both by social actors and their analysts. "We are not innocent in the ways of methodological and normative technological determinism," says Wyatt, "but we can no longer afford to be so obtuse in ignoring the justificatory technological determinism of so many actors" – and in the process eliminate much of what STS studies. It goes without saying that a research-driven decision like Wyatt's – that is, a decision to understand rather than philosophically evaluate technological determinism – does not make the "methodological and normative" issues usually associated with the idea go away.

The “Autonomy” of the Technological Phenomenon

Jacques Ellul

[...]

An autonomous technology. This means that technology ultimately depends only on itself, it maps its own route, it is a prime and not a secondary factor, it must be regarded as an “organism” tending toward closure and self-determination: it is an end in itself. Autonomy is the very condition of technological development. This autonomy corresponds precisely to what J. Baudrillard (*Le Système des objets*) sees under the name of *functionality* when he says that “*functional* qualifies not what is adapted to an end but rather what is adapted to an order or a system.” Each technological element is first adapted to the technological system, and it is in respect to this system that the element has its true functionality, far more so than in respect to a human need or a social order. And Baudrillard presents numerous examples of this autonomy, which transforms everything covered by technology into technological objects *before* being anything else: “The entire kitchen loses its culinary function and becomes a functional laboratory...an elision of prime functions for the sake of secondary functions of calculation and relation, an elision of impulses for the sake of culturality...a passage from a gestural universe of work to a gestural universe of control. ... The simplest mechanism elliptically replaces a sum of gestures, it becomes independent of the operator as of the material to be operated on.”

Performing this function, technology endures no judgment from the outside nor any restraint. It presents itself as an intrinsic necessity. Let us recall a rather typical statement among a thousand. Professor L. Sedov, president of the Permanent Commission for the Coordination of Interplanetary Research in the USSR, has declared that no matter what difficulties or objections crop up, nothing could halt space research. “I feel that there are no forces capable today of stopping the historical processes” (October 1963). This remarkable declaration can apply to all technology. The technological system, embodied, of course, in the technicians, admits no other law, no other rule, than the technological law and rule visualized in itself and in regard to itself.¹...

However, we must know more about this autonomy. First of all, it is the notions or hopes that are modified by technology. An important aspect of this autonomy is that technology radically modifies the objects to which it is applied while being scarcely modified in its own features (if not its forms and modalities). Let us take a simple example. We distinguish between open data and closed data. Open data relates to still unsettled questions, it has an indeterminate content, it implies the participation of the interested parties. Closed data concerns a well-defined object, it can be coded and diffused instantaneously, and, of course, it is closed to participation. Only closed data takes

Jacques Ellul, “The ‘Autonomy’ of the Technological Phenomenon,” from “Autonomy,” ch. 5 of *The Technological System* (New York: Continuum, 1980), pp. 125–150, 335–338, abridged. Reprinted by permission of Bloomsbury Publishing Group Inc. (Continuum).

advantage of all the technological means, only it can be rapidly transmitted, etc.

Hence, the instant that technology is applied more rigorously in coding and transmitting data, the faster it accelerates and the more the data tends to become closed, i.e., to exclude participation by everyone, despite the ideology and the moral desire one may have.

We will not take up here the problem of the relationship between technology and science and technology's relative autonomy from science, since we treated these matters in *The Technological Society*. We will merely add four things emerging from recent studies. The man who ... has investigated this most closely is Simondon. And after showing the interconnections, he concludes not so much – obviously – that there is an autonomy pure and simple of technology, but that there is a possibility for technology to keep developing for a long, long while, even without basic research:

Even if the sciences did not advance for a certain time, the progress of the technological object toward specificity could continue. The principle of this progress is actually the way in which the object causes itself and conditions itself in its own functioning and in the responses of its functioning to utilization – the technological object, issuing from an abstract work of an organization of subensembles, is the arena for a certain number of relationships of reciprocal causality.

This text gives the precise point of the autonomy of the technological object and thereby specifies technology itself. In the same way, but going to extremes, Koyré (*Études d'histoire de la pensée scientifique*) opines that technology is independent of science and has no influence on it – which strikes me as impossible to support. J. C. Beaune, following Hall (*The Scientific Revolution*), likewise feels that science and technology have separate existences and autonomous developments, whose convergence was historically contingent; he also feels that the passage to scientific technology consisted in unifying the empirical and dispersed technologies, which I have called the passage from the technological operation to the technological phenomenon. These ideas merely take up what I wrote in 1950. Lastly, we can find numerous examples of both the correlation and the independence of technology in François de Closets. But they are not very significant!

The second remark: John Boli-Bennet (*Technization*), in another connection, offers a stunning analysis of the relationship between science and technology. His is the most recent analysis that I know of, after Ernest Nagel (*The*

Structure of Science, 1961), Karl Popper (*The Logic of Scientific Discovery*, 1959), and Carl Hempel (*Aspects of Scientific Explanation*, 1965). There are, says Boli-Bennet, two essential characteristics of scientific knowledge. The first is the "empirical proof of error": a statement cannot be accepted as scientific knowledge if it is theoretically impossible to find empirical data in respect to which the statement is invalid. The second is intersubjectivity, a concept that has replaced scientific objectivity: a statement is scientific only if it is liable to verification or "falsification" which is not subjective and individual, but intersubjective, each scientist never being more than one subject; but each subject having a certain knowledge and a certain background can repeat the same experiment, hence arrive at the same result. In sum, a scientific statement is one that is potentially "falsifiable" on an intersubjective level.

On this basis, we can very clearly see the close relationship between science and technology, quite a different relationship from the one that observers have been hunting for years by setting up "causalities." We will come across this science/technology problem again when studying the finalities of technology. But the mutual relationship between science and technology cannot be divorced from the relationship between technology and politics. It is through, and because of, technology that science is put in the service of government and that politics is so enamored of science.

The third remark: The science/technology interpenetration has *inter alia* a radical effect that is admirably set forth by K. Pomian ("Le Malaise de la science" in *Les Terreurs de l'an 2000*, 1976): namely, the end of scientific innocence. There is no more neutral science, no more pure science. All science is implicated in the technological consequences. And the strength of Pomian's long and profound *factual* study lies in showing that there is no political implication here. As he demonstrates beyond dispute, the essential element is not the decision by politicians to use a scientific discovery in a certain way. But rather, the necessary implication of all scientific research in technology is the determining factor. It is the domination of the technological aspect over the epistemic aspect. And the factors operate in terms of one another. Militarization, nationalization, technicization are intercorrelated. In the same way, Pomian also points out that there is no good or bad use of science or technology.

The two are indissoluble, so that science, he claims, is not neutral, but ambivalent. "To believe that a methodology is neither good nor bad is to tacitly assume that

human happiness and suffering are quantities with opposite signs, canceling one another. Far from it. In moral arithmetic, if there is an arithmetic, the sum of two opposite quantities does not equal zero." And we are gradually led to reverse the customary proposition: any *scientific* decision entails *political* consequences. "The decision to build a giant accelerator has political implications that the physicists cannot allow themselves to ignore." Pomian cites numerous present-day cases of scientists realizing the consequences of what they are doing and demanding a halt to research (and not a better political application!). Take for examples, the group working around Berg (1974) and the Conference of Asilomar (1975). In contrast, Pomian reveals the politically oriented character of the manifesto of researchers at the Pasteur Institute (the group for biological information). The object of the manifesto is not really the science/technology problem but rather a political debate in the most banal sense of the word! It is politics which is more and more induced by technology and incapable now of steering technological growth in any direction.

Lastly, we have to bring up a new analysis (1975),² which fairly transforms the present study of the relationship between science and technology. First of all, we have to distinguish between mathematics (which develops deductively, starting with axioms, and operates upon abstract symbols) and the physical or natural sciences (which develop on an instrumental and material basis). These latter sciences can progress only from a technological ensemble, which is itself nothing but the materialization of theoretical schemata.

Technology is both ahead of and behind science, and it is also at the very heart of science; the latter projects itself into technology and is absorbed into it, and technology is formulated in scientific theory. All science, having become experimental, depends on technology, which alone permits reproducing phenomena technologically. Now, technology abstractly reproduces nature to permit scientific experimenting. Hence, the temptation to make nature conform to theoretical models, to reduce nature to techno-scientific artificiality. "Nature is what I produce in my laboratory," says a modern physicist.

In these conditions, science becomes violence (in regard to everything it bears upon), and the technology expressing the scientific violence becomes power exclusively. Thus, we have a new correlation, which I consider fundamental, between science and technology. The scientific method itself determines technology's calling to be a technology of power. And technology, by the

means it makes available to science, induces science into the process of violence (against the ecology, for instance). "The power of technology (theoretically unlimited, but impossible to utilize effectively) materializes in a technology of power. "That is the ultimate point of this relationship." Which the text summed up here calls the "Technological Baroque."

Quite obviously, an autonomy from the state and from politics does not imply that there is no interference with, or political decision-making about, technology. I will certainly not deny the existence of the famous "military-industrial complex." The state cannot help interfering. We have seen that it is tightly bound up with technology, that it is called upon by the technologies to widen its range of intervention. Hence, all the theorists, politicians, partisans, and philosophers agree on a simple view: The state decides, technology obeys. And even more, that is how it must be, it is the true recourse against technology.

In contrast, however, we have to ask who in the state intervenes, and how the state intervenes, i.e., how a decision is reached and by whom in reality, not in the idealist vision. We then learn that technicians are at the origin of political decisions. Next, we have to ask in what direction the state's decision goes. And we perceive very quickly that a remarkable conjunction occurs. The state is furnished with greater power devices by technology, and, being itself an organism of power, the state can only move in the direction of growth, it is strictly conditioned by the technologies not to make any decisions but those to increase power, its own and that of the body social.³

Finally, since the system is far from being fully realized, politicians sometimes intervene, taking measures about technological problems, for purely political and in no way technological reasons. The result is generally disastrous.

Those are the four points that we are going to examine rapidly.

Habermas, starting with the presupposition and the democratic ideology, vaguely poses the question: How can we reconcile technology and democracy? But since his view of the technological reality is inexact, since his discourse is purely ideological, the idea of correcting, of mending technology in the actual world of practice is purely illusory. Certainly, the first question to trouble us is: What is becoming of democracy?

Among the hundreds of articles on this topic, we can point out one by R. Lattés ("Énergie et démocratie," *Le Monde*, April 1975) as significant because, written by

a scientist, it ingenuously expresses all the ideas assumed by the most unreal idealism. I will not repeat my criticism of identical positions, as set forth in my article "Propagande et démocratie" (*Revue de Science politique*, 1963). Instead, I will limit my self to underlining two particular features.

Monsieur Lattés rightly feels that for *the exercise of democracy*, all citizens must be well informed and judge with full knowledge of the facts. If parliamentary debate is to have any sense, all the deputies must be well educated and well informed. Then, regarding the problem of energy, Lattés asks seven "obvious" questions, whose answers one *must* know for any valid opinion in the energy debate. But he does not seem to realize for even an instant that this issue, paramount as its importance may be, is simply one of dozens: the risks of military policies, the multinational corporations, inflation, its causes and remedies, the ways and means of aid to the third world, etc. For each issue, the citizen would have to have a complete, serious, elaborate, and honest file. Who could fail to see the absurdity of the situation! People do not even have time to "keep up to date."

Furthermore, Lattés apparently believes that the correctly informed citizen could decide on the problem of nuclear energy beyond gut responses and panicky reactions. But (and I will develop this further on) what marks the situation is the inextricable conflict of opinions among the greatest scientists and technicians. The more informed the citizen, the *less* he can participate. Because the evaluations are perfectly contradictory, Lattés is deluding himself. But this is certainly more comforting! There is absolutely no way the citizen can decide for himself. Yet the politician is equally deprived (cf. "L'illusion politique" in Finzi: *Il potere tecnocratico*).⁴

Thus, despite the advances made in understanding the state/technology problem, we must emphasize an opinion frequent among intellectuals: "To resolve the problems and difficulties caused by technology, we have to nationalize. We have to let the state run the whole thing." That is Closets's implicit thesis, straight through; he tries to prove that all the dangers and abuses of technology are due to its lack of direction. We have to work out a general policy of progress, set up planning agencies, reorganize, etc. But all this can be done only by the political authorities, although he does not come right out and say so. We know that this is also Galbraith's thesis.

Habermas does a superficial analysis of the relationship between technology and politics. He is content with arguments like: "the orientation of technological progress depends on public investments," hence on politics. He

seems to be totally unaware of dozens of studies (including Galbraith's or mine) showing the subordination of political decisions to technological imperatives. He winds up with the elementary wish to "get hold of technology again" and "place it under the control of public opinion... reintegrate it within the consensus of the citizens." The matter is, alas, a wee bit more complicated; likewise, when he contrasts the technocratic schema with the decision-making schema. To grasp the interaction, he ought to study L. Sfez (*Critique de la décision*, 1974). And Habermas's discussion of the "pragmatic model" is along the lines of a pious hope, a wish: the process of scientification of politics, such as appears desirable to him, is a "must." But the reality of this technicization of politics actually occurs on a different model!

Habermas poses the philosophical problem honestly: The true problem is to know if, having reached a certain level of knowledge capable of bringing certain consequences, one is content to put that knowledge at the disposal of men involved in technological manipulations, or whether one wants men communicating among themselves to retake possession of that knowledge in their very language. But Habermas poses the problem outside of any reality. When reading this text, we need only ask: Who is that "one" who puts technology at the disposal of either group? Who exercises this (if you like) supreme "will"?

And Richta goes along with Galbraith! The state, they feel, returns to its true function of representing the general interest when it encourages science. "It is significant," writes Richta, "that the state intervenes most drastically in sectors in which science makes the most of itself as a productive force that, by nature, is hostile to private property and that endlessly exceeds its boundaries." The American federal government finances 65% of all basic research, the French government 64%, for the profit motive can no longer make technology advance. But we are forgetting that the state thereby becomes a technological agent itself, both integrated into the technological system, determined by its demands, and modified in its structures by its relationship to the imperative of technological growth. [...]

Besides, given that, in any event, technology produces a specialization (which is inevitable and the very condition of its success), but also given that the technological system functions as an overall system, no technician can thus grasp the technological phenomenon. Such a grasp would require the experience of the body social, a non-technologically specialized collective organism – in other words, clearly the state. We find the same thing in the

Mintz and Cohen book *America, Inc.* (1972). With enormous documentation, these authors show that the whole of American society is subject to two hundred ruling industrial firms – and for Mintz and Cohen, the sole issue is once again the supremacy of the government, which alone will permit the fight against technological abuses, against harmful effects (inequality, exploitation, etc.). It is, incidentally, once more the state that can assure technology its true place and its progress, because – they maintain – the giantism of economic ventures is one cause of blockage to technological advances (but Mintz and Cohen never raise the problem of government giantism).

Lastly (but, of course, the list is not closed), we have to recall Saint Mark's enthusiasm for having the state alone protect nature. Nationalizing and socializing nature is the way to save it – and such mastery would also make technology itself controlled, well oriented, useful, etc.

Before such a roster of authorities, one is surprised and amazed. But also confused. Just what are they talking about? That marvelous ideal organism, the incarnation of Truth and Justice, letting a sweet equality reign without suppression or repression, favoring the weak in order to equalize opportunities, representing the general interest without damaging private interests, promoting liberty for all by a happy harmony, insensitive to the pressures and struggles of interest, patient but not paternalistic, liberating while socialistic, administering without creating a bureaucracy, able to encourage new activities of regulation and concertedness without claiming to impose its law, in such a way as to allow the social actors to freely control the effects of technological progress. A state, finally, having Omnipotence, Omni-Science, without abusing them for anything in the world . . .

One can only pinch oneself before such a pastoral! Has anyone ever laid eyes on such a state? And if not, what guarantee, what chance do we have that it will come true? Who are the people who will staff it? Saints and martyrs? The huge, the enormous mistake of all those excellent authors is simply that they never breathe a word about this mythical state, which they entrust with so many functions.

Hitherto, the state, whatever its form, socialist or not, has been an organism of oppression, of repression, eliminating its opponents, and constituted by a political class that governs for its own benefit. Will someone explain to me in the name of whom and of what the state will be any different tomorrow – for the dictatorship of the proletariat is exactly the same thing. The marvelous state that will run technology and solve the problems is composed of men (Why should they no

longer be dominated by the spirit of power?) and structures (which are more and more technological).⁵ What those authors are proposing is that we hand over all power to the administrations, increase administrative power (an ineluctable growth, to be sure, but in no wise a remedy) – i.e., to transform an aleatory control into a technological organization.

In reality, not only is there no guarantee that the state will carry out its envisioned role. But, as can be demonstrated, this state, ruled by the technological imperative and no other, must unavoidably create a society that will be a hundred times more oppressive. It may be able to put order into the technological chaos, but not to control and direct it. It can only accentuate the features we are familiar with. Relying on the state (without considering the autonomy of technology and what the state will turn into under the pressure of technology) means obeying that so technological reflex of a specialist: Things are going badly in my sector, but my neighbor surely has the solution. Finally, it is interesting to note that the advocates of this position, while abominating technocracy, are summoning it with all their might. For a state qualified to dominate technology can only be made up of technicians! But we will come back to technocracy further on.

[...]

To wind up, we will cite a fact that stunningly reveals the dependence of politics and the autonomy of technology. The technological demand is dependent on technological means and not on political ideologies. For instance, Peru has immense copper resources in Cujajone. Experts are unanimous in affirming the incredible wealth of these deposits. But they are very hard to get at and extract. In 1968, Peru turned to the USSR. Soviet experts carefully examined the problem, and their highly detailed report concluded that only the United States had the technology to properly mine the deposits. These experts advised Peru to confide the work to the Americans. In early 1970, the Peruvian government was in a quandary about handing over the "Cujajone contract" after expropriating the International Petroleum Company. But what strikes me as important here is that most of the non-technicized countries must either leave their riches unexploited or else appeal to highly technicized countries – whatever their ideological outlook may be.

Ideological imperialism is nonsense. Only the technological weight gives true superiority.

It might now be useful to focus on the idea of autonomy from economics, for misunderstandings abound. Quite

clearly, one cannot *separate* technology and economy, as Simondon strikingly points out: "Thus there exists a convergence of economic constraints (decrease in raw materials, in work, in energy consumption, etc.) and of properly technological demands. ... But it seems that the latter would predominate in the technological evolution." Simondon shows that the areas in which the technological conditions override the economic conditions are those in which technological progress has been most rapid. The reason, he says, is that the economic causes "are not pure," they interfere with a diffuse network of motivations and preferences, which rotate or overthrow them. And it is to some extent the "pure" character of the technological phenomenon that assures its autonomy.

Hence, sociologists imperceptibly slide from the primacy (and autonomy) of economics to the primacy (and autonomy) of technology. This is not generally formalized, clearly worded, or enunciated as an overall reality; but more often, it is a subliminal thought, latently taken for granted, as it were. "It goes without saying" for most observers that technology is what determines and causes events, progress, general evolution, like an engine that runs on its own energy. Technology in the intellectual panorama plays the same part as spirituality in the Middle Ages or the idea of the individual in the nineteenth century. Observers do not proceed to any clear and total analysis, but one cannot conceive of society or history in any other way. This trend is so powerful that it crops up even in those who deny it.⁶

I must, however, add some clarification. When I first analyzed technology's autonomy from economics, certain readers saw this as a declaration of *absolute* autonomy – and their criticism was aimed at this *absolute*. Yet I had emphasized that my term did not imply an equivalence between technology and divinity. It is no use saying, "Either there is autonomy, and hence it is absolute – or it is not absolute, and hence there is no autonomy."

This kind of theoretical argument does not go very far. Everyone knows that a sovereign state today cannot do anything it pleases with its sovereignty; belonging to the "concert of nations" is a practical limit on sovereignty. Yet being sovereign, being colonized, having a government imposed by an invader, are not one and the same. Thus, I never said that technology was not dependent on anything or anyone, that it was beyond reach, etc. Obviously, it is subject to the counterthrust of political decisions, economic crises. I indicated, for example, that a government decision at odds with the law of development in technology, with the logic of the

system, could halt technological progress, wipe out positive consequences, etc., but that in the conflict between politics and technology, the former would inevitably lose out, and that such a political decision, going against a technological imperative, would ultimately be ruinous for politics itself.

It is quite obvious that technology develops on the basis of a certain number of possibilities offered by the economy. And when the economic resources are lacking, technology cannot operate at its full capacity, achieving what its possibilities allow it to achieve. The relationship between technology and economy is complex. Technology is a determining factor in economic growth, but the converse is equally true. Closets shows clearly that the impact of technology on economy is ambiguous and that economic advances are not proportionately highest where there is the most technological research. Still, technology develops most rapidly in the peak sectors, and it is there too that economy follows. The relationship between the two is striking. In the United States, exports rose an average of 4% in 1967, but 58% for computers, 35% for aeronautics, 30% for telecommunications hardware. Here, the direct relationship is reestablished, but with technology being decisive for economy.

The relationship varies with the periods. It does not appear certain, first of all, that a relationship exists between the great movements of technological *invention* and the economic or social structure. The technological inventions seem like unforeseeable givens of civilization and are by no means tied to the economic level. Nor is technological invention today tied to any one country. It breaks away from those who have encouraged it and benefits countries that did not take part in the effort of scientific or technological invention. But when we leave the domain of invention and proceed to application, technology presumes the involvement of greater and greater capitals.

Can one say that industrial development is what conditions the possibility of technological growth? (Considering that industry is itself a product of technology!) Most technological research in the twentieth century, so it seems, is conditioned and stimulated when the market causes an industrial boom. However, M. Daumas (*Revue d'histoire des sciences et de l'application*, 1969), on the contrary, forcefully asserts the autonomy of technology from industry. And he maintains (which has always been my position): "There is no denying that the evolution of technologies can be understood only if

placed in its original historical context; but it is all right to think that the original task of the historian of technologies consists precisely in revealing the intrinsic logic of the evolution of technologies. This evolution actually takes place with an internal logic, which is a very distinct phenomenon from the logic in the evolution of socio-economic history. ... Investigating this internal logic in the technological evolution is the only way for 'the technological history of the technologies' to slough off its character of data history."

With the spread and growing complexity of technological development, invention in its turn depends on already acquired technological bases (the outcome of earlier applications) and involves *more and more expensive* elements. Hence, technological invention comes to depend *also* on possibilities of economic investment. We thus perceive a mutual influence. On the one side, all modern economic growth depends on technological application, in all areas.⁷ But, vice versa, the possibilities of advanced technological research and of the application of technologies depend both on the economic infrastructure and on possibilities of mobilizing economic resources. ... Negatively, the economy can thus either block technological development for lack of power or prevent technological application. The technological program is conditioned by two series of economic imperatives: in a capitalist country by the profitability of investment; and everywhere by the possibility of obtaining the funds necessary for investment.

Nevertheless, at the moment, this is less and less so, for people are coming to realize how impossible it is to calculate the profitability of investments in basic research, and they are growing more and more "convinced" that this research is essential, cannot be neglected, etc. The relationship between technological research and profitability is no longer direct. Hence, the technological applications will be highly unequal according to the economic forms and levels. The latter cause an inequality both in the intensity of technological progress and in the rapidity of access to the profits of technologies.

All this is obvious. But the importance of the economic factor notwithstanding, I will maintain the concept of technology's self-sufficiency in the sense that economy can be a means of development, a condition for technological progress, or, inversely, it can be an obstacle, but never does it determine, provoke, or dominate that progress. Like political authority, an economic system that challenges the technological imperative is doomed.

It is not economic law that imposes itself on the technological phenomenon; it is the law of technology which orders and ordains, orients and modifies the economy.⁸ Economics is a necessary agent. It is neither the determining factor nor the principle of orientation. Technology obeys its own determination, it realizes itself. And by so doing, it naturally employs many other, nontechnological factors. It may be blocked by their absence, but its reason for functioning and growing comes from nowhere else. Modifying a political or an economic system is perfectly ineffective today and does not alter the true condition of man, because this condition is now defined by its milieu and its technological possibilities, and because the impact of political or economic revolutions on the technological system is practically nil. At most, these troubles can hold up technological progress for a certain time; but revolutionary power changes nothing in the intrinsic law of the system.

This autonomy will get its institutional face in self-organization. That is to say, normally, the technological world will itself organize technological research, the direction of application, the distribution of funds, etc. The autonomy of the technological system must be matched by the autonomy of the institutions that are part of it, that embody it. And this, incidentally, will be the only acceptable autonomy in our society, because it will be the only one providing an ultimate justification. The basic research oriented toward technology cannot develop unless it is sufficiently autonomous! There is an excellent study on this topic by Monsieur Zuckerkandl, research director of France's National Center of Scientific Research (*Le Monde*, November 1964).

One of the effects of autonomy is that technology is becoming the principal factor in reclassifying the domains of activity, of ideological directions. Thus, in 1950, I studied the way technology is making political regimes more similar and reducing the role of ideologies: e.g., the Soviet and the American systems. Likewise, technology is causing a reclassification of public and private activities: the distinction is fading between the economic activities of these two areas. All this was taken up and demonstrated at length by Galbraith in *The New Industrial State* and by M. L. Weidenbaum in "Effets à long terme de la grande Technologie," *Analyse et prévision*, 1969. But the essential point is to see that these effects derive from the autonomy of technology.

Evidently, it is hard for the Marxists to admit that technology has become an autonomous factor, dominating the economic structure and having the same nature

and effects in both a capitalist and a communist regime. The most frequently developed argument is that, without any possible doubt, technology is simply in the service of capital, that the familiar effects are due to its integration in capitalism. The technician is merely a salaried employee like the others, the ideology of efficiency is not technological but rather the reflection of the profit need. The division of labor and specialization are not products of technology, but additional ways of exploiting the working class, etc. The most complete effort at systematically demonstrating this interpretation was made by Benjamin Coriat (*Science, technique et capital*, 1976).⁹ That is why I will stick to his book rather than lesser works along the same lines.

The two themes to be demonstrated bear, first of all, on the fact that the power of decision belongs to capital. It is capital that decides whether or not to use technologies; the capitalist technologies are as much technologies of production as they are technologies of controlling the exploited class; and capital uses the technologies *only* when they can procure greater profits. If the author admits that technology is not neutral, then only in the sense that it serves capitalism exclusively. The capitalist mode of production has one single goal: the valorization of capital; and by examining the contributions made by the different types of inventions to capital in its process of self-valorization, one can expose the (social) causes determining the incorporation or rejection of the various technologies. Capital utilizes only those that increase the extraction of surplus value. Likewise, the law of value defines the very space in which the technological rationality can operate.

Naturally, the author accuses Richta of dodging the law of value and the production relations *in* and *under* which technology is put to work. But the entire basis of his demonstration rests on Marx's demonstration that capital resorts to mechanization only under two conditions: (1) when the use of dead labor (accumulated in the machine) permits obtaining more surplus labor (diminishing the part of the day that the worker devotes to his own production and increasing that part which goes back to capital); (2) when the technologies allow capital to better dominate the labor process.

[...]

But the most characteristic thing about Coriat's unrealism is his living in the past. Coriat takes Taylorism and mechanization as examples, models, and the *ne plus ultra* of technology. We must be dreaming! Nothing fundamental has occurred; there has been no change in

the technological structure since Taylor. Technology is summed up in and boils down to: the machine. We can obviously understand in these circumstances that Marx's analyses are accurate *for those facts* that are contemporary with, or very slightly subsequent to, Karl Marx. But the mistake is to claim that we are still back there. In Coriat, technology is nothing but the *industrial* application of science in terms of the production of *goods* (in the narrow sense). He blissfully declares that the technologies whose goal is not to produce goods are unemployed! And his critique of Taylorism (as if that were the present situation) corresponds to a labor situation of 1930. In other words, Coriat's "demonstration" is acceptable only for the reader who first grants total approval to the literal expression of Karl Marx's thought and who totally "pooh-poohs" the present facts about technology. Coriat remains enclosed in a problematic established on totally obliterated facts.

We would like to dwell on a further aspect of that autonomy from values and ethics.¹⁰ Man in his hubris – above all intellectual – still believes that his mind controls technology, that he can impose any value, any meaning upon it. And the philosophers are in the forefront of this vanity. It is quite remarkable to note that the finest philosophies on the importance of technology, even the materialist philosophies, fall back upon a preeminence of man.¹¹ But this grand pretension is purely ideological. What is the autonomy of technology all about in regard to values and morals? One can, I feel, analyze five aspects.

First of all, technology does not progress in terms of a moral ideal, it does not seek to realize values, it does not aim at a virtue or a Good. ...

Secondly, technology does not endure any moral judgment. The technician does not tolerate any insertion of morality in his work. His work has to be free. It seems obvious that the researcher must absolutely not pose the problem of good and bad for himself, of what is permitted or prohibited in his research. His research, quite simply, *is*. And the same is true for its application. Whatever has been found is applied, quite simply. The technician applies his technology with the same independence as the researcher. Now this is the great illogic of many intellectuals. They agree on the first term, which strikes them as obvious, but they want to reintroduce judgments on good and evil, human and inhuman, etc., when they come to the second term, that the technician ought to use his technology to do good. Yet this makes no sense at all after the first term, for

application coincides exactly with research. Technological invention is already the outcome of a certain behavior. The problem of behavior (on which people claim to have a value judgment) does not arise only with application. (We will study the conflict between power and values in the last part.) It is the same behavior that dictates the attitude of research (claiming it to be free) and the attitude of application. The technician who puts something to work claims to be as free as the scientist who does the research. Thus it is childish of an intellectual to bring morality into the consequences if he has rejected it in the principle. The autonomy of technology is established here chiefly by a radical division of two areas: "each for itself." Morality judges moral problems. It has nothing to do with technological problems: only the technological means and criteria are acceptable.

An absolutely engrossing study was done by an American technologist on the following theme:¹² So long as the problems are purely technological, they can always find a clear and certain solution. But once the human factor has to enter, or once these problems become too large for any direct technological handling, they seem insoluble. Confronted with these difficulties, people have been developing "social engineering." This innovation appeals to the better feelings; a whole improvement of man rests on the finer instincts and it claims that the route will be the improvement of man, albeit obtained by technologies (psychological or psycho-sociological technologies). Now after a certain number of examples, the author feels that this route is unsuccessful and uncertain because there are too many nontechnological factors. The only way out is to transform all the problems into a series of specifically technological questions, each receiving its solution from the adequate technology. Here, we can be sure of getting results by avoiding a mixture of types. There is no finer example affirming technological autonomy! Morality, psychology, humanism – they all get in the way. Such is the obvious verdict.

And this is reinforced by the philosophical certainty that only man can be subjected to a moral appraisal. "We are no longer in that primitive epoch when things were good or bad per se: things are only as man makes them. Everything boils down to him. Technology is nothing in itself." But in formulating this oversimplification, the intellectual fails to realize that man is dependent on technology and that, since the latter has become free of all moral judgment, the above statement would imply precisely that technology could do anything. Man does

what technology allows him to do. He has thus undertaken to do anything. Maintaining that morality should not judge invention or technological operation leads to saying, unwittingly, that any human action is now beyond ethics. The autonomy of technology thus renders us amoral. Henceforth, morality will no longer be part of our domain, it will be shunted off into the void. In the eyes of scientists and technicians, morality – along with all values and what can be called humanism – is a purely private matter, having nothing to do with concrete activity (which can only be technological) and with no great interest in the seriousness of life.

Here is a small example. In March 1961, the French Minister of National Education launched a survey among students at the scientific *Grandes Écoles* (the faculties specializing in professional training) and in the preparatory classes for these schools. The questionnaire dealt with the teaching of philosophy and literature. The outcome was significant. The students were almost unanimous in denying any sense or value in philosophy. As for the teaching of French, they made a distinction: Literature was totally uninteresting; but knowledge of the language, in contrast, was useful for writing reports and describing experiments.

That is a fine illustration. The technician does not see any bearing that the study of ethics or philosophy can have on his work. Naturally, he admits that the specialists on moral problems, the philosophers, et al., can pass opinions on this work, pronounce judgments. But that is no concern of his. It is pure speculation. There are more and more works of philosophy, sociology of technology (and the theology of technology is beginning to blossom); but their only audience is within the circle of philosophers and humanists. They have no outlet whatsoever into the world of technicians, who utterly ignore all this research. And this is not simply due to specialization. These technicians live in a technological world that has become autonomous.¹³

Since technology does not support any ethical judgment, we come to the third aspect of its autonomy. It does not tolerate being halted for a moral reason. Needless to say, it is simply absurd to voice judgments of good or evil against an operation that is deemed technologically necessary. The technician quite frankly shrugs off something that strikes him as utterly fantastic; besides, we know how relative morality is. The discovery of "situational morality" is quite convenient for putting up with anything. How can we cite a variable, fleeting, constantly undefinable good in order to forbid the technician

anything or stop a technological advancer? The latter is at least stable, certain, evident. Technology, judging itself, is now liberated from what was once the main check on human action: beliefs (sacred, spiritual, religious) and ethics. Technology, with a theory and a system, thereby assures the freedom that it has acquired in fact. It no longer has to fear any limitation whatsoever because technology exists beyond good and evil.

For a long time, observers claimed that technology was neutral, and consequently not subject to morality. That is the situation we have just described, and the theoretician who thus described technology was merely rubber-stamping the *de facto* independence of technology and the technician. But this stage is already passed. The power and autonomy of technology are so well assured that now technology itself is turning into a judge of morality. A moral proposition will not be deemed valid for our time if it cannot enter the technological system and be consistent with it.¹⁴

The fourth aspect of this autonomy concerns legitimacy. Modern man takes for granted that anything scientific is legitimate, and, in consequence, anything technological. Today, we can no longer merely say: "Technology is a fact, we have to accept it as such, we cannot go against it." This is a serious position which reserves the possibility of judgment. But such an attitude is looked upon as pessimistic, antitechnological, and retrograde. Indeed, we must enter the technological system by acknowledging that everything occurring within it is legitimate *per se*. There is no exterior reference. There is no asking the question about truth (for now, truth is included in science, and the truth of praxis is technology pure and simple), or the question about good, or the question about finalities. None of these things can be discussed. The instant something is technological, it is legitimate, and any challenge is suspect. Technology has even become a power of legitimation. It is technology that now validates scientific research. [...]

This is very remarkable, for hitherto, man has always tried to refer his actions to a superior value, which both judged and underpinned his actions, his enterprises. But this situation is vanishing for the sake of technology. Man in our society both discerns this autonomy demanded by the system (which can progress only if autonomous) and grants this system autonomy by accepting it as legitimate in itself. This autonomy is obviously not the outcome of a struggle between two personified divinities, Morality and Technology! It is

man who, becoming a true believer in, and loyal supporter of, technology, views it as a supreme object. For it must be supreme if it bears its legitimacy in itself and needs nothing to justify it!

This conviction is spawned by both experience and persuasion; for the technological system contains its own technological power of legitimation, advertising. It is shallow to believe that advertising is an external addition to the system, due to the domination of technology by profit seeking. Advertising is a technology, indispensable to technological growth and meant to supply the system with its legitimacy. This legitimacy actually comes not just from the excellence that man is ready to acknowledge in technology, but by the persuasion that in fact every element of the system is good. That is why advertising had to add public relations and human relations. By no means does "the mass consumer society vote for itself," but rather, it is the technological society that integrates the individual in the technological process by means of that justification.

There is, however, a further stride to be made, and quite a normal one at that. Independent of morals and judgments, legitimate in itself, technology is becoming the creative force of new values, of a new ethics. Man cannot do without morality! Technology has destroyed all previous scales of value; it impugns the judgments coming from outside. After all, it wrecks their foundations. But being thus self-justified, it quite normally becomes justifying. What was done in the name of science was just; and now the same holds true for what is done in the name of technology. It attributes justice to human action, and man is thus spontaneously led to construct an ethics on the basis of, and in terms of, technology.¹⁵

This does not occur in a theoretical or systematic manner. The elaboration only comes afterwards. The technological ethics is constructed bit by bit, concretely. Technology demands a certain number of virtues from man (precision, exactness, seriousness, a realistic attitude, and, over everything else, the virtue of work) and a certain outlook on life (modesty, devotion, cooperation). Technology permits very clear value judgments (what is serious and what is not, what is effective, efficient, useful, etc.). This ethics is built up on these concrete givens; for it is primarily an experienced ethics of the behavior required for the technological system to function well. It thereby has the vast superiority over the other moralities of being truly experienced. Furthermore, it involves obvious and ineluctable sanctions (for it is the

functioning of the technological system that reveals them). And this morality therefore imposes them almost self-evidently before crystallizing as a clear doctrine

located far beyond the simplistic utilitarianisms of the nineteenth century.¹⁶

[...]

Notes

- 1 It is obvious – and this comment holds for all the rest of this discussion – that when I say technology “does not admit,” “wants,” etc., I am not personifying in any way. I am simply using an accepted rhetorical shortcut. In reality, it is the technicians on all levels who make these judgments and have this attitude; but they are so imbued, so impregnated with the technological ideology, so integrated into the system, that their vital judgments and attitudes are its direct expression. One can refer them to the system itself.
- 2 “Neuf thèses sur la Science and la Technique” in *Vivre et survivre* (1975). This anonymous text is probably by Groetenduijk. I have summed up the first five theses.
- 3 Furia, *Techniques et sociétés* (1970), leans toward the same opinion. In contrast, see U. Matz; “Die Freiheit der Wissenschaft in der technischen Welt” in *Politik und Wissenschaft* (1971). But he is actually investigating the freedom necessary for the scientist in a technicized state.
- 4 See Jacques Ellul, *The Political Illusion* (1967), and Finzi, *Il potere tecnocratico* (1977).
- 5 On the capacity of the state to play the role that is presumed, see Jacques Ellul, *The Technological Society*, chap. 4, and *The Political Illusion*. I will not bother repeating these demonstrations here.
- 6 It appears, quite oddly, in one of the most profound and rigorous thinkers of our time. Bertrand de Jouvenel; he keeps insisting that it is man who decides, and that the overall decisions are made on a political level – technology being merely secondary and subsequent. And yet his admirable book *L’Arcadie* (1969) is the best demonstration of the autonomy, the self-sufficiency, of technology. This notion runs all through his book, recurring constantly, so that we wonder if the author wrote “on several levels,” which are complementary but different and at times seemingly opposed to one another.
- 7 Of course, everyone agrees that research is the key to (economic) development and that it is therefore worth accumulating economic resources in order to achieve a greater economic advance by means of technological research. But the relation between the two is growing less and less clear. “Research and development” is a source of very great uncertainties. In France, the O.E.C.D. (Organization for Economic Cooperation and Development) has concluded: “The relations of research and development to economic growth suffer from a paradox. They are both obvious and immeasurable.... Even excluding the money spent on military research, we are unable to bring out the correlation between the expenses of research and development and the growth of the G.N.P.” And Closets has a good formula for defining the relationship between economy and technology: One can only speak of an “economy of uncertainty.” As for research and development, see the series *Analyse et prévision*, 1967 to 1970 – and the writings of Jouvenel.
- 8 Richta underlines an important turnabout in the Weberian school. At first, with Weber, they asserted that “one can rationalize technologically only in terms of commercial reason. ... The law of technological reason must always yield to the law of economic reason.” But since 1960, the Weber disciples (e.g., Papalakas) have been claiming that this economic rationality is relative and that the relationship between capital and technology is reversing: “It is economic reason that must adapt to the harsh technological reality, it is technological rationality that becomes the primary dimension and that thereby dominates the principal focus of tension in society” (R. Richta, *Civilization at the Crossroads*, p. 80).
- 9 Also see S. Rose, *L’Idéologie de et dans la Science* (1977), a work of strict Marxist orthodoxy, which tries to prove that science is ideological. Very scholarly and very disappointing.
- 10 Two very good examples of this autonomy are offered, though on different premises, by G. Vahanian and by H. Orlans. G. Vahanian, *The Death of God*, shows that the “how to do” has become independent of all Christian thought and has, in fact, invaded Christianity, which is subordinated to efficiency. H. Orlans, in *Toward the Year 2000*, Daedalus, 1967, shows that “not all technological development is desirable, of course, but we cannot really see how we can prevent anything technologically possible from being realized.”
- 11 The reader can refer to the excellent analysis of such illusions in Seligman (*A Most Notorious Victory*, 1966), who shows that the tragedy of these illusions comes from technology’s having its own strength, capable of destroying the designs of man, of determining his ideologies. And, as he shows at length, this autonomy of technology makes man’s autonomy “at best questionable.”
- 12 A. M. Weinberg, “Technologie ou ‘engineering’ social,” *Analyse et prévision* 2 (1966).
- 13 Nevertheless, since 1968 we have to modify this statement slightly. Certain scientists (but no technicians as yet) are starting to ask moral questions about the legitimacy of their scientific work and its goals, however, with no results.

- 14 On the autonomy of technology from values, one should read the admirable pages by B. Charbooneau, *Le Chaos et le système*, particularly concerning the atomic bomb. “It is not the most monstrous tyrant that produces the bomb, but the most advanced society. And in 1944, it was not the U.S.S.R. or Nazi Germany, but an evangelical and liberal nation ruled by a president whose goal was to free the earth of fear. Who will have wanted the irreparable if ever it comes? Certainly not the scientists, who are only after knowledge, nor the technicians, who are only after power. As for the politicians, they are only after peace and justice. Unhappily, action commands. It was not Roosevelt who made the bomb: Hitler forced him, and then Stalin. But the Communists will demonstrate that the bomb is a product of capitalism. The proof is that the U.S.S.R. is exploding even more powerful bombs. Who or what, is behind the bomb? Progress (science, technology, the state) left to its own devices. The U.S.S.R. was the second nation to explode the bomb because it was the second power on the globe. Marx has no more to do with this than Jesus.”
- 15 For lengthy treatments on the contents of this ethics, see Jacques Ellul, *Le Vouloir et le faire*, vol. 1, chap. 2 (1963).
- 16 In regard to man, Mumford shows decisively and at length how and why the series of the most advanced technological inventions has absolutely nothing to do with man’s “central historical task, the task of becoming human.” If we take the most recent technological exploits – the moon landing, climate control, artificial survival, creation of life – nothing has the least relationship to the project of “becoming human.” Everything obeys the internal logic of the system.

Do Machines Make History?

Robert L. Heilbroner

The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist.

Marx, *The Poverty of Philosophy*

That machines make history in some sense – that the level of technology has a direct bearing on the human drama – is of course obvious. That they do not make all of history, however that word be defined, is equally clear. The challenge, then, is to see if one can say something systematic about the matter, to see whether one can order the problem so that it becomes intellectually manageable.

To do so calls at the very beginning for a careful specification of our task. There are a number of important ways in which machines make history that will not concern us here. For example, one can study the impact of technology on the *political* course of history, evidenced most strikingly by the central role played by the technology of war. Or one can study the effect of machines on the *social* attitudes that underlie historical evolution: one thinks of the effect of radio or television on political behavior. Or one can study technology as one of the factors shaping the changeable content of life from one epoch to another: when we speak of “life” in the Middle Ages or today we define an existence much of whose texture and substance is intimately connected with the prevailing technological order.

None of these problems will form the focus of this essay. Instead, I propose to examine the impact

of technology on history in another area – an area defined by the famous quotation from Marx that stands beneath our title. The question we are interested in, then, concerns the effect of technology in determining the nature of the *socioeconomic order*. In its simplest terms the question is: did medieval technology bring about feudalism? Is industrial technology the necessary and sufficient condition for capitalism? Or, by extension, will the technology of the computer and the atom constitute the ineluctable cause of a new social order?

Even in this restricted sense, our inquiry promises to be broad and sprawling. Hence, I shall not try to attack it head-on, but to examine it in two stages:

- (1) If we make the assumption that the hand-mill does “give” us feudalism and the steam-mill capitalism, this places technological change in the position of a prime mover of social history. Can we then explain the “laws of motion” of technology itself? Or to put the question less grandly, can we explain why technology evolves in the sequence it does?
- (2) Again, taking the Marxian paradigm at face value, exactly what do we mean when we assert that the

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hand-mill “gives us” society with the feudal lord? Precisely how does the mode of production affect the superstructure of social relationships?

These questions will enable us to test the empirical content – or at least to see if there *is* an empirical content – in the idea of technological determinism. I do not think it will come as a surprise if I announce now that we will find *some* content, and a great deal of missing evidence, in our investigation. What will remain then will be to see if we can place the salvageable elements of the theory in historical perspective – to see, in a word, if we can explain technological determinism historically as well as explain history by technological determinism.

I

We begin with a very difficult question hardly rendered easier by the fact that there exist, to the best of my knowledge, no empirical studies on which to base our speculations. It is the question of whether there is a fixed sequence to technological development and therefore a necessitous path over which technologically developing societies must travel.

I believe there is such a sequence – that the steam-mill follows the hand-mill not by chance but because it is the next “stage” in a technical conquest of nature that follows one and only one grand avenue of advance. To put it differently, I believe that it is impossible to proceed to the age of the steam-mill until one has passed through the age of the hand-mill, and that in turn one cannot move to the age of the hydroelectric plant before one has mastered the steam-mill, nor to the nuclear power age until one has lived through that of electricity.

Before I attempt to justify so sweeping an assertion, let me make a few reservations. To begin with, I am fully conscious that not all societies are interested in developing a technology of production or in channeling to it the same quota of social energy. I am very much aware of the different pressures that different societies exert on the direction in which technology unfolds. Lastly, I am not unmindful of the difference between the discovery of a given machine and its application as a technology – for example, the invention of a steam engine (the aeolipile) by Hero of Alexandria long before its incorporation into a steam-mill. All these problems, to which we will return in our last section, refer however to the way in which

technology makes its peace with the social, political, and economic institutions of the society in which it appears. They do not directly affect the contention that there exists a determinate sequence of productive technology for those societies that are interested in originating and applying such a technology.

What evidence do we have for such a view? I would put forward three suggestive pieces of evidence:

1 The simultaneity of invention

The phenomenon of simultaneous discovery is well known.¹ From our view, it argues that the process of discovery takes place along a well-defined frontier of knowledge rather than in grab-bag fashion. Admittedly, the concept of “simultaneity” is impressionistic,² but the related phenomenon of technological “clustering” again suggests that technical evolution follows a sequential and determinate rather than random course.³

2 The absence of technological leaps

All inventions and innovations, by definition, represent an advance of the art beyond existing base lines. Yet, most advances, particularly in retrospect, appear essentially incremental, evolutionary. If nature makes no sudden leaps, neither, it would appear, does technology. To make my point by exaggeration, we do not find experiments in electricity in the year 1500, or attempts to extract power from the atom in the year 1700. On the whole, the development of the technology of production presents a fairly smooth and continuous profile rather than one of jagged peaks and discontinuities.

3 The predictability of technology

There is a long history of technological prediction, some of it ludicrous and some not.⁴ What is interesting is that the development of technical progress has always seemed *intrinsically* predictable. This does not mean that we can lay down future timetables of technical discovery, nor does it rule out the possibility of surprises. Yet I venture to state that many scientists would be willing to make *general* predictions as to the nature of technological capability twenty-five or even fifty years ahead. This too suggests that technology follows a developmental sequence rather than arriving in a more chancy fashion.

I am aware, needless to say, that these bits of evidence do not constitute anything like a “proof” of my

hypothesis. At best they establish the grounds on which a *prima facie* case of plausibility may be rested. But I should like now to strengthen these grounds by suggesting two deeper-seated reasons why technology *should* display a “structured” history.

The first of these is that a major constraint always operates on the technological capacity of an age, the constraint of its accumulated stock of available knowledge. The application of this knowledge may lag behind its reach; the technology of the hand-mill, for example, was by no means at the frontier of medieval technical knowledge, but technical realization can hardly precede what men generally know (although experiment may incrementally advance both technology and knowledge concurrently). Particularly from the mid-nineteenth century to the present do we sense the loosening constraints on technology stemming from successively yielding barriers of scientific knowledge – loosening constraints that result in the successive arrival of the electrical, chemical, aeronautical, electronic, nuclear, and space stages of technology.⁵

The gradual expansion of knowledge is not, however, the only order-bestowing constraint on the development of technology. A second controlling factor is the material competence of the age, its level of technical expertise. To make a steam engine, for example, requires not only some knowledge of the elastic properties of steam but the ability to cast iron cylinders of considerable dimensions with tolerable accuracy. It is one thing to produce a single steam-machine as an expensive toy, such as the machine depicted by Hero, and another to produce a machine that will produce power economically and effectively. The difficulties experienced by Watt and Boulton in achieving a fit of piston to cylinder illustrate the problems of creating a technology, in contrast with a single machine.

Yet until a metal-working technology was established – indeed, until an embryonic machine-tool industry had taken root – an industrial technology was impossible to create. Furthermore, the competence required to create such a technology does not reside alone in the ability or inability to make a particular machine (one thinks of Babbage’s ill-fated calculator as an example of a machine born too soon), but in the ability of many industries to change their products or processes to “fit” a change in one key product or process.

This necessary requirement of technological congruence⁶ gives us an additional cause of sequencing. For the ability of many industries to co-operate in producing the equipment needed for a “higher” stage of technology depends not alone on knowledge or sheer skill but on the division of labor and the specialization of industry.

And this in turn hinges to a considerable degree on the sheer size of the stock of capital itself. Thus the slow and painful accumulation of capital, from which springs the gradual diversification of industrial function, becomes an independent regulator of the reach of technical capability.

In making this general case for a determinate pattern of technological evolution – at least insofar as that technology is concerned with production – I do not want to claim too much. I am well aware that reasoning about technical sequences is easily faulted as *post hoc ergo propter hoc*. Hence, let me leave this phase of my inquiry by suggesting no more than that the idea of a roughly ordered progression of productive technology seems logical enough to warrant further empirical investigation. To put it as concretely as possible, I do not think it is just by happenstance that the steam-mill follows, and does not precede, the hand-mill, nor is it mere fantasy in our own day when we speak of the coming of the automatic factory. In the future as in the past, the development of the technology of production seems bounded by the constraints of knowledge and capability and thus, in principle at least, open to prediction as a determinable force of the historic process.

II

The second proposition to be investigated is no less difficult than the first. It relates, we will recall, to the explicit statement that a given technology imposes certain social and political characteristics upon the society in which it is found. Is it true that, as Marx wrote in *The German Ideology*, “A certain mode of production, or industrial stage, is always combined with a certain mode of cooperation, or social stage,”⁷ or as he put it in the sentence immediately preceding our hand-mill, steam-mill paradigm, “In acquiring new productive forces men change their mode of production, and in changing their mode of production they change their way of living – they change all their social relations”?

As before, we must set aside for the moment certain “cultural” aspects of the question. But if we restrict ourselves to the functional relationships directly connected with the process of production itself, I think we can indeed state that the technology of a society imposes a determinate pattern of social relations on that society.

We can, as a matter of fact, distinguish at least two such modes of influence:

1 The composition of the labor force

In order to function, a given technology must be attended by a labor force of a particular kind. Thus, the hand-mill (if we may take this as referring to late medieval technology in general) required a work force composed of skilled or semiskilled craftsmen, who were free to practice their occupations at home or in a small atelier, at times and seasons that varied considerably. By way of contrast, the steam-mill – that is, the technology of the nineteenth century – required a work force composed of semiskilled or unskilled operatives who could work only at the factory site and only at the strict time schedule enforced by turning the machinery on or off. Again, the technology of the electronic age has steadily required a higher proportion of skilled attendants; and the coming technology of automation will still further change the needed mix of skills and the locale of work, and may as well drastically lessen the requirements of labor time itself.

2 The hierarchical organization of work

Different technological apparatuses not only require different labor forces but different orders of supervision and co-ordination. The internal organization of the eighteenth-century handicraft unit, with its typical man-master relationship, presents a social configuration of a wholly different kind from that of the nineteenth-century factory with its men-manager confrontation, and this in turn differs from the internal social structure of the continuous-flow, semi-automated plant of the present. As the intricacy of the production process increases, a much more complex system of internal controls is required to maintain the system in working order.

Does this add up to the proposition that the steam-mill gives us society with the industrial capitalist? Certainly the class characteristics of a particular society are strongly implied in its functional organization. Yet it would seem wise to be very cautious before relating political effects exclusively to functional economic causes. The Soviet Union, for example, proclaims itself to be a socialist society although its technical base resembles that of old-fashioned capitalism. Had Marx written that the steam-mill gives you society with the industrial *manager*, he would have been closer to the truth.

What is less easy to decide is the degree to which the technological infrastructure is responsible for some of the sociological features of society. Is anomie, for instance, a disease of capitalism or of all industrial societies? Is the organization man a creature of monopoly capital or

of all bureaucratic industry wherever found? These questions tempt us to look into the problem of the impact of technology on the existential quality of life, an area we have ruled out of bounds for this paper. Suffice it to say that superficial evidence seems to imply that the similar technologies of Russia and America are indeed giving rise to similar social phenomena of this sort.

As with the first portion of our inquiry, it seems advisable to end this section on a note of caution. There is a danger, in discussing the structure of the labor force or the nature of intrafirm organization, of assigning the sole causal efficacy to the visible presence of machinery and of overlooking the invisible influence of other factors at work. Gilfillan, for instance, writes, “engineers have committed such blunders as saying the typewriter brought women to work in offices, and with the typesetting machine made possible the great modern newspaper, forgetting that in Japan there are women office workers and great modern newspapers getting practically no help from typewriters and typesetting machines.”⁷⁸ In addition, even where technology seems unquestionably to play the critical role, an independent “social” element unavoidably enters the scene in the *design* of technology, which must take into account such facts as the level of education of the work force or its relative price. In this way the machine will reflect, as much as mould, the social relationships of work.

These caveats urge us to practice what William James called a “soft determinism” with regard to the influence of the machine on social relations. Nevertheless, I would say that our cautions qualify rather than invalidate the thesis that the prevailing level of technology imposes itself powerfully on the structural organization of the productive side of society. A foreknowledge of the shape of the technical core of society fifty years hence may not allow us to describe the political attributes of that society, and may perhaps only hint at its sociological character, but assuredly it presents us with a profile of requirements, both in labor skills and in supervisory needs, that differ considerably from those of today. We cannot say whether the society of the computer will give us the latter-day capitalist or the commissar, but it seems beyond question that it will give us the technician and the bureaucrat.

III

Frequently, during our efforts thus far to demonstrate what is valid and useful in the concept of technological determinism, we have been forced to defer certain

aspects of the problem until later. It is time now to turn up the rug and to examine what has been swept under it. Let us try to systematize our qualifications and objections to the basic Marxian paradigm:

1 Technological progress is itself a social activity

A theory of technological determinism must contend with the fact that the very activity of invention and innovation is an attribute of some societies and not of others. The Kalahari bushmen or the tribesmen of New Guinea, for instance, have persisted in a neolithic technology to the present day; the Arabs reached a high degree of technical proficiency in the past and have since suffered a decline; the classical Chinese developed technical expertise in some fields while unaccountably neglecting it in the area of production. What factors serve to encourage or discourage this technical thrust is a problem about which we know extremely little at the present moment.⁹

2 The course of technological advance is responsive to social direction

Whether technology advances in the area of war, the arts, agriculture, or industry depends in part on the rewards, inducements, and incentives offered by society. In this way the direction of technological advance is partially the result of social policy. For example, the system of interchangeable parts, first introduced into France and then independently into England failed to take root in either country for lack of government interest or market stimulus. Its success in America is attributable mainly to government support and to its appeal in a society without guild traditions and with high labor costs.¹⁰

The general *level* of technology may follow an independently determined sequential path, but its areas of application certainly reflect social influences.

3 Technological change must be compatible with existing social conditions

An advance in technology not only must be congruent with the surrounding technology but must also be compatible with the existing economic and other institutions of society. For example, labor saving machinery will not find ready acceptance in a society where labor is abundant and cheap as a factor of production. Nor would a mass production technique recommend itself to a society

that did not have a mass market. Indeed, the presence of slave labor seems generally to inhibit the use of machinery and the presence of expensive labor to accelerate it.¹¹

These reflections on the social forces bearing on technical progress tempt us to throw aside the whole notion of technological determinism as false or misleading.¹² Yet, to relegate technology from an undeserved position of *primum mobile* in history to that of a mediating factor, both acted upon by and acting on the body of society, is not to write off its influence but only to specify its mode of operation with greater precision. Similarly, to admit we understand very little of the cultural factors that give rise to technology does not depreciate its role but focuses our attention on that period of history when technology is clearly a major historic force, namely Western society since 1700.

IV

What is the mediating role played by technology within modern Western society? When we ask this much more modest question, the interaction of society and technology begins to clarify itself for us:

1 The rise of capitalism provided a major stimulus for the development of a technology of production

Not until the emergence of a market system organized around the principle of private property did there also emerge an institution capable of systematically guiding the inventive and innovative abilities of society to the problem of facilitating production. Hence the environment of the eighteenth and nineteenth centuries provided both a novel and an extremely effective encouragement for the development of an *industrial* technology. In addition, the slowly opening political and social framework of late mercantilist society gave rise to social aspirations for which the new technology offered the best chance of realization. It was not only the steam-mill that gave us the industrial capitalist but the rising inventor-manufacturer who gave us the steam-mill.

2 The expansion of technology within the market system took on a new "automatic" aspect

Under the burgeoning market system not alone the initiation of technical improvement but its subsequent

adoption and repercussion through the economy was largely governed by market considerations. As a result, both the rise and the proliferation of technology assumed the attributes of an impersonal diffuse “force” bearing on social and economic life. This was all the more pronounced because the political control needed to buffer its disruptive consequences was seriously inhibited by the prevailing laissez-faire ideology.

3 The rise of science gave a new impetus to technology

The period of early capitalism roughly coincided with and provided a congenial setting for the development of an independent source of technological encouragement – the rise of the self-conscious activity of science. The steady expansion of scientific research, dedicated to the exploration of nature’s secrets and to their harnessing for social use, provided an increasingly important stimulus for technological advance from the middle of the nineteenth century. Indeed, as the twentieth century has progressed, science has become a major historical force in its own right and is now the indispensable precondition for an effective technology.

It is for these reasons that technology takes on a special significance in the context of capitalism – or, for that matter, of a socialism based on maximizing production or minimizing costs. For in these societies, both the continuous appearance of technical advance and its diffusion

throughout the society assume the attributes of autonomous process, “mysteriously” generated by society and thrust upon its members in a manner as indifferent as it is imperious. This is why, I think, the problem of technological determinism – of how machines make history – comes to us with such insistence despite the ease with which we can disprove its more extreme contentions.

Technological determinism is thus peculiarly a problem of a certain historic epoch – specifically that of high capitalism and low socialism – in which the forces of technical change have been unleashed, but when the agencies for the control or guidance of technology are still rudimentary.

The point has relevance for the future. The surrender of society to the free play of market forces is now on the wane, but its subservience to the impetus of the scientific ethos is on the rise. The prospect before us is assuredly that of an undiminished and very likely accelerated pace of technical change. From what we can foretell about the direction of this technological advance and the structural alterations it implies, the pressures in the future will be toward a society marked by a much greater degree of organization and deliberate control. What other political, social, and existential changes the age of the computer will also bring we do not know. What seems certain, however, is that the problem of technological determinism – that is, of the impact of machines on history – will remain germane until there is forged a degree of public control over technology far greater than anything that now exists.

Notes

- 1 See Robert K. Merton, “Singletons and Multiples in Scientific Discovery: A Chapter in the Sociology of Science,” *Proceedings of the American Philosophical Society*, CV (October 1961), 470–86.
- 2 See John Jewkes, David Sawers, and Richard Stillerman, *The Sources of Invention* (New York, 1960 [paperback edition]), p. 227, for a skeptical view.
- 3 “One can count 21 basically different means of flying, at least eight basic methods of geophysical prospecting; four ways to make uranium explosive; ...20 or 30 ways to control birth....If each of these separate inventions were autonomous, i.e., without cause, how could one account for their arriving in these functional groups?” S. C. Gilfillan, “Social Implications of Technological Advance,” *Current Sociology*, I (1952), 197. See also Jacob Schmookler, “Economic Sources of Inventive Activity,” *Journal of Economic History* (March 1962), 1–20; and Richard Nelson, “The Economics of Invention: A Survey of the Literature,” *Journal of Business*, XXXII (April 1959), 101–19.
- 4 Jewkes et al. (see n. 2) present a catalogue of chastening mistakes (p. 230 f.). On the other hand, for a sober predictive effort, see Francis Bello, “The 1960s: A Forecast of Technology,” *Fortune*, LIX (January 1959), 74–78; and Daniel Bell, “The Study of the Future,” *Public Interest*, I (Fall 1965), 119–30. Modern attempts at prediction project likely avenues of scientific advance or technological function rather than the feasibility of specific machines.
- 5 To be sure, the inquiry now regresses one step and forces us to ask whether there are inherent stages for the expansion of knowledge, at least insofar as it applies to nature. This is a very uncertain question. But having already risked so much, I will hazard the suggestion that the roughly parallel sequential development of scientific understanding in those few cultures

- that have cultivated it (mainly classical Greece, China, the high Arabian culture, and the West since the Renaissance) makes such a hypothesis possible, provided that one looks to broad outlines and not to inner detail.
- 6 The phrase is Richard LaPiere's in *Social Change* (New York, 1965), p. 263 f.
 - 7 Karl Marx and Friedrich Engels, *The German Ideology* (London, 1942), p. 18.
 - 8 Gilfillan (see n. 3), p. 202.
 - 9 An interesting attempt to find a line of social causation is found in E. Hagen, *The Theory of Social Change* (Homewood, Ill., 1962).
 - 10 See K. R. Gilbert, "Machine-Tools," in Charles Singer, E. J. Holmyard, A. R. Hall, and Trevor I. Williams (eds.), *A History of Technology* (Oxford, 1958), IV, chap. xiv.
 - 11 See LaPiere (see n. 6), p. 284; also H. J. Habakkuk, *British and American Technology in the 19th Century* (Cambridge, 1962), *passim*.
 - 12 As, for example, in A. Hansen, "The Technological Determination of History," *Quarterly Journal of Economics* (1921), 76–83.

The New Forms of Control

Herbert Marcuse

A comfortable, smooth, reasonable, democratic unfreedom prevails in advanced industrial civilization, a token of technical progress. Indeed, what could be more rational than the suppression of individuality in the mechanization of socially necessary but painful performances; the concentration of individual enterprises in more effective, more productive corporations; the regulation of free competition among unequally equipped economic subjects; the curtailment of prerogatives and national sovereignties which impede the international organization of resources. That this technological order also involves a political and intellectual coordination may be a regrettable and yet promising development.

The rights and liberties which were such vital factors in the origins and earlier stages of industrial society yield to a higher stage of this society: they are losing their traditional rationale and content. Freedom of thought, speech, and conscience were – just as free enterprise, which they served to promote and protect – essentially *critical* ideas, designed to replace an obsolescent material and intellectual culture by a more productive and rational one. Once institutionalized, these rights and liberties shared the fate of the society of which they had become an integral part. The achievement cancels the premises.

To the degree to which freedom from want, the concrete substance of all freedom, is becoming a real possibility, the liberties which pertain to a state of lower productivity are losing their former content.

Independence of thought, autonomy, and the right to political opposition are being deprived of their basic critical function in a society which seems increasingly capable of satisfying the needs of the individuals through the way in which it is organized. Such a society may justly demand acceptance of its principles and institutions, and reduce the opposition to the discussion and promotion of alternative policies *within* the status quo. In this respect, it seems to make little difference whether the increasing satisfaction of needs is accomplished by an authoritarian or a non-authoritarian system. Under the conditions of a rising standard of living, non-conformity with the system itself appears to be socially useless, and the more so when it entails tangible economic and political disadvantages and threatens the smooth operation of the whole. Indeed, at least in so far as the necessities of life are involved, there seems to be no reason why the production and distribution of goods and services should proceed through the competitive concurrence of individual liberties.

Freedom of enterprise was from the beginning not altogether a blessing. As the liberty to work or to starve, it spelled toil, insecurity, and fear for the vast majority of the population. If the individual were no longer compelled to prove himself on the market, as a free economic subject, the disappearance of this kind of freedom would be one of the greatest achievements of civilization. The technological processes of mechanization and standardization

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might release individual energy into a yet uncharted realm of freedom beyond necessity. The very structure of human existence would be altered; the individual would be liberated from the work world's imposing upon him alien needs and alien possibilities. The individual would be free to exert autonomy over a life that would be his own. If the productive apparatus could be organized and directed toward the satisfaction of the vital needs, its control might well be centralized; such control would not prevent individual autonomy, but render it possible.

This is a goal within the capabilities of advanced industrial civilization, the "end" of technological rationality. In actual fact, however, the contrary trend operates: the apparatus imposes its economic and political requirements for defense and expansion on labor time and free time, on the material and intellectual culture. By virtue of the way it has organized its technological base, contemporary industrial society tends to be totalitarian. For "totalitarian" is not only a terroristic political coordination of society, but also a non-terroristic economic-technical coordination which operates through the manipulation of needs by vested interests. It thus precludes the emergence of an effective opposition against the whole. Not only a specific form of government or party rule makes for totalitarianism, but also a specific system of production and distribution which may well be compatible with a "pluralism" of parties, newspapers, "countervailing powers," etc.

Today political power asserts itself through its power over the machine process and over the technical organization of the apparatus. The government of advanced and advancing industrial societies can maintain and secure itself only when it succeeds in mobilizing, organizing, and exploiting the technical, scientific, and mechanical productivity available to industrial civilization. And this productivity mobilizes society as a whole, above and beyond any particular individual or group interests. The brute fact that the machine's physical (only physical?) power surpasses that of the individual, and of any particular group of individuals, makes the machine the most effective political instrument in any society whose basic organization is that of the machine process. But the political trend may be reversed; essentially the power of the machine is only the stored-up and projected power of man. To the extent to which the work world is conceived of as a machine and mechanized accordingly, it becomes the *potential* basis of a new freedom for man.

Contemporary industrial civilization demonstrates that it has reached the stage at which "the free society" can no

longer be adequately defined in the traditional terms of economic, political, and intellectual liberties, not because these liberties have become insignificant, but because they are too significant to be confined within the traditional forms. New modes of realization are needed, corresponding to the new capabilities of society.

Such new modes can be indicated only in negative terms because they would amount to the negation of the prevailing modes. Thus economic freedom would mean freedom *from* the economy – from being controlled by economic forces and relationships; freedom from the daily struggle for existence, from earning a living. Political freedom would mean liberation of the individuals *from* politics over which they have no effective control. Similarly, intellectual freedom would mean the restoration of individual thought now absorbed by mass communication and indoctrination, abolition of "public opinion" together with its makers. The unrealistic sound of these propositions is indicative, not of their utopian character, but of the strength of the forces which prevent their realization. The most effective and enduring form of warfare against liberation is the implanting of material and intellectual needs that perpetuate obsolete forms of the struggle for existence.

The intensity, the satisfaction and even the character of human needs, beyond the biological level, have always been preconditioned. Whether or not the possibility of doing or leaving, enjoying or destroying, possessing or rejecting something is seized as a *need* depends on whether or not it can be seen as desirable and necessary for the prevailing societal institutions and interests. In this sense, human needs are historical needs and, to the extent to which the society demands the repressive development of the individual, his needs themselves and their claim for satisfaction are subject to overriding critical standards.

We may distinguish both true and false needs. "False" are those which are superimposed upon the individual by particular social interests in his repression: the needs which perpetuate toil, aggressiveness, misery, and injustice. Their satisfaction might be most gratifying to the individual, but this happiness is not a condition which has to be maintained and protected if it serves to arrest the development of the ability (his own and others) to recognize the disease of the whole and grasp the chances of curing the disease. The result then is euphoria in unhappiness. Most of the prevailing needs to relax, to have fun, to behave and consume in accordance with the advertisements, to love and hate what others love and hate, belong to this category of false needs.

Such needs have a societal content and function which are determined by external powers over which the individual has no control; the development and satisfaction of these needs is heteronomous. No matter how much such needs may have become the individual's own, reproduced and fortified by the conditions of his existence; no matter how much he identifies himself with them and finds himself in their satisfaction, they continue to be what they were from the beginning – products of a society whose dominant interest demands repression.

The prevalence of repressive needs is an accomplished fact, accepted in ignorance and defeat, but a fact that must be undone in the interest of the happy individual as well as all those whose misery is the price of his satisfaction. The only needs that have an unqualified claim for satisfaction are the vital ones – nourishment, clothing, lodging at the attainable level of culture. The satisfaction of these needs is the prerequisite for the realization of *all* needs, of the unsublimated as well as the sublimated ones.

For any consciousness and conscience, for any experience which does not accept the prevailing societal interest as the supreme law of thought and behavior, the established universe of needs and satisfactions is a fact to be questioned – questioned in terms of truth and falsehood. These terms are historical throughout, and their objectivity is historical. The judgment of needs and their satisfaction, under the given conditions, involves standards of *priority* – standards which refer to the optimal development of the individual, of all individuals, under the optimal utilization of the material and intellectual resources available to man. The resources are calculable. “Truth” and “falsehood” of needs designate objective conditions to the extent to which the universal satisfaction of vital needs and, beyond it, the progressive alleviation of toil and poverty, are universally valid standards. But as historical standards, they do not only vary according to area and stage of development, they also can be defined only in (greater or lesser) *contradiction* to the prevailing ones. What tribunal can possibly claim the authority of decision?

In the last analysis, the question of what are true and false needs must be answered by the individuals themselves, but only in the last analysis; that is, if and when they are free to give their own answer. As long as they are kept incapable of being autonomous, as long as they are indoctrinated and manipulated (down to their very instincts), their answer to this question cannot be taken as their own. By the same token, however, no tribunal can justly arrogate to itself the right to decide which

needs should be developed and satisfied. Any such tribunal is reprehensible, although our revulsion does not do away with the question: how can the people who have been the object of effective and productive domination by themselves create the conditions of freedom?

The more rational, productive, technical, and total the repressive administration of society becomes, the more unimaginable the means and ways by which the administered individuals might break their servitude and seize their own liberation. To be sure, to impose Reason upon an entire society is a paradoxical and scandalous idea – although one might dispute the righteousness of a society which ridicules this idea while making its own population into objects of total administration. All liberation depends on the consciousness of servitude, and the emergence of this consciousness is always hampered by the predominance of needs and satisfactions which, to a great extent, have become the individual's own. The process always replaces one system of preconditioning by another; the optimal goal is the replacement of false needs by true ones, the abandonment of repressive satisfaction.

The distinguishing feature of advanced industrial society is its effective suffocation of those needs which demand liberation – liberation also from that which is tolerable and rewarding and comfortable – while it sustains and absolves the destructive power and repressive function of the affluent society. Here, the social controls exact the overwhelming need for the production and consumption of waste; the need for stupefying work where it is no longer a real necessity; the need for modes of relaxation which soothe and prolong this stupefaction; the need for maintaining such deceptive liberties as free competition at administered prices, a free press which censors itself, free choice between brands and gadgets.

Under the rule of a repressive whole, liberty can be made into a powerful instrument of domination. The range of choice open to the individual is not the decisive factor in determining the degree of human freedom, but *what* can be chosen and what *is* chosen by the individual. The criterion for free choice can never be an absolute one, but neither is it entirely relative. Free election of masters does not abolish the masters or the slaves. Free choice among a wide variety of goods and services does not signify freedom if these goods and services sustain social controls over a life of toil and fear — that is, if they sustain alienation. And the spontaneous reproduction of superimposed needs by the individual does not establish autonomy; it only testifies to the efficacy of the controls.

Our insistence on the depth and efficacy of these controls is open to the objection that we overrate greatly the indoctrinating power of the "media," and that by themselves the people would feel and satisfy the needs which are now imposed upon them. The objection misses the point. The preconditioning does not start with the mass production of radio and television and with the centralization of their control. The people enter this stage as preconditioned receptacles of long standing; the decisive difference is in the flattening out of the contrast (or conflict) between the given and the possible, between the satisfied and the unsatisfied needs. Here, the so-called equalization of class distinctions reveals its ideological function. If the worker and his boss enjoy the same television program and visit the same resort places, if the typist is as attractively made up as the daughter of her employer, if the Negro owns a Cadillac, if they all read the same newspaper, then this assimilation indicates not the disappearance of classes, but the extent to which the needs and satisfactions that serve the preservation of the Establishment are shared by the underlying population.

Indeed, in the most highly developed areas of contemporary society, the transplantation of social into individual needs is so effective that the difference between them seems to be purely theoretical. Can one really distinguish between the mass media as instruments of information and entertainment, and as agents of manipulation and indoctrination? Between the automobile as nuisance and as convenience? Between the horrors and the comforts of functional architecture? Between the work for national defense and the work for corporate gain? Between the private pleasure and the commercial and political utility involved in increasing the birth rate?

We are again confronted with one of the most vexing aspects of advanced industrial civilization: the rational character of its irrationality. Its productivity and efficiency, its capacity to increase and spread comforts, to turn waste into need, and destruction into construction, the extent to which this civilization transforms the object world into an extension of man's mind and body makes the very notion of alienation questionable. The people recognize themselves in their commodities; they find their soul in their automobile, hi-fi set, split-level home, kitchen equipment. The very mechanism which ties the individual to his society has changed, and social control is anchored in the new needs which it has produced.

The prevailing forms of social control are technological in a new sense. To be sure, the technical structure and efficacy

of the productive and destructive apparatus has been a major instrumentality for subjecting the population to the established social division of labor throughout the modern period. Moreover, such integration has always been accompanied by more obvious forms of compulsion: loss of livelihood, the administration of justice, the police, the armed forces. It still is. But in the contemporary period, the technological controls appear to be the very embodiment of Reason for the benefit of all social groups and interests – to such an extent that all contradiction seems irrational and all counteraction impossible.

No wonder then that, in the most advanced areas of this civilization, the social controls have been introjected to the point where even individual protest is affected at its roots. The intellectual and emotional refusal "to go along" appears neurotic and impotent. This is the socio-psychological aspect of the political event that marks the contemporary period: the passing of the historical forces which, at the preceding stage of industrial society, seemed to represent the possibility of new forms of existence.

But the term "introjection" perhaps no longer describes the way in which the individual by himself reproduces and perpetuates the external controls exercised by his society. Introjection suggests a variety of relatively spontaneous processes by which a Self (Ego) transposes the "outer" into the "inner." Thus introjection implies the existence of an inner dimension distinguished from and even antagonistic to the external exigencies – an individual consciousness and an individual unconscious *apart from* public opinion and behavior.¹ The idea of "inner freedom" here has its reality: it designates the private space in which man may become and remain "himself."

Today this private space has been invaded and whittled down by technological reality. Mass production and mass distribution claim the *entire* individual, and industrial psychology has long since ceased to be confined to the factory. The manifold processes of introjection seem to be ossified in almost mechanical reactions. The result is, not adjustment but *mimesis*: an immediate identification of the individual with *his* society and, through it, with the society as a whole.

This immediate, automatic identification (which may have been characteristic of primitive forms of association) reappears in high industrial civilization; its new "immediacy," however, is the product of a sophisticated, scientific management and organization. In this process, the "inner" dimension of the mind in which opposition to the status quo can take root is whittled down. The loss of this dimension, in which the power of negative

thinking – the critical power of Reason – is at home, is the ideological counterpart to the very material process in which advanced industrial society silences and reconciles the opposition. The impact of progress turns Reason into submission to the facts of life, and to the dynamic capability of producing more and bigger facts of the same sort of life. The efficiency of the system blunts the individuals' recognition that it contains no facts which do not communicate the repressive power of the whole. If the individuals find themselves in the things which shape their life, they do so, not by giving, but by accepting the law of things – not the law of physics but the law of their society.

I have just suggested that the concept of alienation seems to become questionable when the individuals identify themselves with the existence which is imposed upon them and have in it their own development and satisfaction. This identification is not illusion but reality. However, the reality constitutes a more progressive stage of alienation. The latter has become entirely objective; the subject which is alienated is swallowed up by its alienated existence. There is only one dimension, and it is everywhere and in all forms. The achievements of progress defy ideological indictment as well as justification; before their tribunal, the “false consciousness” of their rationality becomes the true consciousness.

This absorption of ideology into reality does not, however, signify the “end of ideology.” On the contrary, in a specific sense advanced industrial culture is *more* ideological than its predecessor, inasmuch as today the ideology is in the process of production itself.² In a provocative form, this proposition reveals the political aspects of the prevailing technological rationality. The productive apparatus and the goods and services which it produces “sell” or impose the social system as a whole. The means of mass transportation and communication, the commodities of lodging, food, and clothing, the irresistible output of the entertainment and information industry carry with them prescribed attitudes and habits, certain intellectual and emotional reactions which bind the consumers more or less pleasantly to the producers and, through the latter, to the whole. The products indoctrinate and manipulate; they promote a false consciousness which is immune against its falsehood. And as these beneficial products become available to more individuals in more social classes, the indoctrination they carry ceases to be publicity; it becomes a way of life. It is a good way of life – much better than before – and as a good way of life, it militates against qualitative change.

Thus emerges a pattern of *one-dimensional thought and behavior* in which ideas, aspirations, and objectives that, by their content, transcend the established universe of discourse and action are either repelled or reduced to terms of this universe. They are redefined by the rationality of the given system and of its quantitative extension.

The trend may be related to a development in scientific method: operationalism in the physical, behaviorism in the social sciences. The common feature is a total empiricism in the treatment of concepts; their meaning is restricted to the representation of particular operations and behavior. The operational point of view is well illustrated by P. W. Bridgman's analysis of the concept of length:³

We evidently know what we mean by length if we can tell what the length of any and every object is, and for the physicist nothing more is required. To find the length of an object, we have to perform certain physical operations. The concept of length is therefore fixed when the operations by which length is measured are fixed: that is, the concept of length involves as much and nothing more than the set of operations by which length is determined. In general, we mean by any concept nothing more than a set of operations; *the concept is synonymous with the corresponding set of operations.*

Bridgman has seen the wide implications of this mode of thought for the society at large:⁴

To adopt the operational point of view involves much more than a mere restriction of the sense in which we understand “concept,” but means a far-reaching change in all our habits of thought, in that we shall no longer permit ourselves to use as tools in our thinking concepts of which we cannot give an adequate account in terms of operations.

Bridgman's prediction has come true. The new mode of thought is today the predominant tendency in philosophy, psychology, sociology, and other fields. Many of the most seriously troublesome concepts are being “eliminated” by showing that no adequate account of them in terms of operations or behavior can be given. The radical empiricist onslaught ... thus provides the methodological justification for the debunking of the mind by the intellectuals – a positivism which, in its denial of the transcending elements of Reason, forms the academic counterpart of the socially required behavior.

Outside the academic establishment, the “far-reaching change in all our habits of thought” is more serious.

It serves to coordinate ideas and goals with those exacted by the prevailing system, to enclose them in the system, and to repel those which are irreconcilable with the system. The reign of such a one-dimensional reality does not mean that materialism rules, and that the spiritual, metaphysical, and bohemian occupations are petering out. On the contrary, there is a great deal of "Worship together this week," "Why not try God," Zen, existentialism, and beat ways of life, etc. But such modes of protest and transcendence are no longer contradictory to the status quo and no longer negative. They are rather the ceremonial part of practical behaviorism, its harmless negation, and are quickly digested by the status quo as part of its healthy diet.

One-dimensional thought is systematically promoted by the makers of politics and their purveyors of mass information. Their universe of discourse is populated by self-validating hypotheses which, incessantly and monopolistically repeated, become hypnotic definitions or dictations. For example, "free" are the institutions which operate (and are operated on) in the countries of the Free World; other transcending modes of freedom are by definition either anarchism, communism, or propaganda. "Socialistic" are all encroachments on private enterprises not undertaken by private enterprise itself (or by government contracts), such as universal and comprehensive health insurance, or the protection of nature from all too sweeping commercialization, or the establishment of public services which may hurt private profit. This totalitarian logic of accomplished facts has its Eastern counterpart. There, freedom is the way of life instituted by a communist regime, and all other transcending modes of freedom are either capitalistic, or revisionist, or leftist sectarianism. In both camps, non-operational ideas are non-behavioral and subversive. The movement of thought is stopped at barriers which appear as the limits of Reason itself.

Such limitation of thought is certainly not new. Ascending modern rationalism, in its speculative as well as empirical form, shows a striking contrast between extreme critical radicalism in scientific and philosophic method on the one hand, and an uncritical quietism in the attitude toward established and functioning social institutions. Thus Descartes' *ego cogitans* was to leave the "great public bodies" untouched, and Hobbes held that "the present ought always to be preferred, maintained, and accounted best." Kant agreed with Locke in justifying revolution *if and when* it has succeeded in organizing the whole and in preventing subversion.

However, these accommodating concepts of Reason were always contradicted by the evident misery and injustice of the "great public bodies" and the effective, more or less conscious rebellion against them. Societal conditions existed which provoked and permitted real dissociation from the established state of affairs; a private as well as political dimension was present in which dissociation could develop into effective opposition, testing its strength and the validity of its objectives.

With the gradual closing of this dimension by the society, the self-limitation of thought assumes a larger significance. The interrelation between scientific-philosophical and societal processes, between theoretical and practical Reason, asserts itself "behind the back" of the scientists and philosophers. The society bars a whole type of oppositional operations and behavior; consequently, the concepts pertaining to them are rendered illusory or meaningless. Historical transcendence appears as metaphysical transcendence, not acceptable to science and scientific thought. The operational and behavioral point of view, practiced as a "habit of thought" at large, becomes the view of the established universe of discourse and action, needs and aspirations. The "cunning of Reason" works, as it so often did, in the interest of the powers that be. The insistence on operational and behavioral concepts turns against the efforts to free thought and behavior *from* the given reality and *for* the suppressed alternatives. Theoretical and practical Reason, academic and social behaviorism meet on common ground: that of an advanced society which makes scientific and technical progress into an instrument of domination.

"Progress" is not a neutral term; it moves toward specific ends, and these ends are defined by the possibilities of ameliorating the human condition. Advanced industrial society is approaching the stage where continued progress would demand the radical subversion of the prevailing direction and organization of progress. This stage would be reached when material production (including the necessary services) becomes automated to the extent that all vital needs can be satisfied while necessary labor time is reduced to marginal time. From this point on, technical progress would transcend the realm of necessity, where it served as the instrument of domination and exploitation which thereby limited its rationality; technology would become subject to the free play of faculties in the struggle for the pacification of nature and of society.

Such a state is envisioned in Marx's notion of the "abolition of labor." The term "pacification of existence"

seems better suited to designate the historical alternative of a world which – through an international conflict which transforms and suspends the contradictions within the established societies – advances on the brink of a global war. “Pacification of existence” means the development of man’s struggle with man and with nature, under conditions where the competing needs, desires, and aspirations are no longer organized by vested interests in domination and scarcity – an organization which perpetuates the destructive forms of this struggle.

Today’s fight against this historical alternative finds a firm mass basis in the underlying population, and finds its ideology in the rigid orientation of thought and behavior to the given universe of facts. Validated by the accomplishments of science and technology, justified by its growing productivity, the status quo defies all transcendence. Faced with the possibility of pacification on the grounds of its technical and intellectual achievements, the mature industrial society closes itself against this alternative. Operationalism, in theory and practice, becomes the theory and practice of *containment*. Underneath its obvious dynamics, this society is a thoroughly static system of life: self-propelling in its oppressive productivity and in its beneficial coordination. Containment of technical progress goes hand in hand with its growth in the established direction. In spite of the political fetters imposed by the status quo, the more technology appears capable of creating the conditions for pacification, the more are the minds and bodies of man organized against this alternative.

The most advanced areas of industrial society exhibit throughout these two features: a trend toward consummation of technological rationality, and intensive efforts to contain this trend within the established institutions. Here is the internal contradiction of this civilization: the irrational element in its rationality. It is the token of its achievements. The industrial society which makes technology and science its own is organized for the

ever-more-effective domination of man and nature, for the ever-more-effective utilization of its resources. It becomes irrational when the success of these efforts opens new dimensions of human realization. Organization for peace is different from organization for war; the institutions which served the struggle for existence cannot serve the pacification of existence. Life as an end is qualitatively different from life as a means.

Such a qualitatively new mode of existence can never be envisaged as the mere by-product of economic and political changes, as the more or less spontaneous effect of the new institutions which constitute the necessary prerequisite. Qualitative change also involves a change in the *technical* basis on which this society rests – one which sustains the economic and political institutions through which the “second nature” of man as an aggressive object of administration is stabilized. The techniques of industrialization are political techniques; as such, they prejudge the possibilities of Reason and Freedom.

To be sure, labor must precede the reduction of labor, and industrialization must precede the development of human needs and satisfactions. But as all freedom depends on the conquest of alien necessity, the realization of freedom depends on the *techniques* of this conquest. The highest productivity of labor can be used for the perpetuation of labor, and the most efficient industrialization can serve the restriction and manipulation of needs.

When this point is reached, domination – in the guise of affluence and liberty – extends to all spheres of private and public existence, integrates all authentic opposition, absorbs all alternatives. Technological rationality reveals its political character as it becomes the great vehicle of better domination, creating a truly totalitarian universe in which society and nature, mind and body are kept in a state of permanent mobilization for the defense of this universe.

Notes

- 1 The change in the function of the family here plays a decisive role: its “socializing” functions are increasingly taken over by outside groups and media. See my *Eros and Civilization* (Boston: Beacon Press, 1955), p. 96 ff.
- 2 Theodor W. Adorno, *Prismen. Kulturkritik und Gesellschaft* (Frankfurt: Suhrkamp, 1955), p. 24 f.
- 3 P. W. Bridgman, *The Logic of Modern Physics* (New York: Macmillan, 1928), p. 5. The operational doctrine has since

- been refined and qualified. Bridgman himself has extended the concept of “operation” to include the “paper-and-pencil” operations of the theorist (in Philipp J. Frank, *The Validation of Scientific Theories* [Boston: Beacon Press, 1954], Chap. II). The main impetus remains the same: it is “desirable” that the paper-and-pencil operations “be capable of eventual contact, although perhaps indirectly, with instrumental operations.”
- 4 P. W. Bridgman, *The Logic of Modern Physics*, loc. cit., p. 31.

Technological Determinism Is Dead; Long Live Technological Determinism

Sally Wyatt

The story of Robert Moses and the bridges between New York and Long Island made a great impression on me as on many generations of STS students. Langdon Winner argues that Moses, city planner, deliberately allowed overpasses built during the 1920s and '30s that were too low to permit buses to go beneath them, thus excluding poor, black, and working-class people from the beaches of Long Island.¹ I first read Winner's "Do Artifacts Have Politics?" in the mid-1980s, in the first edition of *The Social Shaping of Technology* (MacKenzie and Wajcman, [1985]1999), where it is the opening chapter following the editors' introduction.² As I have described elsewhere (Wyatt, 2001), I am the daughter of a nuclear engineer, so I grew up knowing that technologies are political. Making nuclear power work and justifying his efforts to do so to both his family and a wider public were the stuff of my father's daily life for many years. Despite the continued political differences between me and my father, we shared an appreciation of the existence and implications of technical choices; reading Langdon Winner provided me with a way of thinking about the politics of artifacts more systematically, and perhaps enabled my father and me to discuss these politics more dispassionately. What I learned from

my father was that technology indeed matters and that technical choices have consequences, though perhaps I would not have expressed it in quite such terms when I was six years old and he took me to Niagara Falls, not only to admire the water but also to look at the turbines down river. My father and I did not distinguish between the natural and the technological sublime (Nye, 1996).

In this chapter, I wish to address both the ways in which technology itself and the idea of technological determinism continue to fascinate, even if those of us in the STS community sometimes deny this fascination. In the next section, I discuss technological determinism and then turn to the "principle of symmetry" (see also Table 1) in order to make two points, one about success and failure and the other about treating actors' and analysts' concepts symmetrically, as a way of allowing technological determinism back into our analyses. I then return to technological determinism, arguing that one way of taking it more seriously is to disentangle the different types and what work they do. I identify four different types: justificatory, descriptive, methodological, and normative (see also Table 2).

Sally Wyatt, "Technological Determinism Is Dead," from *The Handbook of Science and Technology Studies*, ed. Edward J. Hackett, Olga Amsterdamska, Michael E. Lynch, and Judy Wajcman, 3rd edn. (Cambridge, MA: MIT Press, 2007), pp. 165–180. © 2007 Massachusetts Institute of Technology. Reprinted by permission of the MIT Press.

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Table 1 Extending the Principle of Symmetry

<i>Bloor (1973, 1976) on Science</i>	<i>Pinch & Bijker (1984) on Technology</i>	<i>Callon (1986) on Socio-technology</i>	<i>Wyatt (1998) on Method in STS</i>
Impartial to a statement being true or false	Impartial to a machine being a success or failure	Impartial to an actor being human or nonhuman	Impartial to an actor being identified by other actors or the analyst
Symmetrical with respect to explaining truth and falsity	Symmetrical with respect to explaining success and failure	Symmetrical with respect to explaining the social world and the technical world	Symmetrical with respect to using concepts from analysts and actors
What we take to be nature is the result and not the cause of a statement becoming a true fact	<i>“Working” is the result and not the cause of a machine becoming a successful artifact</i>	Distinction between the “technical” and the “social” is the result and not the cause of the stabilization of socio-technical ensembles	<i>“Success” is the result and not the cause of a machine becoming a working artifact</i>

Source: First three columns adapted from Bijker (1995: 275).

Table 2 Four Types of Technological Determinism**Justificatory**

- EU Information Society Forum (2000)

Descriptive

- Technology developed independently of social forces (Misa, 1988)
- Technology causes social change (Misa, 1988; Smith & Marx, 1994)
- Technology developed independently of social forces and causing social change (MacKenzie and Wajcman, [1985] 1999)
- Limited autonomy of science and technology in determining economic developments (Freeman, 1987)

Methodological

- “Look to the technologies available to societies, organizations, and so on” (Heilbroner, 1994a or b)
- “Momentum” (Hughes, 1983, 1994)
- “Society is determined by technology in use” (Edgerton, 1999)

Normative

- Decoupling of technology from political accountability (Bimber, 1994)
- Triumph of technological rationality (Winner, 1977, 1986)

Technological Determinism Is Dead, or Is It?

Technological determinism persists in the actions taken and justifications given by many actors; it persists in analysts’ use of it to make sense of the introduction of technology in a variety of social settings; it persists in manifold theoretical and abstract accounts of the relationship between the technical and the social; it persists in the responses of policy makers and politicians to challenges about the need for or appropriateness of new technologies; and it persists in the reactions we all experience when confronted with new machines and new ways of

doing things. (Examples of each of these can be found in the Back to Technological Determinism section.)

Hannah Arendt (1958; 144) wrote, “[t]ools and instruments are so intensely worldly objects that we can classify whole civilizations using them as criteria.” Not only can we, but frequently we do; thus, we speak of the “stone,” “iron,” “steam,” and “computer” ages. We also characterize nations by reference to technologies in which they have played a prominent developmental role and/or which are highly symbolic of their culture: Holland and windmills, the United States and cars, Japan and microelectronics. Robert Heilbroner (1994b) and David Edgerton (1999) argue that it is the availability of different machines that defines what it is like to live in a

particular place and time. Lewis Mumford (1961) suggests that the tendency to associate whole millennia or entire nations with a single material artifact has arisen because the first academic disciplines to treat technological change seriously were anthropology and archaeology, which often focus on nonliterate societies for which material artifacts are the sole record.

[T]he stone or pottery artifact came to be treated as self-existent, almost self-explanatory objects ... These tools, utensils, and weapons even created strange technological homunculi, called 'Beaker Men', 'Double Axe Men', or 'Glazed Pottery Men' ... The fact that such durable artifacts could be arranged in an orderly progressive series often made it seem that technological change had no other source than the tendency to manipulate the materials, improve the processes, refine the shapes, make the product efficient. Here the absence of documents and the paucity of specimens resulted in a grotesque overemphasis of the material object, as a link in a self-propelling, self-sustaining technological advance, which required no further illumination from the culture as a whole even when the historic record finally became available. (Mumford, 1961: 231)

Those of us concerned with more contemporary societies have no similarly convenient excuse for such reductionist thinking. Yet the linguistic habit persists of naming whole historical epochs and societies by their dominant technological artifacts. This habit can be witnessed frequently in museums, schoolbooks, and newspapers and on television and radio.³ Even a few years into the twenty-first century, it is still difficult to predict for which of its many new technologies the twentieth century will be remembered by future generations, yet the habit of thought and language of associating places and time periods with their technologies endures, even if causality is not always explicit. This way of thinking about the relationship between technology and society has been "common sense" for so long that it has hardly needed a label. But its critics have termed it "technological determinism," which has two parts. The first part is that technological developments take place outside society, independently of social, economic, and political forces. New or improved products or ways of making things arise from the activities of inventors, engineers, and designers following an internal, technical logic that has nothing to do with social relationships. The more crucial second part is that technological change causes or determines social change. Misa (1988) suggests that what I have presented here as two parts of a single whole are actually two different versions of

technological determinism. Defining it as two different versions enables the scourges of technological determinism to cast their condemnatory net more widely by defining people like Winner and Ellul as technological determinists because they point to the inexorable logic of capitalist rationality. This is to confuse their materialism and realism with determinism. If they are to be accused of any sort of determinism, economic determinism is the more appropriate charge. I follow MacKenzie and Wajcman ([1985]1999) in defining technological determinism as having two parts, both of which are necessary,⁴ and I will return to this distinction later. Over the past 25 years, STS has focused primarily on demonstrating how limited the first part of technological determinism is, usually by doing empirically rich historical or ethnographic studies demonstrating how deeply social the processes of technological development are.⁵

Technological determinism is imbued with the notion that technological progress equals social progress. This was the view of Lenin (1921) when he claimed that "Communism is Soviet power plus the electrification of the whole country" and it remains the view of politicians of all political persuasions. For example, George W. Bush, a politician very different from Lenin, is committed to missile defense, and as he stated in his 2006 State of the Union address, he sees technology as the solution to the looming energy crisis in the United States.⁶ There is also a strand of very pessimistic technological determinism, associated with the work of Ellul (1980), Marcuse (1964), and the Frankfurt School generally. Historically, technological determinism means that each generation produces a few inventors whose inventions appear to be both the determinants and stepping stones of human development. Unsuccessful inventions are condemned by their failure to the dust heap of history. Successful ones soon prove their value and are more or less rapidly integrated into society, which they proceed to transform. In this way, a technological breakthrough can be claimed to have important social consequences.

The simplicity of this model is, in large part, the reason for its endurance. It is also the model that makes most sense of many people's experience. For most of us, most of the time, the technologies we use every day are of mysterious origin and design. We have no idea whence they came and possibly even less idea how they actually work. We simply adapt ourselves to their requirements and hope that they continue to function in the predictable and expected ways promised by those who sold them to us. It is because technological determinism

conforms with a huge majority of people's experiences that it remains the "common sense" explanation.

One of the problems with technological determinism is that it leaves no space for human choice or intervention and, moreover, absolves us from responsibility for the technologies we make and use. If technologies are developed outside of social interests, then workers, citizens, and others have very few options about the use and effects of these technologies. This serves the interests of those responsible for developing new technologies, regardless of whether they are consumer products or power stations. If technology does indeed follow an inexorable path, then technological determinism does allow all of us to deny responsibility for the technological choices we individually and collectively make and to ridicule those people who do challenge the pace and direction of technological change.

This chapter demonstrates that we cannot ignore technological determinism in the hope that it will disappear and that the world will embrace the indeterminacy and complexity of other types of accounts of the technology-society relationship. I argue that we in the STS community cannot simply despair of the endurance of technological determinism and carry on with our more subtle analyses. We must take technological determinism more seriously, disentangle the different types, clarify the purposes for which it is used by social actors in specific circumstances. Moreover, I argue that in order to do this we have to recognize the technological determinists within ourselves.

A Brief and Symmetrical Detour

Before returning to the discussion of technological determinism, I want to digress slightly and discuss the principle of symmetry (Table 1) in order to demonstrate two points. The first is the more conventional application of the principle of symmetry related to working and success versus nonworking and failure. The second relates to the symmetrical treatment of actors' and analysts' concepts.

First, the principle of symmetry was initially articulated by David Bloor (1973, 1976) in relation to the sociology of science. He argues that knowledge claims that are accepted as true and those that are regarded as false are both amenable to sociological explanation, an explanation that must be given in the same terms.

Nature itself must not be used to justify one claim and not another: what we take to be nature is the result of something being accepted as true, not the cause. In the case of technology, the principle of symmetry suggests that successful and failed machines or artifacts need to be explained in the same, social terms. However, unequivocally successful systems do not provide such a rigorous test for Pinch and Bijker's (1984) claim that working is the result and not the cause of a machine becoming a successful artifact. For successful systems, such a claim is tautological. However, there are other, more ambiguous systems,⁷ in terms of success and failure, working and nonworking, which are a better illustration of how right Pinch and Bijker are, especially if an iterative loop is added, to the statement. In previous work about ICT-network systems in the U.S. and U.K. central government administrations (Wyatt, 1998, 2000), I demonstrated how such systems worked, were not successful, and no longer work. Playing the postmodern trick⁸ of reversing the wording of the claim so that it becomes, "success is the result and not the cause of a machine becoming a working artifact" illustrates the significance of Callon's contribution to Table 1, namely, his exhortation to treat the sociotechnical divide as a consequence of the stabilization of sociotechnical ensembles and not as a prior cause. One of the difficulties with the Pinch and Bijker claim about working being the result rather than the cause of a machine becoming a successful artifact is that they presume the existence of that divide in their association of success with the social world and of working with the technical world, thus presuming a binary divide between the social and the technical, whereas much of STS is concerned with demonstrating how interwoven the social and technical are with one another. Moreover, one cannot privilege the social, as they do by placing "success" prior to "working." It has to be possible to reverse the claim as I have done here in order to make visible the mutual constitution of the social and the technical, but that means that successive extensions of the principle of symmetry have led us back to a position of classical realism. This should not come as a surprise. The claims of "success" and "working" have to be interchangeable to enable us to treat the social and the technical symmetrically. Rather than seeing the bottom items in the columns in Table 1 attributed to Pinch and Bijker and Wyatt as alternatives, they need to be understood as two sides of the same coin. Neither is adequate on its own.

The second point is that actors' and analysts' concepts need to be treated symmetrically, the middle claim by Wyatt in Table 1. Others (Bijsterveld, 1991; Martin and Scott, 1992; Russell, 1986; Winner, 1993) have pointed to the limits of "following the actors" (Latour, 1987), in particular that by doing so analysts may miss important social groups that are invisible to the actors but nonetheless important. Users are often overlooked by developers. Often it is possible to define clearly who the users are or will be. But with information networks, for example, there can be at least two sets of users. The first group is those people who are conventionally considered to be the users; employees who use the system to access information in order to perform their job tasks. In many cases, there is also a second group of users: clients or customers whom the more direct users ultimately serve with the help of the system and who have different interests.

To understand the role of users, it is important to distinguish between "real" users in the "real" world and the images of those users and their relationships held by designers, engineers, and other sorts of system builders. It is also important to be aware of "implicated users" (Clarke, 1998), those who are served by the system but who do not have any physical contact with it. Again, distinctions need to be made about their actual social relations and the images held of them. Sometimes both sorts of users are ignored during systems development, in other words, serious attempts are not always made to configure the users (cf. Woolgar, 1991), raising both methodological and normative issues.

There are problems with following the actors. Identifying all the relevant social groups as mentioned above and defining scale⁹ and success can become messy or impossible if analysts are over-reliant on actors' accounts. As analysts, we have to rely on ourselves and on the research done by others to help us define our concepts and identify relevant groups. Let us continue to take seriously the principle of symmetry. If, as analysts, we allow our own categories and interpretations into the constructions of our stories, we also need to allow actors' concepts and theories to inform our accounts. Actors and analysts all have access to both the abstract and the material.

Anthony Giddens (1984) has a particular view of the double hermeneutic in social science:¹⁰ Not only do social scientists need to find ways of understanding the world of social actors, they also need to understand the ways in which their theories of the social world are interpreted by those social actors. In other

words, the ideas, concepts, theories of both social actors and social scientists need to be given space. "Follow the actors" can be rescued by recourse to the higher principle of symmetry. Actors' and analysts' identification of other actors and their interests should be treated symmetrically. But I certainly do not wish to grant the analyst the status of an omniscient, superior being. In the next and final section, I will return to the persistence of technological determinism and argue that its continued use by actors necessitates that as analysts we take it more seriously than we have done in recent years. Following Giddens (1984) means that actors' theoretical ideas need to be treated symmetrically with our own, even if they are antithetical to our deeply held views.

Back to Technological Determinism

Within the humanities and social sciences¹¹ we frequently ignore the equivalent of a thundering herd of elephants when we dismiss the role of technological determinism in shaping the views and actions of actors.¹² Michael L. Smith eloquently expresses a similar view,

We scholars of technology and culture lament the stubborn tenacity of technological determinism, but we rarely try to identify the needs it identifies and attempts to address. On the face of it, our brief against this variety of superstition resembles the academy's response to creationism: How can something so demonstrably wrong-headed continue to sway adherents? (1994: 38–39)

Smith is correct to point to the importance of understanding the needs and interests served by a continued adherence to technological determinism, and I will return to that below. He is wrong, however, to dismiss technological determinism (and creationism) as wrong-headed superstition or as a form of false consciousness. Recall Bloor's (1973, 1976) original formulation of the principle of symmetry, namely, that both true and false beliefs stand in need of explanation. We need to remain impartial in our attempt to explain the persistence of technological determinism in order to understand why it continues to be regarded as true by so many people. In the previous section, I argued that the categories deployed by both actors and analysts need to be pursued in order to justify paying attention to users who might never be noticed if analysts naïvely follow the actors.

Now it is time to follow the actors in their continued commitment to technological determinism.

One of the most misleading and dangerous aspects of technological determinism is its equation of technological change with progress.¹³ From the many histories and contemporary case studies of technological change we know how messy and ambiguous the processes of developing technologies can be. But this is not always the perspective of actors. Some actors, some of the time, present projects as simple and straightforward. It is necessary for them to do so in order to make things happen and to justify their actions. Sometimes sociotechnical ensembles work; sometimes they do not. Including stories of systems that do not work or were not used or were not successful provides further armory in the arsenal to be used against technological determinism because such stories challenge the equation of technology with progress, though not, of course, if we have an evolutionary perspective on progress. But we should not be under any illusions that technological determinism will disappear, and we should recognize that it has a useful function for system builders.

In this section, I return to an exploration of the endurance of technological determinism – endurance in the accounts of some analysts, in the actions of system builders, as well as the justifications proffered by policy makers and other social groups. Despite all the detailed empirical work in STS about both historical and contemporary examples of the contingency of technological change and despite the nuanced and sophisticated theoretical alternatives that have been proposed, technological determinism persists. One of the dangers of simply ignoring it in the hope it will disappear is that we do not pay sufficient attention to its subtlety and variety. Sometimes it is a table upon which to thump our realist credentials; occasionally it can be a rapier to pierce the pretensions of pompous pedants. In whatever way it is used, my argument here is that we need to take it more seriously.

One of the few sustained engagements with technological determinism to be published is the collection, *Does Technology Drive History? The Dilemma of Technological Determinism*, edited by Merritt Roe Smith and Leo Marx (1994). All the contributors are professors of history at U.S. universities, and the concerns they express are largely those of historians of technology, in their relationship with other historians, and of Americans, with their historic paradigmatic equation of technology with progress and their collective but partial loss of faith with that equation. The contributors provide a valuable mapping

of the terrain of meanings associated with the concept of technological determinism.

In their introduction, Smith and Marx (1994: ix–xv) suggest that technological determinism can take several forms, along a spectrum between hard and soft poles.

At the “hard” end of the spectrum, agency (the power to effect change) is imputed to technology itself, or to some of its intrinsic attributes; thus the advance of technology leads to a situation of inescapable necessity ... To optimists, such a future is the outcome of many free choices and the realization of the dream of progress; to pessimists, it is a product of necessity’s iron hand, and it points to a totalitarian nightmare. (Smith & Marx, 1994: xii)

At the pole of “soft” determinism, technology is located, “in a far more various and complex social, economic, political, and cultural matrix” (Smith & Marx, 1994: xiii). In my view, this soft determinism is vague and is not really determinism at all, as it returns us to the stuff of history, albeit a history in which technology is taken seriously.

Robert Heilbroner’s famous article, “Do Machines Make History?,” originally published in *Technology and Culture* in 1967, is reproduced in the collection, together with his own recent reflections on the question. He is the most avowedly technologically determinist of the contributors, in both an ontological and methodological sense. He suggests that a good place to start in the study of an unfamiliar society is to examine the availability of different machines, since this will define what it is like to live in a particular place and time (1994a: 69–70). He proposes this as a heuristic for investigation, not as a normative prescription. “[T]echnological determinism does not imply that human behaviour must be deprived of its core of consciousness and responsibility” (1994a: 74). David Edgerton makes a similar point when he argues that technological determinism must be seen as the “the thesis that society is determined by technology in use” (1999: 120), which, as he points out, allows inclusion of societies with technology but not necessarily with high rates of technological change.

Bruce Bimber picks up the theme of normative prescription. He distinguishes between three interpretations of technological determinism, what he terms “normative,” “nomological,” and “unintended consequences” accounts.¹⁴ The first he associates with the work of Winner (1977), Ellul (1980), and Habermas (1971), among others, who suggest that technology can be considered autonomous and determining when the norms by which it is developed have become removed

from political and ethical debates. For all the authors Bimber mentions, the decoupling of technology from political accountability is a matter of great concern. Nomological technological determinism is Bimber's very hard version: "in light of the past (and current) state of technological development and the laws of nature, there is only one possible future course of social change" (1994: 83). To make this even harder, Bimber imposes a very narrow definition of technology: artifacts only. No knowledge of production or use can be incorporated because that would allow social factors to enter this otherwise asocial world. His final category arises from the observation that social actors are unable to anticipate all the effects of technological change. However, since this is true for many other activities and does not arise from some intrinsic property of technology, Bimber dismisses this as a form of technological determinism. Bimber is concerned to rescue Karl Marx from the accusation of technological determinism. This he does by setting up these three accounts, suggesting that the nomological is the only true technological determinism and that Marx does not meet the strict criteria.¹⁵

Thomas Hughes returns to the spirit of the distinctions made by Smith and Marx between hard and soft determinism, albeit in different terms and with the explicit objective of establishing "technological momentum" as "a concept that can be located somewhere between the poles of technical determinism and social constructivism." For Hughes, "[a] technological system can be both a cause and an effect; it can shape or be shaped by society. As they grow larger and more complex, systems tend to be more shaping of society and less shaped by it" (Hughes, 1994: 112). On a methodological level, he suggests that social constructivist accounts are useful for understanding the emergence and development of technological systems, but momentum is more useful for understanding their subsequent growth and the acquisition of at least the appearance of autonomy.

This discussion leads me to distinguish between four types of technological determinism, which I term justificatory, descriptive, methodological, and normative (Table 2). Justificatory technological determinism is deployed largely by actors. It is all around us. It is the type of technological determinism used by employers to justify downsizing and reorganization. It is the technological determinism we are all susceptible to when we consider how people's lives have changed in the past 200 years. It is the technological determinism (and frustration) we feel when confronted with an automated call

response system. It can be found in policy documents, including the EU Information Society Forum report, which claims, "[t]he tremendous achievement of the ICT sector in the last few years, and particularly of the Internet, have practically cancelled the concept of time and distance ... The emerging digital economy is radically changing the way we live, work and communicate, and there is no doubt about the benefits that will lead us to a better quality of life" (2000: 3). It is similar to what Paul Edwards has called the "ideology of technological determinism" (1995: 268) when he reflects on "managers' frequent belief that productivity gains and social transformation will be automatic results of computerization." (1995: 268)

Second is the descriptive technological determinism identified by MacKenzie and Wajcman ([1985]1999), Misa (1988), and Smith and Marx (1994: ix-xv). These authors eschew technological determinism as modes of explanation for themselves but certainly recognize it when they see it in others. Having recognized it, they rarely attempt to understand the reasons for it and instead focus on developing richer, more situated explanations of sociotechnical change. They simply reject technological determinism because of its inadequate explanatory power. Christopher Freeman (1987) is more assertive in his defense of this type of technological determinism, arguing that in some cases at least, technological determinism is quite a good description of the historical record.

Third is the methodological technological determinism of Heilbroner, Edgerton, and Hughes. Heilbroner reminds us to start our analyses of societies, and of smaller scale social organizations, by examining the technologies available to them. Hughes' methodological technological determinism is more analytical. But, like Heilbroner, he too is attempting to develop a tool for helping us understand the place of technology in history. In STS, that is what we are all doing – attempting to understand the role of technology in history and in contemporary social life; actor-network theory, social constructivism, history of technology, and innovation theory all take technology seriously. All of these approaches are regarded as deviant by their parent disciplines because they include technologies in their analyses of the social world. My provocation here is that our guilty secret in STS is that really we are all technological determinists. If we were not, we would have no object of analysis; our *raison d'être* would disappear. Winner hints at this obliquely at the end of the preface of *Autonomous Technology* (1977) when he writes, "there are institutions [machines] one must

oppose and struggle to modify even though one also has considerable affection for them" (1977: x).

Finally, there is the normative technological determinism identified by Bimber, by Misa in his second version, and implicit in Hughes' concept of momentum. This is the autonomous technology of Langdon Winner, technology that has grown so big and so complex that it is no longer amenable to social control. It is this version of technological determinism that has resulted in the intra-STS skirmishes, in which Winner (1993) accuses constructivists of abandoning the need to render technology and technological change more accountable, and it is with this accusation in mind that I conclude.

Conclusion

Does Technology Drive History? ends with a moving plea from John Staudenmaier to continue to take the history of technology seriously, to treat artifacts, "as crystallized moments of past human vision ... each one buffeted by the swirl of passion, contention, celebration, grief and violence that makes up the human condition" (1994: 273). Scholars concerned with understanding the relationship between technology and society share that commitment.

In STS we study people and things, and we study images of people and things. We also need to study explanations of people and things. Just as we treat technology seriously, we must treat technological determinism seriously. It is no longer sufficient to dismiss it for its conceptual crudeness, nor is it enough to dismiss it as false consciousness on the part of actors or as a bleak, Nietzschean outlook for the future of humanity. Technological determinism is still here and unlikely to disappear. It remains in the justifications of actors who are keen to promote a particular direction of change, it remains as a heuristic for organizing accounts of technological change, and it remains as part of a broader public discourse which seeks to render

technology opaque and beyond political intervention and control.

What I have done here is to delineate different types of technological determinism, not because I believe it to be an adequate framework for understanding the relationship between the social and technical worlds but because lots of other actors do, and therefore we need to understand its different manifestations and functions. Within STS, we have always treated technology seriously; we have always been concerned with the risks and dangers of autonomous technology. We are not innocent in the ways of methodological and normative technological determinism. But we can no longer afford to be so obtuse in ignoring the justificatory technological determinism of so many actors. Only by taking that type of technological determinism seriously will we be able to deepen our understanding of the dynamics of sociotechnical systems and the rhetorical devices of some decision makers.

The challenges for STS remain: to understand how machines make history in concert with current generations of people; to conceptualize the dialectical relationship between the social shaping of technology and the technical shaping of society; and to treat symmetrically the categories of analysts and those of actors even if the latter includes technological determinism, anathema to so much contemporary scholarship in the humanities and social sciences. These dialectics are unresolvable one way or another, but that is as it should be. What is important is to continue to wrestle with them. We need to take seriously the efforts to stabilize and extend the messy and heterogeneous collections of individuals, groups, artifacts, rules, and knowledges that make up our sociotechnical world. We need to continue to grapple with understanding why sometimes such efforts succeed and sometimes they do not. Only then will people have the tools to participate in creating a more democratic sociotechnical order.

Notes

I am very grateful to the editors and three anonymous reviewers for their thoughtful and provocative comments, which helped improve this chapter considerably. [...] My father died at the end of 2005, when I should have been preparing the final version. As the reader will learn from the first paragraph, my father had an enormous influence on my own views about technology. The most difficult revisions

I had to make were to the verb tenses in that paragraph. This chapter is dedicated to the memory of my father, Alan Wyatt.

1 See discussion by Joerges (1999) and Woolgar and Cooper (1999) regarding the mythic status of the Moses/Winner story. For my purposes here, it is precisely the mythic quality of the story that counts.

- 2 The foundational status of this piece is confirmed by its inclusion in the second edition (MacKenzie & Wajcman, 1.1985]1999), still in the number one spot.
- 3 For example, the 2005 BBC Reith lectures were given by Lord Broers, Chairman of the British House of Lords Science and Technology Committee and President of the Royal Academy of Engineers. The title of his first lecture was "Technology will determine the future of the human race." The title for the series of five lectures was "The Triumph of Technology" (see www.bbc.co.uk/programmes/p00gm3kk).
- 4 Feenberg also identifies two premises on which technological determinism is based, what he calls "unilinear progress" and "determination by the base" (1999: 77). This is much the same as the two parts of MacKenzie and Wajcman, since unilinear progress refers to the internal logic of technological development and determination by the base refers to the ways in which social institutions are required to adapt to the technological "base."
- 5 Two early examples are Latour and Woolgar (1986) and Traweek (1988). However, the pages of *Social Studies of Science* and of *Science, Technology & Human Values* are filled with such case studies.
- 6 For the full text of Bush's speech, see <http://www.whitehouse.gov/stateoftheunion/2006/index.html>.
- 7 For example, it is often very difficult to evaluate clearly the success and failure of many information technology-based systems in terms of their success and failure, working and nonworking.
- 8 See Derrida (1976): The signified is always already in the position of the signifier, often paraphrased as X is always already Y.
- 9 Defining scale is not only an analytical problem facing the researcher (Joerges, 1988), it is also a practical one for the actors. The resolution of this problem is necessary for the researcher to circumscribe the object of study, but it is also a problem experienced by the actors.
- 10 Within philosophy, the "double hermeneutic" is used more generally to refer to the problem that social scientists have in dealing with the interpretations of social life produced by social actors themselves as well as the interpretations of social life produced by analysts.
- 11 I exempt historians from this criticism, especially in light of the publication of Smith and Marx (1994) and, more recently, of Oldenziel (1999), in which she carefully traces the shifting meaning of technology and the rise of technocracy in the United States.
- 12 Equally peculiar is the way in which technology itself is ignored. As Brey (2003) points out in his comprehensive review of literature pertaining to technology and modernity, much of the modernity literature makes, at best, only passing reference to technology. Brey argues that this is not because modernity authors do not recognize the importance of technology but rather because they see it as the means by which regulative frameworks such as capitalism, the nation state, or the family are governed and not as an institution itself. Another reason may be that social science and humanities scholars may not have the tools or the confidence to analyze technology as such, and at most are only able to critique discourses around technology.
- 13 See Leo Marx (1994) for a detailed historical account of the emergence of technology and its relationship to ideas of progress.
- 14 These are not dissimilar to Radder's (1992) distinctions between methodological, epistemological, and ontological relativism.
- 15 I agree with Bimber that Karl Marx was not a technological determinist, but this point has already been more than adequately made by MacKenzie (1984) in his detailed review of this literature.

References

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- Arendt, Hannah (1958) *The Human Condition* (Chicago: University of Chicago Press).
- Bijker, Wiebe (1995) *Of Bicycles, Bakelites and Bulbs, Toward a Theory of Socio-Technical Change* (Cambridge, MA: MIT Press).
- Bijsterveld, Karin (1991) "The Nature of Aging: Some Problems of 'An Insider's Perspective' Illustrated by Dutch Debates about Aging (1945–1982)," presented at the Society for Social Studies of Science conference, Cambridge, MA, November.
- Bimber, Bruce (1994) "Three Faces of Technological Determinism," in M. R. Smith & L., Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press): 79–100.
- Bloor, David (1973) "Wittgenstein and Mannheim on the Sociology of Mathematics," *Studies in History and Philosophy of Science* 4: 173–91.
- Bloor, David (1976) *Knowledge and Social Imagery* (London: Routledge & Kegan Paul).
- Brey, Philip (2003) "Theorizing Modernity and Technology," in T. Misa, P. Brey, & A. Feenberg (eds), *Modernity and Technology* (Cambridge, MA: MIT Press): 33–72.
- Callon, Michel (1986) "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieue Bay," in J. Law (ed), *Power, Action and Belief: A New Sociology of Knowledge?* (London: Routledge & Kegan Paul): 196–233.

- Clarke, Adele (1998) *Disciplining Reproduction: Modernity, American Life and 'The Problem of Sex'* (Berkeley: University of California Press).
- Derrida, Jacques (1976) *Of Grammatology*, trans. G Spivak (Baltimore, MD: Johns Hopkins University Press).
- Edgerton, David (1999) "From Innovation to Use: Ten Eclectic Theses on the Historiography of Technology," *History and Technology* 16: 111–36.
- Edwards, Paul (1995) "From 'Impact' to Social Process: Computers in Society and Culture," in S. Jasanoff, G. Markle, J. Petersen, & T. Pinch (eds), *Handbook of Science and Technology Studies* (Thousand Oaks: Sage).
- Ellul, Jacques (1980) *The Technological System* (New York: Continuum).
- Feenberg, Andrew (1999) *Questioning Technology* (London & New York: Routledge).
- Freeman, Christopher (1987) "The Case for Technological Determinism," in R. Finnegan, G. Salaman, & K. Thompson (eds), *Information Technology: Social Issues: A Reader* (Sevenoaks, U.K.: Hodder & Stoughton in association with the Open University): 5–18.
- Giddens, Anthony (1984) *The Constitution of Society: Outline of the Theory of Structuration* (Cambridge, U.K.: Polity Press).
- Habermas, Jürgen (1971) *Toward a Rational Society: Student Protest, Science, and Politics*, trans. J. Shapiro (London: Heinemann).
- Heilbroner, Robert (1994a) "Do Machines Make History?" in M. R. Smith & L. Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press): 53–66.
- Heilbroner, Robert (1994b) "Technological Determinism Revisited," in M. R. Smith & L. Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press): 67–78.
- Hughes, Thomas P. (1983) *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore, MD: Johns Hopkins University Press).
- Hughes, Thomas P. (1994) "Technological Momentum," in M. R. Smith & L. Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press): 101–14.
- Information Society Forum (2000) *A European Way for the Information Society* (Luxembourg: Office for Official Publications of the European Communities).
- Joerges, Bernward (1988) "Large Technical Systems: Concepts and Issues," in R. Mayntz and T. P. Hughes (eds), *The Development of Large Technical Systems* (Frankfurt: Campus Verlag): 9–36.
- Joerges, Bernward (1999) "Do Politics Have Artefacts?" *Social Studies of Science* 29(3): 411–31.
- Latour, Bruno (1987) *Science in Action, How to Follow Scientists and Engineers through Society* (Milton Keynes: Open University Press).
- Latour, Bruno & Steve Woolgar (1986) *Laboratory Life: the Construction of Scientific Facts*, 2nd ed. (Princeton, NJ: Princeton University Press).
- Lenin, Vladimir Ilyich (1921) "Notes on Electrification," February 1921, reprinted (1977) in *Collected Works*, vol. 42 (Moscow: Progress Publishers): 280–81.
- MacKenzie, Donald (1984) "Marx and the Machine," *Technology and Culture* 25(3): 473–502.
- MacKenzie, Donald & Judy Wajcman (eds) ([1985]1999) *The Social Shaping of Technology: How the Refrigerator Got Its Hum* (Milton Keynes, U.K.: Open University Press); 2nd ed. (1999) (Philadelphia: Open University Press).
- Marcuse, Herbert (1964) *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society* (Boston: Beacon Press).
- Martin, Brian & Pam Scott (1992) "Automatic Vehicle Identification: A Test of Theories of Technology," *Science, Technology & Human Values* 17(4): 485–505.
- Marx, Leo (1994) "The Idea of 'Technology' and Postmodern Pessimism," in M. R. Smith & L. Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press): 237–58.
- Misa, Thomas (1988) "How Machines Make History and How Historians (and Others) Help Them To Do So," *Science, Technology & Human Values* 13(3 and 4): 308–31.
- Mumford, Lewis (1961) "History: Neglected Clue to Technological Change," *Technology & Culture* 2(3): 230–36.
- Oldenziel, Ruth (1999) *Making Technology Masculine. Men, Women and Modern Machines in America, 1870–1945* (Amsterdam: University of Amsterdam Press).
- Nye, David (1996) *American Technological Sublime* (Cambridge, MA: MIT Press).
- Pinch, Trevor & Wiebe Bijker (1984) "The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other," *Social Studies of Science* 14: 399–441.
- Radder, Hans (1992) "Normative Reflections on Constructivist Approaches to Science and Technology," *Social Studies of Science* 22: 141–73.
- Russell, Stewart (1986) "The Social Construction of Artefacts: A Response to Pinch and Bijker," *Social Studies of Science* 16: 331–46.
- Smith, Merritt Roe & Leo Marx (eds) (1994) *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press).
- Smith, Michael L. (1994) "Recourse of Empire: Landscapes of Progress in Technological America," in M. R. Smith & L. Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press): 37–52.
- Staudenmeier, John (1994) "Rationality Versus Contingency in the History of Technology," in M. R. Smith & L. Marx (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press): 259–74.

- Traweek, Sharon (1988) *Beamtimes and Lifetimes, The World of High Energy Physicists* (Cambridge, MA: Harvard University Press).
- Winner, Langdon (1977) *Autonomous Technology, Technics-out-of-control as a Theme in Political Thought* (Cambridge, MA: MIT Press).
- Winner, Langdon (1980) "Do Artifacts Have Politics?" *Daedalus* 109: 121–36 (reprinted in Mackenzie & Wajcman, 1985 and 1999).
- Winner, Langdon (1986) *The Whale and the Reactor, A Search for Limits in an Age of High Technology* (Chicago: University of Chicago Press).
- Winner, Langdon (1993) "Upon Opening the Black Box and Finding It Empty: Social Constructivism and the Philosophy of Technology," *Science, Technology & Human Values* 18(3): 362–78.
- Woolgar, Steve (1991) "Configuring the User: The Case of Usability Trials," in J. Law (ed), *A Sociology of Monsters: Essays on Power, Technology and Domination* (London: Routledge): 57–99.
- Woolgar, Steve & Geoff Cooper (1999) "Do Artefacts Have Ambivalence? Moses' Bridges, Winner's Bridges and Other Urban Legends in S&TS," *Social Studies of Science* 29(3): 433–49.
- Wyatt, Sally (1998) *Technology's Arrow: Developing Information Networks for Public Administration in Britain and the United States*. Doctoral dissertation, University of Maastricht.
- Wyatt, Sally (2000) "ICT Innovation in Central Government: Learning from the Past," *International Journal of Innovation Management* 4(4): 391–416.
- Wyatt, Sally (2001) "Growing up in the Belly of the Beast," in F. Henwood, H. Kennedy, & N. Miller (eds), *Cyborg Lives? Women's Technobiographies* (York: Raw Nerve): 77–90.

Technology, Ecology, and the Conquest of Nature

Introduction

As the selections in this part's first two sections show, to consider the role technology plays (or ought to play) in human life is both to make an issue of our own nature (Are we fundamentally tool-using animals? Power-hungry? Desirous of being creative? Destined to be cogs in a mega-machine?) and also to consider the extent to which the development of technoscience does or might serve human purposes. Clearly, what we conclude about these issues will strongly influence our conception of our legitimate relations to our surroundings. To what extent is it permissible to exploit nature for our own purposes? Are there any limits to power-exercising "Baconianism"? Are there non-exploitive relations with our surroundings that now, for various reasons, are marginalized or ignored? To what extent are various relations really subject to choice? The articles in this section all attempt to bring some focus to these questions – one in the context of feminist criticism of mainstream positions, two in relation to the ecological issues that seem to press in upon us through the development of modern technologies, and one in light of recent "posthumanist" speculations that take off from the new possibilities offered by human enhancement technologies.

Carolyn Merchant's "Mining the Earth's Womb," adapted from her influential book *The Death of Nature*, offers her famously controversial account of a major transition in Western history from a pagan and medieval view of Mother Earth to the modern view of nature as

inanimate and barren. Merchant is especially concerned to demonstrate how these two broad and general descriptions have very different "normative import," that is, encourage and even seem to justify very different sorts of human practices. The transition itself, as well as the normative changes that come with it, can be especially well illuminated, she argues, by tracing the radical alteration of attitudes toward mining. Merchant notes that African smiths and ancient natural historians like Pliny expressed respect for the earth as a living and nurturing being and thus regarded mining as inherently a violation and defilement (cf. Schadewaldt on the ancient Greek conception of *physis*, Chapter 3). What little mining did occur was undertaken with trepidation, in fear of nature's revenging herself in earthquakes and volcanic eruptions. During the Renaissance the remnants of this pagan view that had survived into the Christian Middle Ages were eradicated. Merchant analyzes Georg Agricola's influential *De Re Metallica*, in which the old prohibitions against mining are turned "on their head" with arguments that pry loose the old assumption that activities like mining are disruptive from the traditional idea that what the Earth conceals is not to be acquired. Agricola argues that mining is not inherently more disruptive than catching fish or making metal tools, especially if one digs in areas that are otherwise undesirable. He insists, moreover, that raw materials are "neutral" in themselves. What is good or bad is our intentions, our reasons for making use of them. In short, what Agricola succeeds in showing by implication – with the key example of mining – is how, quite in

general, legitimate use and exploitation of nature might better be distinguished by its (human) purpose than by appeal to (allegedly “natural”) essences. Such arguments, argues Merchant, set the stage for the development of a new global “ethic of exploitation” – one that transforms the idea of defiling a Nurturing Mother into the imagery of exploring and appropriating Mother Nature’s treasures. Further, Merchant stresses how this change of attitude was accompanied and encouraged by changing attitudes toward women. Females and the birth process became less revered. Male medical practitioners discredited female peasant healers, whose arts had been respected by male Renaissance hermeticists and magicians such as Paracelsus and Cornelius Agrippa. With the rise of scientific rationality came the burning of (mainly female) witches. Exit alchemy, with its belief in the “vegetative powers” of gold and silver operative in the “warm womb” of the earth. Enter Bacon, who in Merchant’s view gave crucial assistance to all these changes by providing a kind of codification of the new attitudes toward both nature and women through his analogy between the experimental interrogation of nature and the seduction and conquest of woman.

Some philosophers have objected that feminists like Merchant and Sandra Harding are seriously misreading Bacon’s use of metaphors of forceful seduction in his articulations of the new relation between scientist and nature. They argue that it is illegitimate to construe Bacon’s famous imagery of the scientist “hounding” nature as rape, and that a closer analysis of Bacon’s metaphors reveals that either the imagined sexual connotations are not really there or, when they are, they are not intended to demean women. So, for example, is it really necessary to accept Merchant’s claim that Bacon’s model for “interrogating” nature is the interrogation of witches by torture? Bacon nowhere actually states this connection; hence, there is no indisputable proof. In short, the general strategy is to reject sociocultural appeals to the context of Bacon’s references to sex and to nature as female. Nevertheless, the interpretive waters remain muddy here. Some years after Bacon’s death, founders of the Baconian-inspired British Royal Society – among them, Henry Oldenburg, Joseph Glanvill, and Thomas Sprat – advocated the establishment of an entirely “masculine philosophy” that would eliminate anything “feminine” from their theories and activities. As other articles in this anthology suggest, the crucial question remains how little or how much the gendered character of the dominant images and language in traditional

philosophy matters, and the issue is not merely one of setting the historical record straight.

The next two articles concentrate on the “deep-ecological” claim that an excessive estimation of our own importance, a pervasive “anthropocentrism,” has come to threaten our very universe. The views of Arne Naess – a Norwegian philosopher of empirical linguistics who founded the Deep Ecology movement – are discussed and clarified in Bill Devall’s paper. As he shows, Naess grounds his conception of deep ecology in what he calls an “ecosophy” rather than ecology. The latter is just the scientific study of the environment as we find it, one that makes predictions about what we can expect under various conditions and offers expert advice on policy issues. But the ecological movement, characterized in a manner that echoes Merchant, is “clearly and forcefully normative” – which means it is as much concerned with “wisdom” as with scientific “knowledge.” Naess views ecosophy as a kind of general systems theory, inspired by the naturalisms of Spinoza and Aristotle. Spinoza in particular seems to have influenced him; for his pantheistic, monistic rationalism treats God and the world as one substance, and mind and body as complementary aspects of a single unity. (Some of Naess’ followers have noted that Einstein, too, revered Spinoza, and that in following out the full implications of General Relativity, he treated objects as singularities in the space-time continuum rather than as separate substances.) Like Spinoza, Naess denies metaphysical status to presumably “separate” entities, just as he denies that it is a sufficiently “global” response to our current circumstances to fight against pollution and resource depletion. Such fights reflect a “shallow” ecological movement through which piecemeal environmental problem-solving effectively aids primarily the affluent populations of developed countries. In his later writings, Naess draws on the Buddhist conception of the unreality of the ego-self in order to argue for a kind of self-realization that would involve moving beyond the conception of one’s being as an “individual,” toward a more expansive understanding of the “ecological self” (cf. Schumacher, Chapter 35).

Devall’s article makes more explicit the philosophical influences relied upon not only by Naess himself but by others in the deep ecology movement. Using Kuhn’s terminology (see the Kuhn selection, Chapter 10), Devall formulates deep ecology as an alternative to the dominant (albeit now widely criticized) paradigm of economic growth, progress, and domination of nature (the “storehouse”). He cites numerous sources of inspiration –

for example, White (see Chapter 44) on the Judeo-Christian origins of the idea of the domination of nature, Eastern spiritual and Native American earth-centered traditions, Spinoza's critique of Descartes and Bacon, and Heidegger (see Chapter 27). Devall claims that to displace the traditional paradigm and promote the newly emerging "ecological consciousness," we will have to develop a new cosmology that stresses Naess' "biological equalitarianism," a new "ecological psychology" that attunes us to the "total intermingling" of every real thing, and a new philosophical anthropology that inspires a politics based on hunter-gatherer societies rather than on industrial capitalist societies with their stress on scarcity and acquisition.

Australian philosopher Ariel Kay Salleh criticizes deep ecology from an eco-feminist perspective. Citing both Naess and Devall, Salleh complains of the pervasive rationalistic and scientific language in which they still philosophize. In her view, the influence on Naess of the logical empiricist and contemporary analytic philosophical traditions often appears to blunt the presentation of his alternative. Thus, he likens his approach to general systems theory and speaks in the idiom of policy science, data, programming, and control – apparently not realizing how this merely reintroduces the very "cultural scientism" of the shallow ecology he opposes. Moreover, he formulates ecosophy as a set of "intuitions" to be analytically clarified and formulated into an axiology – again, without taking note of the way this reintroduces precisely the dualisms of norm and fact, ruler and ruled, control and submission that he supposes to be part of the problem. Above all, argues Salleh, one sees in the new paradigm that Naess advocates for our relations with our environment that "man" is still used generically. Here, again, deep ecologists seem to uncritically ignore and carry forward central features of the dominant Western intellectual tradition – this time in connection with the pervasive sexism that feminists have been especially concerned to challenge. Perhaps Devall has avoided Naess' scientism with his appeal to phenomenology and Heidegger, and by looking for the source of our urge to dominate nature in the Judeo-Christian creation story, or in the technics-run-wild as portrayed by Mumford (see Chapter 32), or in capitalism as portrayed by Marx; but he too fails to recognize that patriarchy is the real cause of this urge. In contrast, claims Salleh, the convergence of the feminist and ecology movements is no accident. In a seemingly more essentialist voice than Haraway (see Chapter 51) or social constructionist

feminists would find acceptable, Salleh speaks of women both as intrinsically more connected with nature through menstruation, childbirth, and breast-feeding, and also, again unlike men, as much more likely to form small, intimate collectivities instead of hierarchical power structures. For Salleh, males would therefore appear to be constitutionally unable to consistently present or realize the ideals of deep ecology.

In general, then, the question to ponder is how far deep ecologists can get by gesturing toward current Continental philosophy, and by locating the source of our urge to dominate nature in religious myth, technological excess, economic ideology, or cultural patriarchy. Are these strategies sufficient to challenge the pervasive (and quite probably gender-linked) "Baconian" view of our surroundings in which human life seems currently (as Heidegger says) "enframed"?

In contrast with Merchant, Naess, Devall, and Salleh, Bostrom embraces the modern outlook that they oppose. Where they sense everywhere a fundamentally problematic atmosphere, he sees instead technological progress, punctuated with specific "social problems" to be met as they arise – with facts, education, and wide public debate about wise choices, not with abstract and alarmist rhetoric or science-fictional horror stories. Bostrom's discussion centers on the question of human enhancement technologies, where medical and biological advances now make possible not only relatively uncontroversial practices like organ transplants and restorative surgery, but also, literally, "enhancements," that is, somatic and cognitive alterations like genetic engineering and machine intelligence that push the boundaries of our understanding of what it is to be human and that are (at least potentially) available simply for the choosing by otherwise perfectly "normal" people. In this paper, Bostrom defends a "transhumanist" outlook on these developments – which is the outlook that he sees as the natural outgrowth of Enlightenment optimism about science and technology (see Mitcham, Chapter 45) and the secular humanism that accompanies it – against "bioconservatives" – which is what he labels a cluster of thinkers who tend to see the very idea of technological enhancement as a threat to our conceptions of human nature and human dignity.

Bostrom's basic strategy is to dispose of the bioconservatives' outlook with a thousand cuts – by discrediting, one by one, their examples of what they think is or might be undesirable about this or that human enhancement. In each case, he argues that they tend to

mistakenly rely on and pessimistically over-generalize from a static conception either of human nature (as if “we” have always had the same nature, when in fact it has been developing, largely through improvements in our technologies, all along) or of technology (as if our present technologies, with all their limitations and dangers, are the best there will ever be). “Human nature,” he notes, is not a Platonic form. In the eyes of the hunter-gatherer, today’s “normal human beings” would no doubt seem “posthuman.” Of course, he says, not all change is good; but this is hardly a telling mark against technology specifically when it is generally true about all change.

In passing, Bostrom makes some interesting remarks about how to conceptualize what is humanly or cosmically real. In addressing the bioconservatives’ tendency to rely on unchanging ideas of what is “natural,” Bostrom turns the tables on them. Where they see a threat to any idea of human dignity that is not grounded in something “essential,” he argues that the greater danger comes when it is. Fortunately, he observes, we have tended not to be essentialists about human nature. As a result, women and people of color are now considered human too. Besides, the problem of treating “others” as less than human is hardly unique to the use of technology. Finally, Bostrom questions the promotion of essentialist ideas of nature. “Had Mother Nature been a real parent,” he retorts, “she would have been in jail for

child abuse and murder.” The point is, bioconservatives actually seem to presuppose an exaggerated fear that change will be disastrous, and then pessimistically and without adequate empirical grounds deduce that it will give us only more of the same, perhaps under somewhat improved conditions. Transhumanists, however, project from what has actually happened, and thus anticipate not just much better but maybe eventually even “posthuman” conditions – which if they come, will be facilitated in the same way improved conditions have always come – through technological progress.

Bostrom makes all opposition to his technoscientific progressivism seem “conservative” or even reactionary. But is it? Can all the objections to transhumanism be satisfactorily met by Bostrom’s paeans to growth and development, to his liberal-democratic appeals to “human rights and individual choice,” and to the idea of expanding “morphological” and “reproductive” freedoms? Can all technological excess and misuse – for example, “military and terrorist abuse [as opposed to mere use?] of bioweapons,” or “unwanted [by whom?] environmental or social side-effects” – be adequately understood as merely “concrete threats” calling for specific “social remedies”? And what of Salleh’s concerns about the modern outlook’s pervasive sexism? Obviously, such questions are not easily answered, and they are certainly not rhetorical; but it is useful to keep them in mind when considering the selections in Part VI.

Mining the Earth's Womb

Carolyn Merchant

The domination of the earth through technology and the corresponding rise of the image of the world as *Machina ex Deo* were features of the Scientific Revolution of the sixteenth and seventeenth centuries. During this period, the two ideas of mechanism and the domination of nature came to be core concepts and controlling images of our modern world. An organically oriented mentality prevalent from ancient times to the Renaissance, in which the female principle played a significant positive role, was gradually undermined and replaced by a technological mindset that used female principles in an exploitative manner. As Western culture became increasingly mechanized during the 1600s, a female nurturing earth and virgin earth spirit were subdued by the machine.

The change in controlling imagery was directly related to changes in human attitudes and behavior toward the earth. Whereas the older nurturing earth image can be viewed as a cultural constraint restricting the types of socially and morally sanctioned human actions allowable with respect to the earth, the new images of mastery and domination functioned as cultural sanctions for the denudation of nature. Society needed these new images as it continued the processes of commercialism and industrialization, which depended on activities directly altering the earth – mining, drainage, de-forestation, and assarting (grubbing up stumps to clear fields). The new activities utilized new technologies – lift and force

pumps, cranes, windmills, geared wheels, flap valves, chains, pistons, treadmills, under- and overshot watermills, fulling mills, flywheels, bellows, excavators, bucket chains, rollers, geared and wheeled bridges, cranks, elaborate block and tackle systems, worm, spur, crown, and lantern gears, cams and eccentrics, ratchets, wrenches, presses, and screws in magnificent variation and combination.

These technological and commercial changes did not take place quickly; they developed gradually over the ancient and medieval eras, as did the accompanying environmental deterioration. Slowly, over many centuries, early Mediterranean and Greek civilization had mined and quarried the mountainsides, altered the forested landscape, and overgrazed the hills. Nevertheless, technologies were low level, people considered themselves parts of a finite cosmos, and animism and fertility cults that treated nature as sacred were numerous. Roman civilization was more pragmatic, secular, and commercial and its environmental impact more intense. Yet Roman writers such as Ovid, Seneca, Pliny, and the Stoic philosophers openly deplored mining as an abuse of their mother, the earth. With the disintegration of feudalism and the expansion of Europeans into new worlds and markets, commercial society began to have an accelerated impact on the natural environment. By the sixteenth and seventeenth centuries, the tension between technological development in the world of action and the controlling organic images in the world of the mind had become too great.

Carolyn Merchant, "Mining the Earth's Womb," from *Machina ex Dea: Feminist Perspectives on Technology*, ed. Joan Rothschild (Oxford: Pergamon Press, 1983), pp. 99–117. © Carolyn Merchant. Reprinted by kind permission of the author.

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The old structures were incompatible with the new activities.

Both the nurturing and domination metaphors had existed in philosophy, religion, and literature – the idea of dominion over the earth in Greek philosophy and Christian religion; that of the nurturing earth, in Greek and other pagan philosophies. But, as the economy became modernized and the Scientific Revolution proceeded, the dominion metaphor spread beyond the religious sphere and assumed ascendancy in the social and political spheres as well. These two competing images and their normative associations can be found in sixteenth-century literature, art, philosophy, and science.

The image of the earth as a living organism and – nurturing mother had served as a cultural constraint restricting the actions of human beings. One does not readily slay a mother, dig into her entrails for gold, or mutilate her body, although commercial mining would soon require that. As long as the earth was considered to be alive and sensitive, it could be considered a breach of human ethical behavior to carry out destructive acts against it. For most traditional cultures, minerals and metals ripened in the uterus of the Earth Mother, mines were compared to her vagina, and metallurgy was the human hastening of the birth of the living metal in the artificial womb of the furnace – an abortion of the metals' natural growth cycle before its time. Miners offered propitiation to the deities of the soil and subterranean world, performed ceremonial sacrifices, and observed strict cleanliness, sexual abstinence, and fasting before violating the sacredness of the living earth by sinking a mine. Smiths assumed an awesome responsibility in precipitating the metal's birth through smelting, fusing, and beating it with hammer and anvil; they were often accorded the status of shaman in tribal rituals and their tools were thought to hold special powers (Eliade 1962, pp. 53–70, 79–96).

The Renaissance image of the nurturing earth still carried with it subtle ethical controls and restraints. Such imagery found in a culture's literature can play a normative role within the culture. Controlling images operate as ethical restraints or as ethical sanctions – as subtle "oughts" or "ought-nots." Thus, as the descriptive metaphors and images of nature change, a behavioral restraint can be changed into a sanction. Such a change in the image and description of nature was occurring during the course of the Scientific Revolution.

It is important to recognize the normative import of descriptive statements about nature. Contemporary

philosophers of language have critically reassessed the earlier positivist distinction between the "is" of science and the "ought" of society, arguing that descriptions and norms are not opposed to one another by linguistic separation into separate "is" and "ought" statements, but are contained within each other. Descriptive statements about the world can presuppose the normative; they are then ethic-laden. A statement's normative function lies in the use itself as description. The norms may be tacit assumptions hidden within the descriptions in such a way as to act as invisible restraints or moral ought-nots. The writer or culture may not be conscious of the ethical import yet may act in accordance with its dictates. The hidden norms may become conscious or explicit when an alternative or contradiction presents itself. Because language contains a culture within itself, when language changes, a culture is also changing in important ways. By examining changes in descriptions of nature, we can then perceive something of the changes in cultural values. To be aware of the interconnectedness of descriptive and normative statements is to be able to evaluate changes in the latter by observing changes in the former (Cavell 1971, pp. 148, 165).

Not only did the image of nature as nurturing mother contain ethical implications but the organic framework itself, as a conceptual system, also carried with it an associated value system. Contemporary philosophers have argued that a given normative theory is linked with certain conceptual frameworks and not with others. The framework contains within itself certain dimensions of structural and normative variation, while denying others belonging to an alternative or rival framework (Taylor 1973).

We cannot accept a framework of explanation and yet reject its associated value judgments, because the connections to the values associated with the structure are not fortuitous. New commercial and technological innovations, however, can upset and undermine an established conceptual structure. New human and social needs can threaten associated normative constraints, thereby demanding new ones.

While the organic framework was for many centuries sufficiently integrative to override commercial development and technological innovation, the acceleration of such changes throughout Western Europe during the sixteenth and seventeenth centuries began to undermine the organic unity of the cosmos and society. Because the needs and purposes of society as a whole were changing with the commercial revolution, the values associated with the organic view of nature were no longer applicable;

hence, the plausibility of the conceptual framework itself was slowly, but continuously, being threatened.

The Geocosm: The Earth As a Nurturing Mother

Not only was nature in a generalized sense seen as female, but also the earth, or geocosm, was universally viewed as a nurturing mother – sensitive, alive, and responsive to human action. The changes in imagery and attitudes relating to the earth were of enormous significance as the mechanization of nature proceeded. The nurturing earth would lose its function as a normative restraint as it changed to a dead, inanimate, physical system.

The macrocosm theory likened the cosmos to the human body, soul, and spirit with male and female reproductive components. Similarly, the geocosm theory compared the earth to the living human body, with breath, blood, sweat, and elimination systems.

For the Stoics, who flourished in Athens during the third century B.C., after the death of Aristotle, and in Rome through the first century A.D., the world itself was an intelligent organism; God and matter were synonymous. Matter was dynamic, composed of two forces: expansion and condensation – the former directed outward, the latter inward. The tension between them was the inherent force generating all substances, properties, and living forms in the cosmos and the geocosm.

Zeno of Citium (ca. 304 B.C.) and M. Tullius Cicero (106–43 B.C.) held that the world reasons, has sensation, and generates living rational beings: “The world is a living and wise being, since it produces living and wise beings” (Cicero 1775, p. 96). Every part of the universe and the earth was created for the benefit and support of another part. The earth generated and gave stability to plants, plants supported animals, and animals in turn served human beings; conversely, human skill helped to preserve these organisms. The Universe itself was created for the sake of rational beings – gods and men – but God’s foresight insured the safety and preservation of all things. Humankind was given hands to transform the earth’s resources and dominion over them: timber was to be used for houses and ships, soil for crops, iron for plows, and gold and silver for ornaments. Each part and imperfection existed for the sake and ultimate perfection of the whole.

The living character of the world organism meant not only that the stars and planets were alive, but that the earth too was pervaded by a force giving life and motion to the

living beings on it. Lucius Seneca (4 B.C.–A.D. 65), a Roman Stoic, stated that the earth’s breath nourished both the growths on its surface and the heavenly bodies above by its daily exhalations:

How could she nourish all the different roots that sink into the soil in one place and another, had she not an abundant supply of the breath of life? ... all these [heavenly bodies] draw their nourishment from materials of earth ... and are sustained ... by nothing else than the breath of the earth. ... Now the earth would be unable to nourish so many bodies ... unless it were full of breath, which it exhales from every part of it day and night. (Seneca 1910, p. 244)

The earth’s springs were akin to the human blood system; its other various fluids were likened to the mucus, saliva, sweat, and other forms of lubrication in the human body, the earth being organized “... much after the plan of our bodies, in which there are both veins and arteries, the former blood vessels, the latter air vessels. ... So exactly alike is the resemblance to our bodies in nature’s formation of the earth, that our ancestors have spoken of veins (= springs) of water.” Just as the human body contained blood, marrow, mucus, saliva, tears, and lubricating fluids, so in the earth there were various fluids. Liquids that turned hard became metals, such as gold and silver, other fluids turned into stones, bitumens, and veins of sulfur. Like the human body, the earth gave forth sweat: “There is often a gathering of thin, scattered moisture like dew, which from many points flows into one spot. The dowers call it *sweat*, because a kind of drop is either squeezed out by the pressure of the ground or raised by the heat” (Seneca 1910, pp. 126–27).

Leonardo da Vinci (1452–1519) elaborated the Greek analogy between the waters of the earth and the ebb and flow of human blood through the veins and heart:

The water runs from the rivers to the sea and from the sea to the rivers, always making the same circuit. The water is thrust from the utmost depth of the sea to the high summits of the mountains, where, finding the veins cut, it precipitates itself and returns to the sea below, mounts once more by the branching veins and then falls back, thus going and coming between high and low, sometimes inside, sometimes outside. It acts like the blood of animals which is always moving, starting from the sea of the heart and mounting to the summit of the head. (Cornford 1937, p. 330)

The earth’s venous system was filled with metals and minerals. Its veins, veinlets, seams, and canals coursed through the entire earth, particularly in the mountains.

Its humors flowed from the veinlets into the larger veins. The earth, like the human, even had its own elimination system. The tendency for both to break wind caused earthquakes in the case of the former and another type of quake in the latter:

The material cause of earth quakes ... is no doubt great abundance of wind, or store of gross and dry vapors, and spirits, fast shut up, and as a man would say, emprisoned in the caves, and dungeons of the earth; which wind, or vapors, seeking to be set at liberty, and to get them home to their natural lodgings, in a great fume, violently rush out, and as it were, break prison, which forcible eruption, and strong breath, causeth an earthquake (Gabriel Harvey quoted in Kendrick 1974, p. 542, spelling modernized).

Its bowels were full of channels, fire chambers, glory holes, and fissures through which fire and heat were emitted, some in the form of fiery volcanic exhalations, others as hot water springs. The most commonly used analogy, however, was between the female's reproductive and nurturing capacity and the mother earth's ability to give birth to stones and metals within its womb through its marriage with the sun.

In his *De Rerum Natura* of 1565, the Italian philosopher Bernardino Telesio referred to the marriage of the two great male and female powers: "We can see that the sky and the earth are not merely large parts of the world universe, but are of primary – even principal rank. ... They are like mother and father to all the others" (Telesio 1967, p. 308). The earth and the sun served as mother and father to the whole of creation: all things are "made of earth by the sun and that in the constitution of all things the earth and the sun enter respectively as mother and father." According to Giordano Bruno (1548–1600), every human being was "a citizen and servant of the world, a child of Father Sun and Mother Earth" (Bruno 1964, p. 72).

A widely held alchemical belief was the growth of the baser metals into gold in womblike matrices in the earth. The appearance of silver in lead ores or gold in silvery assays was evidence that this transformation was underway. Just as the child grew in the warmth of the female womb, so the growth of metals was fostered through the agency of heat, some places within the earth's crust being hotter and therefore hastening the maturation process. "Given to gold, silver, and the other metals [was] the vegetative powers whereby they could also reproduce themselves. For, since it was impossible for God to make anything that was not perfect, he gave to all created things, with their being, the power of multiplication,"

The sun acting on the earth nurtured not only the plants and animals but also "the metals, the broken sulfuric, bituminous, or nitrogenous rocks; ... as well as the plants and animals – if these are not made of earth by the sun, one cannot imagine of what else or by what other agent they could be made" (Telesio 1967, p. 309).

The earth's womb was the matrix or mother not only of metals but also of living things. Paracelsus compared the earth to a female whose womb nurtured all life.

Woman is like the earth and all the elements and in this sense she may be considered a matrix; she is the tree which grows in the earth and the child is like the fruit born of the tree. ... Woman is the image of the tree. Just as the earth, its fruits, and the elements are created for the sake of the tree and in order to sustain it, so the members of woman, all her qualities, and her whole nature exist for the sake of her matrix, her womb. ...

And yet woman in her own way is also a field of the earth and not at all different from it. She replaces it, so to speak: she is the field and the garden mold in which the child is sown and planted (Paracelsus 1951, p. 25).

The earth in the Paracelsian philosophy was the mother or matrix giving birth to plants, animals, and men.

The image of the earth as a nurse, which had appeared in the ancient world in Plato's *Timaeus* and the *Emerald Tablet* of Hermes Trismegistus, was a popular Renaissance metaphor. According to sixteenth-century alchemist Basil Valentine, all things grew in the womb of the earth, which was alive, and vital, and the nurse of all life:

The quickening power of the earth produces all things that grow forth from it, and he who says that the earth has no life makes a statement flatly contradicted by facts. What is dead cannot produce life and growth, seeing that it is devoid of the quickening spirit. ... This spirit is the life and soul that dwell in the earth, and are nourished by heavenly and sidereal influences. ... This spirit is itself fed by the stars and is thereby rendered capable of imparting nutriment to all things that grow and of nursing them as a mother does her child while it is yet in the womb. ... If the earth were deserted by this spirit it would be dead (Valentine 1974, p. 333).

In general, the Renaissance view was that all things were permeated by life, there being no adequate method by which to designate the inanimate from the animate. It was difficult to differentiate between living and nonliving things because of the resemblance in structures. Like plants and animals, minerals and gems were filled with small pores, tubelets, cavities, and streaks through which

they seemed to nourish themselves. Crystalline salts were compared to plant forms, but criteria by which to differentiate the living from the nonliving could not successfully be formulated. This was due not only to the vitalistic framework of the period but to striking similarities between them. Minerals were thought to possess a lesser degree of the vegetative soul, because they had the capacity for medicinal action and often took the form of various parts of plants. By virtue of the vegetative soul, minerals and stones grew in the human body, in animal bodies, within trees, in the air and water, and on the earth's surface in the open country (Adams 1938, pp. 102–36).

Popular Renaissance literature was filled with hundreds of images associating nature, matter, and the earth with the female sex. The earth was alive and considered to be a beneficent, receptive, nurturing female. For most writers, there was a mingling of traditions based on ancient sources. In general, the pervasive animism of nature created a relationship of immediacy with the human being.

An I-thou relationship in which nature was considered to be a person-writ-large was sufficiently prevalent that the ancient tendency to treat it as another human still existed. Such vitalistic imagery was thus so widely accepted by the Renaissance mind that it could effectively function as a restraining ethic.

In much the same way, the cultural belief-systems of many American Indian tribes had for centuries subtly guided group behavior toward nature. Smohalla of the Columbia Basin Tribes voiced the Indian objections to European attitudes in the mid-1800s:

You ask me to plow the ground! Shall I take a knife and tear my mother's breast? Then when I die she will not take me to her bosom to rest.

You ask me to dig for stone! Shall I dig under her skin for her bones? Then when I die I cannot enter her body to be born again.

You ask me to cut grass and make hay and sell it, and be rich like white men! But how dare I cut off my mother's hair? (quoted in McLuhan 1971, p. 56).

In the 1960s, the Native American became a symbol in the ecology movement's search for alternatives to Western exploitative attitudes. The Indian animistic belief-system and reverence for the earth as a mother were contrasted with the Judeo-Christian heritage of dominion over nature and with capitalist practices resulting in the "tragedy of the commons" (exploitation of resources available for any person's or nation's use). But

as will be seen, European culture was more complex and varied than this judgment allows. It ignores the Renaissance philosophy of the nurturing earth as well as those philosophies and social movements resistant to mainstream economic change.

Normative Constraints against the Mining of Mother Earth

If sixteenth-century descriptive statements and imagery can function as an ethical constraint and if the earth was widely viewed as a nurturing mother, did such imagery actually function as a norm against improper use of the earth? Evidence that this was indeed the case can be drawn from theories of the origins of metals and the debates about mining prevalent during the sixteenth century.

What ethical ideas were held by ancient and early modern writers on the extraction of the metals from the bowels of the living earth? The Roman compiler Pliny (A.D. 23–79), in his *Natural History*, had specifically warned against mining the depth of Mother Earth, speculating that earthquakes were an expression of her indignation at being violated in this manner:

We trace out all the veins of the earth, and yet ... are astonished that it should occasionally cleave asunder or tremble: as though, forsooth, these signs could be any other than expressions of the indignation felt by our sacred parent! We penetrate into her entrails, and seek for treasures ... as though each spot we tread upon were not sufficiently bounteous and fertile for us! (Pliny 1858, vol. 6, pp. 68–69)

He went on to argue that the earth had concealed from view that which she did not wish to be disturbed, that her resources might not be exhausted by human avarice:

For it is upon her surface, in fact, that she has presented us with these substances, equally with the cereals, bounteous and ever ready, as she is, in supplying us with all things for our benefit! It is what is concealed from our view, what is sunk far beneath her surface, objects, in fact, of no rapid formation, that urge us to our ruin, that send us to the very depth of hell ... when will be the end of thus exhausting the earth, and to what point will avarice finally penetrate! (Pliny 1858, vol. 6, p. 69)

Here, then, is a striking example of the restraining force of the beneficent mother image – the living earth in her wisdom has ordained against the mining of metals by concealing them in the depths of her womb.

While mining gold led to avarice, extracting iron was the source of human cruelty in the form of war, murder, and robbery. Its use should be limited to agriculture and those activities that contributed to the “honors of more civilized life”:

For by the aid of iron we lay open the ground, we plant trees, we prepare our vineyard trees, and we force our vines each year to resume their youthful state, by cutting away their decayed branches. It is by the aid of iron that we construct houses, cleave rocks, and perform so many other useful offices of life. But it is with iron also that wars, murders, and robberies are effected, . . . not only hand to hand, but . . . by the aid of missiles and winged weapons, now launched from engines, now hurled by the human arm, and now furnished with feathery wings. Let us therefore acquit nature of a charge that here belongs to man himself (Pliny 1858, vol. 6, p. 205).

In past history, Pliny stated, there had been instances in which laws were passed to prohibit the retention of weapons and to ensure that iron was used solely for innocent purposes, such as the cultivation of fields.

In the *Metamorphoses* (A.D. 7), the Roman poet Ovid wrote of the violence done to the earth during the age of iron, when evil was let loose in the form of trickery, slyness, plotting, swindling, and violence, as men dug into the earth's entrails for iron and gold:

The rich earth
Was asked for more; they dug into her vitals.
Pried out the wealth a kinder lord had hidden
In stygian shadow, all that precious metal,
The root of evil. They found the guilt of iron.
And gold, more guilty still. And War came forth.
(Ovid 1955, I. 137–43)

The violation of Mother Earth resulted in new forms of monsters, born of the blood of her slaughter:

Jove struck them down
With thunderbolts, and the bulk of those huge bodies
Lay on the earth, and bled, and Mother earth,
Made pregnant by that blood, brought forth new bodies,
And gave them, to recall her older offspring,
The forms of men. And this new stock was also
Contemptuous of gods, and murder-hungry
And violent. You would know they were sons of blood.
(Ovid 1955, I. 155–62)

Seneca also deplored the activity of mining, although, unlike Pliny and Ovid, he did not consider it a new vice, but one that had been handed down from ancient times.

“What necessity caused man, whose head points to the stars, to stoop, below, burying him in mines and plunging him in the very bowels of innermost earth to root up gold?” Not only did mining remove the earth's treasures, but it created “a sight to make [the] hair stand on end – huge risers and vast reservoirs of sluggish waters.” The defiling of the earth's waters was even then a noteworthy consequence of the quest for metals (Seneca 1910, p. 207–08).

These ancient strictures against mining were still operative during the early years of the commercial revolution when mining activities, which had lapsed after the fall of Rome, were once again revived. Ultimately, such constraints would have to be defeated by proponents of the new mercantilist philosophy.

An allegorical tale, reputedly sent to Paul Schneevoegel, a professor at Leipzig about 1490–1495, expressed opposition to mining encroachments into the farmlands of Lichtenstat in Saxony, Germany, an area where the new mining activities were developing rapidly. In the following allegorical vision of an old hermit of Lichtenstat, Mother Earth is dressed in a tattered green robe and seated on the right hand of Jupiter who is represented in a court case by “glib-tongued Mercury” who charges a miner with matricide. Testimony is presented by several of nature's deities:

Bacchus complained that his vines were uprooted and fed to the flames and his most sacred places desecrated. Ceres stated that her fields were devastated; Pluto that the blows of the miners resound like thunder through the depths of the earth, so that he could hardly reside in his own kingdom, the Naiad, that the subterranean waters were diverted and her fountains dried up; Charon that the volume of the underground waters had been so diminished that he was unable to float his boat on Acheron and carry the souls across to Pluto's realm, and the Fauns protested that the charcoal burners had destroyed whole forests to obtain fuel to smelt the miner's ores (Adams 1938, p. 172).

In his defense, the miner argued that the earth was not a real mother, but a wicked stepmother who hides and conceals the metals in her inner parts instead of making them available for human use.

In the old hermit's tale, we have a fascinating example of the relationship between images and values. The older view of nature as a kindly mother is challenged by the growing interests of the mining industry in Saxony, Bohemia, and the Harz Mountains, regions of newly found prosperity. The miner, representing these newer

commercial activities, transforms the image of the nurturing mother into that of a stepmother who wickedly conceals her bounty from the deserving and needy children.

Henry Cornelius Agrippa's polemic *The Vanity of Arts and Sciences* (1530) reiterated some of the moral strictures against mining found in the ancient treatises, quoting the passage from Ovid portraying miners digging into the bowels of the earth in order to extract gold and iron. "These men," he declared, "have made the very ground more hurtful and pestiferous, by how much they are more rash and venturous than they that hazard themselves in the deep to dive for pearls." Mining thus despoiled the earth's surface, infecting it, as it were, with an epidemic disease (Agrippa 1694, pp. 81–82).

If mining were to be freed of such strictures and sanctioned as a commercial activity, the ancient arguments would have to be refuted. This task was taken up by Georg Agricola (1494–1555), who wrote the first "modern" treatise on mining. His *De Re Metallica* ("On Metals," 1556) marshaled the arguments of the detractors of mining in order to refute them and thereby promote the activity itself.

According to Agricola, people who argued against the mining of the earth for metals did so on the basis that nature herself did not wish to be discovered what she herself had concealed:

The earth does not conceal and remove from our eyes those things which are useful and necessary to mankind, but, on the contrary, like a beneficent and kindly mother she yields in large abundance from her bounty and brings into the light of day the herbs, vegetables, grains, and fruits, and trees. The minerals, on the other hand, she buries far beneath in the depth of the ground, therefore they should not be sought (Agricola 1950, pp. 6–7).

This argument, taken directly from Pliny, reveals the normative force of the image of the earth as a nurturing mother.

A second argument of the detractors, reminiscent of Seneca and Agrippa, and based on Renaissance "ecological" concerns was the disruption of the natural environment and the pollutive effects of mining.

But, besides this, the strongest argument of the detractors [of mining] is that the fields are devastated by mining operations, for which reason formerly Italians were warned by law that no one should dig the earth for metals and so injure their very fertile fields, their vineyards, and

their olive groves. Also they argue that the woods and groves are cut down, for there is need of wood for timbers, machines, and the smelting of metals. And when the woods and groves are felled, then are exterminated the beasts and birds, many of which furnish a pleasant and agreeable food for man. Further, when the ores are washed, the water which has been used poisons the brooks and streams, and either destroys the fish or drives them away. Therefore the inhabitants of these regions, on account of the devastation of their fields, woods, groves, brooks, and rivers, find great difficulty in procuring the necessities of life, and by reason of the destruction of the timber they are forced to greater expense in erecting buildings. Thus it is said, it is clear to all that there is greater detriment from mining than the value of the metals which the mining produces (Agricola 1950, p. 8).

Agricola may have been alluding to laws passed by the Florentines between 1420 and 1485, preventing people from dumping lime into rivers upstream from the city for the purpose of "poisoning or catching fish," as it caused severe problems for those living downstream. The laws were enacted both to preserve the trout, "a truly noble and impressive fish" and to provide Florence with "a copious and abundant supply of such fish" (Trexler 1974, p. 463).

Such ecological consciousness, however, suffered because of the failure of law enforcement, as well as because of the continuing progress of mining activities. Agricola, in his response to the detractors of mining, pointed out the congruences in the need to catch fish and to construct metal tools for the well-being of the human race. His effort can be interpreted as an attempt to liberate the activity of mining from the constraints imposed by the organic framework and the nurturing earth image, so that new values could sanction and hasten its development.

To the argument that the woods were cut down and the price of timber therefore raised, Agricola responded that most mines occurred in unproductive, gloomy areas. Where the trees were removed from more productive sites, fertile fields could be created, the profits from which would reimburse the local inhabitants for their losses in timber supplies. Where the birds and animals had been destroyed by mining operations, the profits could be used to purchase "birds without number" and "edible beasts and fish elsewhere" and refurbish the area (Agricola 1950, p. 17).

The vices associated with the metals – anger, cruelty, discord, passion for power, avarice, and lust – should be

attributed instead to human conduct: "It is not the metals which are to be blamed, but the evil passions of men which become inflamed and ignited; or it is due to the blind and impious desires of their minds." Agricola's arguments are a conscious attempt to separate the older normative constraints from the image of the metals themselves so that new values can then surround them (Agricola 1950, p. 16).

Edmund Spenser's treatment of Mother Earth in the *Faerie Queene* (1595) was representative of the concurrent conflict of attitudes about mining the earth. Spenser entered fully into the sixteenth-century debates about the wisdom of mining, the two greatest sins against the earth being, according to him, avarice and lust. The arguments associating mining with avarice had appeared in the ancient texts of Pliny, Ovid, and Seneca, while during Spenser's lifetime the sermons of Johannes Mathesius, entitled *Beregpostilla, oder Sarepta* (1578), inveighed against the moral consequences of human greed for the wealth created by mining for metals (Kendrick 1974, pp. 548–53).

In Spenser's poem, Guyon presents the arguments against mining taken from Ovid and Agricola, while the description of Mammon's forge is drawn from the illustrations to the *De Re Metallia*. Gold and silver pollute the spirit and debase human values just as the mining operation itself pollutes the "purest streams" of the earth's womb:

Then gan a cursed hand the quiet wombe
Of his great Grandmother with steele to wound,
And the hid treasures in her sacred tombe
With Sacrilege to dig. Therein he found
Fountaines of gold and silver to abound,
Of which the matter of his huge desire
And pompous pride eftsoones he did compound.
(Spenser 1758, Bk II, Canto 7, verse 17)

The earth in Spenser's poem is passive and docile, allowing all manner of assault, violence, ill-treatment, rape by lust, and despoilment by greed. No longer a nurturer, she indiscriminately, as in Ovid's verse, supplies flesh to all life and lacking in judgment brings forth monsters and evil creatures. Her offspring fall and bite her in their own death throes. The new mining activities have altered the earth from a bountiful mother to a passive receptor of human rape (Kendrick 1974).

John Milton's *Paradise Lost* (1667) continues the Ovidian image, as Mammon leads "bands of pioneers with Spade and Pickaxe" in the wounding of the living female earth:

...By him first
Men also, and by his suggestion taught.
Ransack'd the Center, and with impious hands
Rifl'd the bowels of their mother Earth
For Treasures better hid. Soon had his crew
Op'nd into the Hill a spacious wound
And dig'd out ribs of Gold.

(Milton 1975, Bk I, 11. 684–90)

Not only did mining encourage the mortal sin of avarice, it was compared by Spenser to the second great sin, human lust. Digging into the matrices and pockets of earth for metals was like mining the female flesh for pleasure. The sixteenth- and seventeenth-century imagination perceived a direct correlation between mining and digging into the nooks and crannies of a woman's body. Both mining and sex represent for Spenser the return to animality and earthly slime. In the *Faerie Queene*, lust is the basest of all human sins. The spilling of human blood, in the rush to rape the earth of her gold, taints and muddies the once fertile fields (Kendrick 1974).

The sonnets of the poet and divine John Donne (1573–1631) also played up the popular identity of mining with human lust. The poem "Love's Alchemie" begins with the sexual image, "Some that have deeper digged loves Myne than I,/say where his centrique happiness doth lie" (Donne 1957, p. 35). The Platonic lover, searching for the ideal or "centrique" experience of love, begins by digging for it within the female flesh, an act as debasing to the human being as the mining of metals is to the female earth. Happiness is not to be obtained by avarice for gold and silver, nor can the alchemical elixir be produced from base metals. Nor does ideal love result from an ascent up the hierarchical ladder from base sexual love to the love of poetry, music, and art to the highest Platonic love of the good, virtue, and God. The same equation appears in *Elegie XVIII*, "Love's Progress":

Search every sphaere
And firmament, our Cupid is not there;
He's an infernal god and under ground,
With Pluto dwells, where gold and fire abound:
Men to such Gods, their sacrificing Coles,
Did not in Altars lay, but pits and holes,
Although we see Celestial bodies move
Above the earth, the earth we Till and love:
So we her ayres contemplate, words and heart
And Virtues; but we love the Centrique part.

(Donne 1957, p. 104, 11. 27–36)

Lust and love of the body do not lead to the celestial love of higher ideals; rather, physical love is associated with the pits and holes of the female body, just as the love of gold depends on the mining of Pluto's caverns within the female earth, "the earth we till and love." Love of the sexual "centrique" part of the female will not lead to the aery spiritual love of virtue. The fatal association of monetary revenue with human avarice, lust, and the female mine is driven home again in the last lines of the poem:

Rich Nature hath in women wisely made
Two purses, and their mouths aversely laid:
They then, which to the lower tribute owe,
That way which that Exchequer looks, must go.

Avarice and greed after money corrupted the soul, just as lust after female flesh corrupted the body.

The comparison of the female mine with the new American sources of gold, silver, and precious metals appears again in *Elegie XIX*, "Going to Bed." Here, however, Donne turns the image upside down and uses it to extoll the virtues of the mistress.

License my roaving hands, and let them go,
Before, behind, between, above, below.
O my America! my new-found-land,
My kingdome, safeliest when with one man man'd
My Myne of precious stones, My Emperie,
How blest am I in this discovering thee!

(Donne 1957, p. 107, ll. 25–30)

In these lines, the comparison functions as a sanction – the search for precious gems and metals, like the sexual exploration of nature or the female, can benefit a kingdom or a man.

Moral restraints were thus clearly affiliated with the Renaissance image of the female earth and were strengthened by associations with greed, avarice, and lust. But the analogies were double-edged. If the new values connected with mining were positive, and mining was viewed as a means to improve the human condition, as they were by Agricola, then the comparison could be turned upside down. Sanctioning mining sanctioned the rape or technological exploration of the earth. The organic framework, in which the Mother-Earth image was a moral restraint against mining, was literally being undermined by the new commercial activity.

In the seventeenth century, Francis Bacon carried the new ethic a step further through metaphors that compared miners and smiths to scientists and technologists

penetrating nature and shaping her on the anvil. Bacon's new man of science must not think that the "inquisition of nature is in any part interdicted or forbidden." Nature must be "bound into service" and made a "slave," put "in constraint" and "molded" by the mechanical arts. The "searchers and spies of nature" are to discover her plots and secrets (Bacon 1870, vol. 4, pp. 20, 287, 294).

This method, so readily applicable when nature is denoted by the female gender, degraded and made possible the exploitation of the natural environment. Nature's womb harbored secrets that through technology could be wrested from her grasp for use in the improvement of the human condition:

There is therefore much ground for hoping that there are still laid up in the womb of nature many secrets of excellent use having no affinity or parallelism with anything that is now known ... only by the method which we are now treating can they be speedily and suddenly and simultaneously presented and anticipated (quoted in Marsak 1964, p. 45).

The final step was to recover and sanction man's dominion over nature. Due to the Fall from the Garden of Eden (caused by the temptation of a woman), the human race lost its "dominion over creation." Before the Fall, there was no need for power or dominion, because Adam and Eve had been made sovereign over all other creatures. In this state of dominion, mankind was "like unto God." While some, accepting God's punishment, had obeyed the medieval strictures against searching too deeply into God's secrets, Bacon turned the constraints into sanctions. Only by "digging further and further into the mine of natural knowledge" could mankind recover that lost dominion. In this way, "the narrow limits of man's dominion over the universe" could be stretched "to their promised bounds" (Bacon 1870, vol. 4, p. 247, vol. 3, pp. 217, 219; Bacon 1964, p. 62).

Although a female's inquisitiveness may have caused man's fall from his god-given dominion, the relentless interrogation of another female, nature, could be used to regain it. As he argued in *The Masculine Birth of Time*, "I am come in very truth leading to you nature with all her children to bind her to your service and make her your slave." "We have no right," he asserted, "to expect nature to come to us." Instead, "Nature must be taken by the forelock, being bald behind." Delay and subtle argument "permit one only to clutch at nature, never to lay hold of her and capture her" (Bacon 1964, pp. 62, 129, 130).

Nature existed in three states – at liberty, in error, or in bondage:

She is either free and follows her ordinary course of development as in the heavens, in the animal and vegetable creation, and in the general array of the universe; or she is driven out of her ordinary course by the perverseness, insolence, and forwardness of matter and violence of impediments, as in the case of monsters; or lastly, she is put in constraint, molded, and made as it were new by art and the hand of man; as in things artificial (Bacon 1870, vol. 4, p. 294).

The first instance was the view of nature as immanent self-development, the nature naturing herself of the Aristotelians. This was the organic view of nature as a living, growing, self-actualizing being. The second state was necessary to explain the malfunctions and monstrosities that frequently appeared and that could not have been caused by God or another higher power acting on his instruction. Since monstrosities could not be explained by the action of form or spirit, they had to be the result of matter acting perversely. Matter in Plato's *Timaeus* was recalcitrant and had to be forcefully shaped by the demiurge. Bacon frequently described matter in female imagery, as a "common harlot." "Matter is not devoid of an appetite and inclination to dissolve the world and fall back into the old chaos." It therefore must be "restrained and kept in order by the prevailing concord of things." "The vexations of art are certainly as the bonds and handcuffs of Proteus, which betray the ultimate struggles and efforts of matter" (Bacon 1870, vol. 4, pp. 320, 325, 257).

The third instance was the case of art (*techne*) – man operating on nature to create something new and artificial. Here, "nature takes orders from man and works under his authority." Miners and smiths should become the model for the new class of natural philosophers who would interrogate and alter nature. They had developed the two most important methods of wresting nature's secrets from her, "the one searching into the bowels of nature, the other shaping nature as on an anvil." "Why should we not divide natural philosophy into two parts, the mine and the furnace?" For "the truth of nature lies hid in certain deep mines and caves," within the earth's bosom. Bacon, like some of the practically minded alchemists, would "advise the studious to sell their books and build furnaces" and, "forsaking Minerva and the Muses as barren virgins, to rely upon Vulcan" (Bacon 1870, vol. 4, pp. 343, 287, 343, 393).

The new method of interrogation was not through abstract notions, but through the instruction of the understanding "that it may in very truth dissect nature." The instruments of the mind supply suggestions, those of the hand give motion and aid the work. "By art and the hand of man," nature can then be "forced out of her natural state and squeezed and molded." In this way, "human knowledge and human power meet as one" (Bacon 1870, vol. 4, pp. 246, 29, 247).

Here, in bold sexual imagery, is the key feature of the modern experimental method – constraint of nature in the laboratory, dissection by hand and mind, and the penetration of hidden secrets – language still used today in praising a scientist's "hard facts," "penetrating mind," or the "thrust of his argument." The constraints against mining the earth have been turned into sanctions in language that legitimates the exploitation and "rape" of nature for human good.

Scientific method, combined with mechanical technology, would create a "new organon," a new system of investigation, that unified knowledge with material power. The technological discoveries of printing, gunpowder, and the magnet in the fields of learning, warfare, and navigation "help us to think about the secrets still locked in nature's bosom." "They do not, like the old, merely exert a gentle guidance over nature's course; they have the power to conquer and subdue her, to shake her to her foundations." Under the mechanical arts, "nature betrays her secrets more fully . . . than when in enjoyment of her natural liberty" (Bacon 1964, pp. 96, 93, 99).

Mechanics, which gave man power over nature, consisted in motion; that is, in "the uniting or disuniting of natural bodies." Most useful were the arts that altered the materials of things – "agriculture, cookery, chemistry, dying, the manufacture of glass, enamel, sugar, gunpowder, artificial fires, paper, and the like." But in performing these operations, one was constrained to operate within the chain of causal connections; nature could "not be commanded except by being obeyed." Only by the study, interpretation, and observation of nature could these possibilities be uncovered; only by acting as the interpreter of nature could knowledge be turned into power. Of the three grades of human ambition, the most wholesome and noble was "to endeavor to establish and extend the power and dominion of the human race itself over the universe." In this way, "the human race [could] recover that right over nature which belongs to it by divine bequest" (Bacon 1870, Vol. 4, pp. 294, 257, 32, 114, 115).

By the close of the seventeenth century, a new science of mechanics in combination with the Baconian ideal of technological mastery over Nature had helped to create the modern worldview. The core of female principles

that had for centuries subtly guided human behavior toward the earth had given way to a new ethic of exploitation. The nurturing earth mother was subdued by science and technology.

References

- Adams, Frank D. 1938. *The birth and development of the geological sciences*. New York: Dover.
- Agricola, Georg. 1556. *De re metallica*, 1556. trans. Herbert C. Hoover and Lou H. Hoover. New York: Dover.
- Agrippa, Henry C. 1694. *The vanity of arts and sciences*. London. (Orig. publ. in Latin, 1530.)
- Bacon, Francis. 1870. Works, ed. James Spedding, Robert L. Ellis, Douglas D. Heath. 14 vols. London: Longmans Green.
- Bacon, Francis. 1964. *The philosophy of Francis Bacon*, ed. and trans. Benjamin Farrington. Liverpool, England: Liverpool University Press.
- Bruno, Giordano. 1964. *The expulsion of the triumphant beast*, 1584, ed. and trans. Arthur D. Imerti. New Brunswick, N.J.: Rutgers University Press.
- Cavell, Stanley. 1971. Must we mean what we say? *Philosophy and linguistics*, ed. Colin Lyas. London: Macmillan: 131–65.
- Cicero, M. Tullius. 1775. *Of the nature of the gods*, ed. T. Francklin. London.
- Cornford, Francis M. 1937. *Plato's cosmology*. New York: Liberal Arts Press.
- Donne, John. 1957. *Poems of John Donne*, ed. Herbert Grierson. London: Oxford University Press.
- Eliade, Mircea. 1962. *The forge and the crucible*, trans. Stephan Corrin. New York: Harper & Row.
- Kendrick, Walter M. 1974. Earth of flesh, flesh of earth: Mother Earth in the *Faerie Queene*. *Renaissance Quarterly* 27:33–48.
- Marsak, Leonard M., ed. 1964. *The rise of modern science in relation to society*. London: Collier-Macmillan.
- McLuhan, T. C. 1971. *Touch the earth*. New York: Simon & Schuster.
- Merchant, Carolyn. 1980. *The Death of Nature: Women, Ecology, and the Scientific Revolution*. New York: Harper & Row.
- Milton, John. 1975. *Paradise lost*, 1667, ed., Scott Elledge. New York: W.W. Norton.
- Ovid, Publius. 1955. *Metamorphoses*, A.D. 7, trans. Rolfe Humphries. Bloomington: Indiana University Press.
- Paracelsus, Theophrastus. 1951. *Selected Writings*, ed. J. . Jacobi. Princeton, N.J.: Princeton University Press.
- Pliny. 1858. *Natural history*, ca. A.D. 23–79, trans. J. Bostock and H. T. Riley. London: Bohn.
- Seneca, Lucius. 1910. *Physical science in the time of Nero: being a translation of the Quaestiones naturales of Seneca*, ca. A.D. 65, trans. John Clarke. London: Macmillan. Spenser, Edmund. 1758. *The Faerie Queene*, 1590–95, ed. John Upton, 2 vols. London. Vol. 1.
- Taylor, Charles. 1973. Neutrality in political science. *The Philosophy of social explanation*, ed. Alan Ryan. London: Oxford: 139–70.
- Telesio, Bernardino. 1967. *De rerum natura iuxta propria principia*, 1587 (first published 1565). *Renaissance Philosophy* ed. and trans. Arturo B. Fallico and Herman Shapiro. New York: Modern Library.
- Trexler, Richard. 1974. Measures against water pollution in fifteenth-century Florence. *Viator* 5:455–67.
- Valentine, Basil. 1974. *The practice, with twelve keys*, 1678. In *The hermetic museum restored and enlarged*, trans. Arthur E. Waite. New York: Samuel Weiser.

The Deep Ecology Movement

Bill Devall

There are two great streams of environmentalism in the latter half of the twentieth century. One stream is reformist, attempting to control some of the worst of the air and water pollution and inefficient land use practices in industrialized nations and to save a few of the remaining pieces of wild-lands as “designated wilderness areas.” The other stream supports many of the reformist goals but is revolutionary, seeking a new metaphysics, epistemology, cosmology, and environmental ethics of person/planet. This paper is an intellectual archeology of the second of these streams of environmentalism, which I will call *deep ecology*.

There are several other phrases that some writers are using for the perspective I am describing in this paper. Some call it “eco-philosophy” or “foundational ecology” or the “new natural philosophy.” I use “deep ecology” as the shortest label. Although I am convinced that deep ecology is radically different from the perspective of the dominant social paradigm, I do not use the phrase “radical ecology” or “revolutionary ecology” because I think those labels have such a burden of emotive associations that many people would not hear what is being said about deep ecology because of their projection of other meanings of “revolution” onto the perspective of deep ecology.

I contend that both streams of environmentalism are reactions to the successes and excesses of the implementation of the dominant social paradigm. Although reformist environmentalism treats some of the symptoms of the environmental crisis and challenges some of the

assumptions of the dominant social paradigm (such as growth of the economy at any cost), deep ecology questions the fundamental premises of the dominant social paradigm. In the future, as the limits of reform are reached and environmental problems become more serious, the reform environmental movement will have to come to terms with deep ecology.

The analysis in the present paper was inspired by Arne Naess’ paper on “shallow and deep, long-range” environmentalism.¹ The methods used are patterned after John Rodman’s seminal critique of the resources conservation and development movement in the United States.² The data are the writings of a diverse group of thinkers who have been developing a theory of deep ecology, especially during the last quarter of a century. Relatively few of these writings have appeared in popular journals or in books published by mainstream publishers. I have searched these writings for common threads or themes such as Max Weber searched the sermons of Protestant ministers for themes which reflected from and back to the intellectual and social crisis of the emerging Protestant ethic and the spirit of capitalism.³ Several questions are addressed in this paper: What are the sources of deep ecology? How do the premises of deep ecology differ from those of the dominant social paradigm? What are the areas of disagreement between reformist environmentalism and deep ecology? What is the likely future role of the deep ecology movement?

Bill Devall, “The Deep Ecology Movement,” from *Natural Resources Journal*, 20/2 (1980), pp. 219–303, abridged.

The Dominant Paradigm

A paradigm is a shorthand description of the world view, the collection of values, beliefs, habits, and norms which form the frame of reference of a collectivity of people – those who share a nation, a religion, a social class. According to one writer, a *dominant* social paradigm is the mental image of social reality that guides expectations in a society.

The dominant paradigm in North America includes the belief that “economic growth,” as measured by the Gross National Product, is a measure of Progress, the belief that the primary goal of the governments of nation-states, after national defense, should be to create conditions that will increase production of commodities and satisfy material wants of citizens, and the belief that “technology can solve our problems.” Nature, in this paradigm, is only a storehouse of resources which should be “developed” to satisfy ever increasing numbers of humans and ever increasing demands of humans. Science is wedded to technology, the development of *techniques* for control of natural processes (such as weather modification). Change (“planned obsolescence”) is an end in itself. The new is valued over the old and the present over future generations. The goal of persons is personal satisfaction of wants and a higher standard of living as measured by possession of commodities (houses, autos, recreation vehicles, etc.).⁴ Whatever its origin, this paradigm continues to be dominant, to be preached through publicity (i.e., advertising), and to be part of the world view of most citizens in North America.⁵

For some writers, the dominant social paradigm derives from Judeo-Christian origins.⁶ For others, the excesses of air and water pollution, the demand for more and more centralization of political and economic power and the disregard for future generations, and the unwise use of natural resources derive from the ideology and structure of capitalism or from the Lockean view that property must be “improved” to make it valuable to the “owner” and to society.⁷ For others, the dominant social paradigm derives from the “scientism” of the modern West (Europe and North America) as applied to the technique of domination.⁸

Following Thomas Kuhn’s theory of the dominance of paradigms in modern science and the operation of scientists doing what he calls normal science within a paradigm, it can be argued that (1) those who subscribe to a given paradigm share a definition of what problems

are and their priorities; (2) the general heuristics, or rules of the game, for approaching problems is widely agreed upon; (3) there is a definite, underlying confidence among believers of the paradigm that solutions within the paradigm do exist; and (4) those who believe the assumptions of the paradigm may argue about the validity of data, but rarely are their debates about the definition of what the problem is or whether there are solutions or not. Proposed solutions to problems arising from following the assumptions of the paradigms are evaluated as “reasonable,” “realistic,” or “valid” in terms of the agreed upon “rules of the game.” When the data is difficult to fit to the paradigm, frequently there is dissonance disavowal, an attempt to explain away the inconsistency.⁹

It is possible for a paradigm shift to occur when a group of persons finds in comparing its data with generally accepted theory that the conclusions become “weird” when compared with expectations. In terms of the shared views of the goals, rules, and perceptions of reality in a nation, a tribe, or a religious group, for example, a charismatic leader, a social movement, or a formation of social networks of persons exploring a new social paradigm may be at the vanguard of a paradigm shift.

Reformist environmentalism in this paper refers to several social movements which are related in that the goal of all of them is to change society for “better living” without attacking the premises of the dominant social paradigm. These reform movements each defined a problem – such as need for more open space – and voluntary organizations were formed to agitate for social changes. There has also been considerable coalition building between different voluntary organizations espousing reform environmentalism. Several reformist environmental movements, including at least the following, have been active during the last century: (1) the movement to establish urban parks, designated wilderness areas, and national parks;¹⁰ (2) the movement to mitigate the health and public safety hazards created by the technology which was applied to create the so-called industrial revolution.¹¹ The Union of Concerned Scientists, for example, has brought to the attention of the general public some of the hazards to public health and safety of the use of nuclear power to generate electricity; (3) the movement to develop “proper” land-use planning. This includes the city beautiful movement of the late nineteenth century and the movement to zone and plan land use such as the currently controversial attempts to zone uses along the coastal zones;¹² (4) the resources

conservation and development movement symbolized by the philosophy of multiple use of Gifford Pinchot and the U.S. Forest Service;¹³ (5) the “back to the land” movement of the 1960s and 1970s and the “organic farming” ideology; (6) the concern with exponential growth of human population and formation of such groups as Zero Population Growth;¹⁴ (7) the “humane” and “animal liberation” movement directed at changing the attitudes and behavior of humans towards some other aspects of animals;¹⁵ and (8) the “limits to growth” movement which emphasizes we should control human population and move towards a “steady-state” or “conservator society” as rapidly as possible.¹⁶

Sources of Deep Ecology

What I call deep ecology in this paper is premised on a gestalt of person-in-nature. The person is not above or outside of nature. The person is part of creation on-going. The person cares for and about nature, shows reverence towards and respect for nonhuman nature, loves and lives with nonhuman nature, is a person in the “earth household” and “lets being be,” lets nonhuman nature follow separate evolutionary destinies. Deep ecology, unlike reform environmentalism, is not just a pragmatic, short-term social movement with a goal like stopping nuclear power or cleaning up the waterways. Deep ecology first attempts to question and present alternatives to conventional ways of thinking in the modern West. Deep ecology understands that some of the “solutions” of reform environmentalism are counter-productive. Deep ecology seeks transformation of values and social organization.

The historian Lynn White, Jr., in his influential 1967 article, “The Historical Roots of Our Ecological Crisis,” provided one impetus for the current upwelling of interest in deep ecology by criticizing what he saw as the dominant Judeo-Christian view of man *versus* nature, or man at war with nature. But there are other writers, coming from diverse intellectual and spiritual disciplines, who have provided, in the cumulative impact of their work, a profound critique of the dominant social paradigm and the “single vision” of science in the modern (post-1500) West.¹⁷

One major stream of thought influencing the development of deep ecology has been the influx of Eastern spiritual traditions into the West which began in the 1950s with the writings of such people as Alan Watts¹⁸ and Daisetz Suzuki.¹⁹ Eastern traditions provided a radically different man/nature vision than that of the

dominant social paradigm of the West. During the 1950s the so-called “beat poets” such as Alan Ginsberg seemed to be groping for a way through Eastern philosophy to cope with the violence, insanity, and alienation of people from people and people from nature they experienced in North America. Except for Gary Snyder, who developed into one of the most influential eco-philosophers of the 1970s, these beat poets, from the perspective of the 1970s, were naive in their understanding of both Eastern philosophy, ecology, and the philosophical traditions of the West.

During the late 1960s and 1970s, however, philosophers, scientists, and social critics have begun to compare Eastern and Western philosophic traditions as they relate to science, technology, and man/nature relations. Fritjoff Capra’s *Tao of Physics*, for example, emphasizes the parallels between Eastern philosophies and the theories of twentieth century physics.²⁰ Joseph Needham’s massive work, *Science and Civilization in China*, brought to the consciousness of the West the incredibly high level of science, technology, and civilization achieved in the East for millennia and made available to Western readers an alternative approach to science and human values.²¹ More recently, Needham has suggested that modern Westerners take the philosophies of the East as a spiritual and ethical basis for modern science.²² Works by Huston Smith, among others, have also contributed to this resurgent interest in relating the environmental crisis to the values expressed in the dominant Western paradigm. Smith and others have looked to the Eastern philosophies for spiritual-religious guidance.²³

Several social philosophers have written brilliant critiques of Western societies but have not presented a new metaphysical basis for their philosophy nor attempted to incorporate Eastern philosophy into their analyses. Jacques Ellul wrote on *technique* and the technological society.²⁴ Paul Goodman discussed the question “can there be a humane technology?”²⁵ Herbert Marcuse analyzed “one-dimensional man” as the prototypical “modern” urbanite.²⁶ The works of Theodore Roszak have also had considerable impact on those thinkers interested in understanding the malaise and contradictions of modern societies by examining the premises of the dominant social paradigm.²⁷

A second stream of thought contributing to deep ecology has been the re-evaluation of Native Americans (and other preliterate peoples) during the 1960s and 1970s. This is not a revival of the Romantic view of Native Americans as “noble savages” but rather an attempt to evaluate traditional religions, philosophies, and social organizations of Native Americans in objective, comparative, analytic, and critical ways.

A number of questions have been asked. How did different tribes at different times cope with changes in their natural environment (such as prolonged drought) and with technological innovation? What were the “separate realities” of Native Americans and can modern Western man *understand* and *know*, in a phenomenological sense, these “separate realities”? The experiences of Carlos Castaneda, for example, indicate it may be very difficult for modern man to develop such understanding since this requires a major perceptual shift of man/nature. Robert Ornstein concludes, “Castaneda’s experience demonstrates primarily that the Western-trained intellectual, even a ‘seeker’ is by his culture almost completely unprepared to understand esoteric traditions.”²⁸

From the many sources on Native Americans which have become available during the 1970s, I quote a statement by Luther Standing Bear, an Oglala Sioux, from *Touch the Earth* to illustrate the contrast with the modern paradigm of the West:

We do not think of the great open plains, the beautiful rolling hills, and winding streams with tangled growth, as “wild.” Only to the white man was nature a “wilderness” and only to him was the land “infested” with “wild” animals and “savage” people. To us it was tame. Earth was bountiful and we were surrounded with the blessings of the Great Mystery. Not until the hairy man from the east came and with brutal frenzy heaped injustices upon us and the families we loved was it “wild” for us. When the very animals of the forest began fleeing from his approach, then it was that for us the “wild west” began.²⁹

A third source of deep ecology is found in the “minority tradition” of Western religious and philosophical traditions. The philosopher George Sessions has claimed that:

[I]n the civilized West, a tenuous thread can be drawn through the Presocratics, Theophrastus, Lucretius, St. Francis, Bruno and other neo-Platonic mystics, Spinoza, Thoreau, John Muir, Santayana, Robinson Jeffers, Aldo Leopold, Loren Eiseley, Gary Snyder, Paul Shepard, Arne Naess, and maybe that desert rat, Edward Abbey. This minority tradition, despite differences, could have provided the West with a healthy basis for a realistic portrayal of the balance and interconnectedness of three artificially separable components (God/Nature/Man) of an untimely seamless and inseparable Whole.³⁰

Sessions, together with Arne Naess and Stuart Hampshire, has seen the philosopher Spinoza as

providing a unique fusion of an integrated man/nature metaphysic with modern European science.³¹ Spinoza’s ethics is most naturally interpreted as implying biospheric egalitarianism, and science is endorsed by Spinoza as valuable primarily for contemplation of a pantheistic, sacred universe and for spiritual discipline and development. Spinoza stands out in a unique way in opposition to other 17th century philosophers – e.g., Bacon, Descartes, and Leibniz – who were at that time laying the foundations for the technocratic-industrial social paradigm and the fulfillment of the Christian imperative that man *must* dominate and control all nature. It has been claimed by several writers that the poet-philosopher Robinson Jeffers, who lived most of his life on the California coastline at Big Sur, was Spinoza’s twentieth century “evangelist” and that Jeffers gave Spinoza’s philosophy an explicitly ecological interpretation.³²

Among contemporary European philosophers, the two most influential have been Alfred North Whitehead and Martin Heidegger.³³ In particular, more American philosophers, both those with an interest in ecological consciousness and those interested in contemporary philosophers, are discussing Heidegger’s critique of Western philosophy and contemporary Western societies. Because Heidegger’s approach to philosophy and language is so different from the language we are accustomed to in American academia, any summary of his ideas would distort the theory he is presenting. The reader is referred to the books and articles on Heidegger cited below.³⁴

A fourth source of reference for the deep ecology movement has been the scientific discipline of *ecology*. For some ecology is a science of the “home,” of the “relationships between,” while for others ecology is a perspective. The difference is important, for ecology as a science is open for co-optation by the engineers, the “technological fixers” who want to “enhance,” “manage,” or “humanize” the biosphere. At the beginning of the “environmental decade” of the 1970s, two ecologists issued a warning against this approach:

Even if we dispense with the idea that ecologists are some sort of environmental engineers and compare them to the pure physicists who provide scientific rules for engineers, do the tentative understandings we have outlined (in their article) provide a sound basis for action by those who would manage the environment? It is self-evident that they do not We submit that ecology as such probably cannot do what many people expect it to do; it cannot provide a set of “rules” of the kind needed to manage the environment.³⁵

Donald Worster, at the conclusion of his scholarly and brilliant history of ecological thinking in the West, is of the same opinion.³⁶

But ecologists do have an important task in the deep ecology movement. They can be *subversive* in their perspective. For human ecologist Paul Shepard, “the ideological status of ecology is that of a resistance movement” because its intellectual leaders such as Aldo Leopold challenge the major premises of the dominant social paradigm.³⁷ As Worster in his history of ecology points out:

[A]ll science, though primarily concerned with the “Is,” becomes implicated at some point with the “Ought.” The continuing environmental crisis makes it obvious that man’s moral visions and utopias are little more than empty enterprise when they depart too far from nature’s ways. This is the major lesson we have learned from studying the effects of men’s hands on environment. An ecological ethic of interdependence, man in nature may be the outcome of a dialectical relation between scientist and ethicist.³⁸

A final source of inspiration for the deep, long-range ecology movement is those artists who have tried to maintain a sense of place in their work.³⁹ Some artists, standing against the tide of mid-century pop art, minimalist art, and conceptual art have shown remarkable clarity and objectivity in their perception of nature. This spiritual-mystical objectivism is found, for example, in the photographs of Ansel Adams.⁴⁰ For these artists, including Morris Graves, who introduced concepts of Eastern thought (including Zen Buddhism) into his art, and Larry Gray, who reveals the eloquent light of revelation of nature in his skylines, men reaffirm their spiritual kinship with the eternity of God in nature through art.⁴¹

Themes of Deep Ecology

I indicated in preceding pages that many thinkers are questioning some of the premises of the dominant social paradigm of the modern societies. They are attempting to extend on an appropriate metaphysics, epistemology, and ethics for what I call an “ecological consciousness.” Some of these writers are very supportive of reformist environmental social movements, but they feel reform while necessary is not sufficient. They suggest a new paradigm is required and a new utopian vision of “right livelihood” and the “good society.” Utopia stimulates our thinking concerning alternatives to present society.⁴² Some persons, such as Aldo Leopold, have suggested that

we begin our thinking on utopia not with a statement of “human nature” or “needs of humans” but by trying to “think like a mountain.” This profound extending, “thinking like a mountain,” is part and parcel of the phenomenology of ecological consciousness.⁴³ Deep ecology begins with Unity rather than dualism which has been the dominant theme of Western philosophy⁴⁴

Philosopher Henryk Skolimowski, who has written several papers on the options for the ecology movements, asserts:

[W]e are in a period of ferment and turmoil, in which we have to challenge the limits of the analytical and empiricist comprehension of the world as we must work out a new conceptual and philosophical framework in which the multitude of new social, ethical, ecological, epistemological, and ontological problems can be accommodated and fruitfully tackled. The need for a new philosophical framework is felt by nearly everybody. It would be lamentable if professional philosophers were among the last to recognize this.⁴⁵

Numerous other writers on deep ecology, including William Ophuls, E. F. Schumacher, George Sessions, Theodore Roszak, Paul Shepard, Gary Snyder, and Arne Naess, have in one way or another called for a new social paradigm or a new environmental ethic. We must “think like a mountain” according to Aldo Leopold. And Roderick Nash says:

Do rocks have rights? If the time comes when to any considerable group of us such a question is no longer ridiculous, we may be on the verge of a change of value structures that will make possible measures to cope with the growing ecologic crisis. One hopes there is enough time left.⁴⁶

Any attempt to create artificially a “new ecological ethics” or a “new ontology of man’s place in nature” out of the diverse strands of thought which make up the deep ecology movement is likely to be forced and futile. However, by explicating some of the major themes embodied in and presupposed by the intellectual movement I am calling deep ecology, some groundwork can be laid for further discussion and clarification.⁴⁷ Following the general outline of perennial philosophy, the order of the following statements summarizing deep ecology’s basic principles are metaphysical-religious, psychological-epistemological, ethical, and social-economic-political. These concerns of deep ecology encompass most of reformist environmentalism’s concerns but subsume them in its fundamental critique of the dominant paradigm.

According to deep ecology:

- (1) *A new cosmic/ecological metaphysics which stresses the identity (I/thou) of humans with non-human nature is a necessary condition for a viable approach to building an eco-philosophy.* In deep ecology, the wholeness and integrity of person/planet together with the principle of what Arne Naess calls “biological equalitarianism” are the most important ideas. Man is an integral part of nature, not over or apart from nature. Man is a “plain citizen” of the biosphere, not its conqueror or manager. There should be a “democracy of all God’s creatures” according to St. Francis; or as Spinoza said, man is a “temporary and dependent mode of the whole of God/Nature.” Man flows with the system of nature rather than attempting to control all of the rest of nature. The hand of man lies lightly on the land. Man does not perfect nature, nor is man’s primary duty to make nature more efficient.⁴⁸
- (2) *An objective approach to nature is required.* This approach is found, for example, in Spinoza and in the works of Spinoza’s twentieth century disciple, Robinson Jeffers. Jeffers describes his orientation as a philosophy of “inhumanism” to draw a sharp and shocking contrast with the subjective anthropocentrism of the prevailing humanistic philosophy, art, and culture of the 20th century West.⁴⁹
- (3) *A new psychology is needed to integrate the metaphysics in the minefield of post-industrial society.* A major paradigm shift results from psychological changes of perception. The new-paradigm requires rejection of subject/object, man/nature dualisms and will require a pervasive awareness of total intermingling of the planet earth. Psychotherapy seen as adjustment to ego-oriented society is replaced by a new ideal of psychotherapy as spiritual development.⁵⁰ The new metaphysics and psychology leads logically to a posture of biospheric egalitarianism and liberation in the sense of autonomy, psychological/emotional freedom of the individual, spiritual development for *Homo sapiens*, and the right of other species to pursue their own evolutionary destinies.⁵¹
- (4) *There is an objective basis for environmentalism, but objective science in the new paradigm is different from the narrow, analytic conception of the “scientific method” currently popular.* Based on “ancient wisdom,” science should be both objective and participatory without modern science’s subject/object dualism. The main value of science is seen in its ancient perspective as contemplation of the cosmos and the enhancement of understanding of self and creation.⁵²
- (5) *There is wisdom in the stability of natural processes unchanged by human intervention.* Massive human-induced disruptions of ecosystems will be unethical and harmful to men. Design for human settlement should be with nature, not against nature.⁵³
- (6) *The quality of human existence and human welfare should not be measured only by quantity of products.* Technology is returned to its ancient place as an appropriate tool for human welfare, not an end in itself.⁵⁴
- (7) *Optimal human carrying capacity should be determined for the planet as a biosphere and for specific islands, valleys, and continents.* A drastic reduction of the rate of growth of population of *Homo sapiens* through humane birth control programs is required.⁵⁵
- (8) *Treating the symptoms of man/nature conflict, such as air or water pollution, may divert attention from more important issues and thus be counterproductive to “solving” the problems.* Economics must be subordinate to ecological-ethical criteria. Economics is to be treated as a small sub-branch of ecology and will assume a rightfully minor role in the new paradigm.⁵⁶
- (9) *A new philosophical anthropology will draw on data of hunting/gathering societies for principles of healthy, ecologically viable societies.* Industrial society is not the end toward which all societies should aim or try to aim.⁵⁷ Therefore, the notion of “reinhancing the land” with hunting-gathering, and gardening as a goal and standard for post-industrial society should be seriously considered.⁵⁸
- (10) *Diversity is inherently desirable both culturally and as a principle of health and stability of ecosystems.*⁵⁹
- (11) *There should be a rapid movement toward “soft” energy paths and “appropriate technology” and toward lifestyles which will result in a drastic decrease in per capita energy consumption in advanced industrial societies while increasing appropriate energy in decentralized villages in so-called “third world” nations.*⁶⁰ Deep ecologists are committed to rapid movement to a “steady-state” or “conservator society” both from ethical principles of harmonious integration of humans with nature and from appreciation of ecological realities.⁶¹ Integration of sophisticated, elegant, unobtrusive, ecologically sound, appropriate technology with greatly scaled down, diversified, organic, labor-intensive agriculture, hunting, and gathering is another goal.⁶²

- (12) *Education should have as its goal encouraging the spiritual development and personhood development of the members of a community, not just training them in occupations appropriate for oligarchic bureaucracies and for consumerism in advanced industrial societies.*⁶³
- (13) *More leisure as contemplation in art, dance, music, and physical skills will return play to its place as the nursery of individual fulfilment and cultural achievement.*⁶⁴
- (14) *Local autonomy and decentralization of power is preferred over centralized political control through oligarchic bureaucracies.* Even if bureaucratic modes of organization are more “efficient,” other modes of organization for small scale human communities are more “effective” in terms of the principles of deep ecology.⁶⁵
- (15) *In the interim, before the steady-state economy and radically changed social structure are instituted, vast areas of the planet biospheres will be zoned “off limits” to further industrial exploitation and large-scale human settlement; these should be protected by defensive groups of people. One ecologist has called such groups a “world wilderness police.”*⁶⁶
[...]

Notes

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- 1 Naess, “The Shallow and the Deep, Long-Range Ecology Movement,” *Inquiry* 16 (1973): 95.
- 2 Rodman, “Four Forms of Ecological Consciousness: Beyond Economics, Resource Conservation,” Pitzer College, 1977.
- 3 M. Weber, *The Protestant Ethic and the Spirit of Capitalism* (1930).
- 4 D. Pirages & P. Erlich, *Ark II: Social Response to Environmental Imperatives* (1974), 43. See also, *The Future of the Great Plains*, H. R. Doc. No. 144, 75th Cong., 1st Sess. (1937).
- 5 On the history of the paradigm see V. Ferkiss, *The Future of Technological Civilization* (1974). For a critique of the “me now” consumerism of the 1970s see C. Lasch, *The Culture of Narcissism: American Life in an Age of Diminishing Expectations* (1979). See also Manager’s Journal, “Monitoring America, Values of Americans,” *Wall St. J.* (Oct. 2, 1978).
- 6 L. White, Jr., “The Historical Roots of Our Ecological Crisis,” *Science* 155 (1967): 1203.
- 7 B. Weisberg, *Beyond Repair: The Ecology of Capitalism* (1971); England & Bluestone, “Ecology and Class Conflict,” *Rev. Radical Political Econ.* 3 (1971): 31. On Locke’s view of “property,” see Ferkiss, *supra* note 5.
- 8 L. Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (1967); and L. Mumford, *The Pentagon of Power* (1970).
- 9 T. Kuhn, *The Structure of Scientific Revolutions* (2nd ed. 1970). For criticism of Kuhn, I. Lakatos & A. Musgrave, *Criticism and the Growth of Knowledge* (1970).
- 10 R. Nash, *Wilderness and the American Mind* (rev. ed. 1973); Sax, “America’s National Parks: Their Principles, Purposes and their Prospects,” *Nat. Hist.* 35 (1976): 57.
- 11 B. Commoner, *The Closing Circle* (1971); J. Ridgeway, *The Politics of Ecology* (1970).
- 12 *Natural Resources Defense Council, Land Use Controls in the United States: A Handbook of Legal Rights of Citizens* (1977); I. McHarg, *Design with Nature* (1971).
- 13 Rodman, *supra* note 2; S. Hays, *Conservation and the Gospel of Efficiency* (1959); G. Pinchot, *Breaking New Ground* (1947).
- 14 P. Ehrlich, *The Population Bomb* (1968). See generally publications of the organization Zero Population Growth. *Population and the American Future: Report of the Commission on Population Growth and the American Future* (1972).
- 15 T. Regan & P. Singer, *Animal Rights and Human Obligation* (1976); P. Singer, *Animal Liberation* (1977).
- 16 D. L. Meadows & D. H. Meadows, *The Limits to Growth* (2nd ed. 1974); M. Mesarovic & E. Pestel, *Mankind at the Turning Point: Second Report of the Club of Rome* (1974); D. Meadows, *Alternatives to Growth* (1977). For a critique of the limits to growth model see *Models of Doom: A Critique of the Limits to Growth* (H. Cole ed. 1973); *Toward a Steady-State Economy* (H. Daly ed. 1973).
- 17 White, *supra* note 6.
- 18 A. Watts, *Psychotherapy East and West* (1975); A. Watts, *Nature, Man and Woman* (1970); A. Watts, *The Spirit of Zen: A Way of Life, Work and Art in the Far East* (1955); A. Watts, *The Essence of Alan Watts* (1977).
- 19 D. Suzuki, *Essays in Zen Buddhism* (1961).
- 20 F. Capra, *The Tao of Physics* (1975).
- 21 J. Needham, *Science and Civilization in China* (multi. vol. 1954–76).
- 22 Needham, “History and Human Values: A Chinese Perspective for World Science and Technology,” *Centennial Rev.* 20 (1976): 1.
- 23 H. Smith, *Forgotten Truth* (1976); Smith, “Tao Now: An Ecological Testament,” in *Earth Might be Fair* (I. Barbour ed. 1972).
- 24 J. Ellul, *The Technological Society* (1964).

- 25 Goodman, "Can Technology Be Humane?," in *Western Man and Environmental Ethics* (I. Barbour ed. 1973), 225.
- 26 H. Marcuse, *One-Dimensional Man* (1964).
- 27 T. Roszak, *The Making of a Counter-Culture* (1969); T. Roszak, *Where the Wasteland Ends: Politics and Transcendence in Post-Industrial Society* (1972); T. Roszak, *Unfinished Animal: The Aquarian Frontier and the Evolution of Consciousness* (1975); T. Roszak, *Person/Planet* (1978).
- 28 R. Ornstein, *The Mind Field* (1976), 105. The works of Carlos Castaneda have been influential. They include *The Teachings of Don Juan* (1968); *A Separate Reality* (1971); *Journey to Ixtlan* (1972); *Tales of Power* (1974).
- 29 L. Standing Bear, in *Touch the Earth* (T. McLuhan ed. 1971). Among the most significant and original theories of Native Americans and non-human nature see V. Deloria, *God is Red* (1975); C. Martin, *Keepers of the Game* (1978); S. Steiner, *The Vanishing White Man* (1976).
- 30 Sessions, "Spinoza and Jeffers on Man in Nature," *Inquiry* 20 (1977): 481; G. Sessions, "Spinoza, Perennial Philosophy and Deep Ecology," unpublished paper, Sierra College, 1979.
- 31 Hampshire, *Two Theories of Morality* (1977); Hampshire, *Spinoza* (1956); Naess, "Spinoza and Ecology," *Philosophia* 7 (1977): 45.
- 32 Sessions, *supra* note 30. See also A. Coffin, *Robinson Jeffers: Poet of Inhumanism* (1971); B. Hotchkiss, *Jeffers: The Siviatic Vision* (1975); R. Brophy, "Robinson Jeffers, Metaphysician of the West," unpublished paper, dept. of English, Long Reach State University, Long Beach, California, n.d.
- 33 J. Cobb, Jr., *Is It Too Late? A Theology of Ecology* (1972); C. Hartshorne, *Beyond Humanism: Essays in the Philosophy of Nature* (1937); Whitehead, *Science and the Modern World* (1925), chs. 5, 13; Griffin, "Whitehead's Contribution to the Theology of Nature," *Bucknell Rev.* 20 (1972): 95.
- 34 M. Heidegger, *The Question Concerning Technology and Other Essays* (W. Levitt trans, 1977); G. Steiner, *Martin Heidegger* (1979); V. Vycinas, *Earth and Gods: An Introduction to the Philosophy of Martin Heidegger* (1961). On the approach taken by Heidegger and the contemporary ecological consciousness, see D. LaChapelle, *Earth Wisdom* (1978), ch. 9, "Martin Heidegger and the Quest for Being." The writings of Michael Zimmerman on Heidegger are also useful, including his "Beyond 'Humanism': Heidegger's Understanding of Technology," *Listening* 12 (1977): 74. See also Zimmerman, "Marx and Heidegger on the Technological Domination of Nature," *Philosophy Today* 12 (Summer 1979): 99.
- 35 Murdoch & Connell, "All About Ecology," in *Western Man and Environmental Ethics* (I. Barbour ed. 1973).
- 36 Donald Worster, epilogue, *Nature's Economy* (1977). The importance of the thinking of Aldo Leopold should be emphasized. There are many articles interpreting Leopold's message. See, e.g., Jung, "The Splendor of the Wild: Zen and Aldo Leopold," *Atlantic Naturalist* 29 (1974): 5.
- 37 Shepard, "Introduction: Man and Ecology," in *The Subversive Science* (P. Shepard & D. McKinley eds. 1969), 1. See also Everndon, "Beyond Ecology," *N. Am. Rev.* 263 (1978): 16.
- 38 D. Worster, *supra* note 36.
- 39 Huth, "Wilderness and Art," in *Wilderness: America's Living Heritage* (D. Brower ed. 1961), 60; Shepard, "A Sense of Place," *N. Am. Rev.* 262 (1977): 22.
- 40 Adams, "The Artist and the Ideals of Wilderness," in *Wilderness: America's Living Heritage* (D. Brower ed. 1961), 60.
- 41 M. Graves, *The Drawings of Morris Graves* (1974).
- 42 M. Sibley, *Nature and Civilization: Some Implications for Politics* (1977), 251 (ch. 7, "Nature, Civilization and the Problem of Utopia") Sibley makes a case for more utopian visions from contemporary intellectuals. Although many people have been revolted by the visions of Marxism and Fascist dictatorships, "the student of politics has an obligation not only to explain and criticize but also to propose and explicate ideals. We need more utopian visions, not fewer. For if politics be that activity through which man seeks consciously and deliberately to order and control his collective life, then one of the salient questions in all politics must be: Order and control for what ends? Without utopian visions these ends cannot be stated as wholes; and even a discussion of means and strategies will be clouded unless ends are at least relatively clear" (*ibid.*, 47).
- 43 Jung, "To Save the Earth," *Philosophy Today* 8 (1975): 108.
- 44 Sessions, *supra* note 30.
- 45 Skolimowski, "Ecology Movement Re-examined," *Ecologist* 6 (1976): 298; Skolimowski, "Options for the Ecology Movement," *Biologist* 7 (1977): 318.
- 46 Nash, "Do Rocks Have Rights?," *Centre Magazine* 10 (1977): 2.
- 47 Skolimowski, *supra* note 45.
- 48 J. Needleman, *A Sense of the Cosmos* (1975), 76-7, 100-2.
- 49 Sessions, *supra* note 30. Spinoza is one of the most important philosophers for deep ecology. The new translations of Spinoza's work are absolutely essential for understanding his thought. See P. Wienpahl, *The Radical Spinoza* (1979).
- 50 R. Ornstein, *supra* note 28.
- 51 Sessions, *supra* note 30; G. Snyder, *The Old Ways* (1977).
- 52 Capra, *supra* note 20, Sessions, *supra* note 30; Needleman, *supra* note 48.
- 53 Commoner, *supra* note 11; McHarg, *supra* note 12.
- 54 Needleman, *supra* note 48; Sessions, *supra* note 30.
- 55 E. Schumacher, *Small is Beautiful, Economics as if People Mattered* (1973). See as an example of this argument P. Ehrlich, A. Ehrlich, & J. Holdren, *Ecoscience* (1977).
- 56 W. Ophuls, *Ecology and the Politics of Scarcity* (1977) Schumacher, *supra* note 55.
- 57 S. Steiner, *supra* note 29; Snyder, *supra* note 51; P. Shepard, *The Tender Carnivore and the Sacred Game* (1974).
- 58 P. Berg, *Reinhabiting a Different Kind of Country* (1978).

- 59 R. Dasmann, *A Different Kind of Country* (1968); N. Myers, *The Sinking Ark: A New Look at the Problems of Disappearing Species* (1979).
- 60 R. Dasmann, *Ecological Principles for Economic Development* (1973).
- 61 W. Ophuls, *supra* note 56. On the “steady-state” see *Toward a Steady-State Economy* (H. Daly ed. 1973).
- 62 E. Schumacher, *supra* note 55.
- 63 T. Roszak, *supra* note 27.
- 64 J. Huizinga, *Homo Ludens: The Play Element in Culture* (1950). Collier, “The Fullness of Life Through Leisure,” in *The Subversive Science* (P. Shepard & D. McKinley eds. 1969), 416.
- 65 W. Ophuls, *supra* note 56; *The Sustainable Society* (D. Pirages ed. 1977); P. Berg & R. Dasmann, *Reinhabiting a Separate Country* (1978).
- 66 “Editorial,” *Greenpeace Chronicles* 3 (March, 1979), I, No. 14. On the suggestion for a “world wilderness police” see Iltis, “Wilderness, Can Man Do Without It?,” in *Recycle This Book: Ecology, Society and Man* (J. Allan & A. Hanson eds. 1972), 167. On “earth festivals” and getting in touch with nature again, see D. LaChapelle, *supra* note 34.

The world wilderness police is a defensive force. The defense of nature against despoilers is the goal. I think the prototype of this policeman is Morel the hero of Romain Gary’s novel *The Roots of Heaven* (1958). Only after all appeals to the United Nations, to all nations, to all reasonable men have failed does Morel turn to the force of arms to defend the elephants of central Africa from poachers.

Deeper than Deep Ecology: The Eco-Feminist Connection

Ariel Salleh

...beyond that perception of otherness lies the perception of psyche, polity and cosmos, as metaphors of one another...

John Rodman¹

In what sense is eco-feminism “deeper than deep ecology”? Or is this a facile and arrogant claim? To try to answer this question is to engage in a critique of a critique, for deep ecology itself is already an attempt to transcend the shortsighted instrumental pragmatism of the resource-management approach to the environmental crisis. It argues for a new metaphysics and an ethic based on the recognition of the intrinsic worth of the nonhuman world. It abandons the hardheaded scientific approach to reality in favor of a more spiritual consciousness. It asks for voluntary simplicity in living and a non-exploitive steady-state economy. The appropriateness of these attitudes as expressed in Naess’ and Devall’s seminal papers on the deep ecology movement is indisputable.² But what is the organic basis of this paradigm shift? Where are Naess and Devall “coming from,” as they say? Is deep ecology a sociologically coherent position?

The first feature of the deep ecology paradigm introduced by Naess is replacement of the Man/Nature dualism with a *relational total-field image*, where man is not simply “in” his environment, but essentially “of” it. The deep ecologists do not appear to recognize the primal source of this destructive dualism, however, or the deeply ingrained motivational complexes which

grow out of it.³ Their formulation uses the generic term *Man* in a case where use of a general term is not applicable. Women’s monthly fertility cycle, the tiring symbiosis of pregnancy, the wrench of childbirth and the pleasure of suckling an infant, these things already ground women’s consciousness in the knowledge of being coterminous with Nature. However tacit or unconscious this identity may be for many women, bruised by derogatory patriarchal attitudes to motherhood, including modern male-identified feminist ones, it is nevertheless “a fact of life.” The deep ecology movement, by using the generic term *Man*, simultaneously presupposes the difference between the sexes in an uncritical way, and yet overlooks the significance of this difference. It overlooks the point that if women’s lived experience were recognized as meaningful and were given legitimation in our culture, it could provide an immediate “living” social basis for the alternative consciousness which the deep ecologist is trying to formulate and introduce as an abstract ethical construct. Women already, to borrow Devall’s turn of phrase, “flow with the system of nature.”

The second deep ecology premise, according to Naess is a move away from anthropocentrism, a move toward

Ariel Salleh, “Deeper than Deep Ecology: The Eco-Feminist Connection,” from *Environmental Ethics*, 6/4 (1984), pp. 339–345. Reprinted by permission of the author.

biological egalitarianism among all living species. This assumption, however, is already cancelled in part by the implicit contradiction contained in Naess' first premise. The master–slave role which marks man's relation with nature is replicated in man's relation with woman. A self-consistent biological egalitarianism cannot be arrived at unless men become open to both facets of this same urge to dominate and use. As Naess rightly, though still somewhat anthropocentrically, points out, the denial of dependence on Mother/Nature and the compensatory drive to mastery which stems from it, have only served to alienate man from his true self. Yet the means by which Naess would realize this goal of species equality is through artificial limitation of the human population. Now putting the merits of Naess' "ends" aside for the moment, as a "means" this kind of intervention in life processes is supremely rationalist and technicist, and quite at odds with the restoration of life-affirming values that is so fundamental to the ethic of deep ecology. It is also a solution that interestingly enough cuts right back into the nub of male dependence on women as mothers and creators of life – another grab at women's special potency, inadvertent though it may be.

The third main assumption of deep ecology is the *principle of diversity and symbiosis*: an attitude of live and let live, a beneficial mutual coexistence among living forms. For humans the principle favors cultural pluralism, an appreciation of the rich traditions emerging from Africa, China, the Australian Aboriginal way, and so on. These departures from anthropocentrism, and from ethnocentrism, are only partial, however, if the ecologist continues to ignore the cultural inventiveness of that other half of the human race, women; or if the ecologist unwittingly concurs in those practices which impede women's full participation in his own culture. The annihilation of seals and whales, the military and commercial genocide of tribal peoples, are unforgivable human acts, but the annihilation of women's identity and creativity by patriarchal culture continues as a fact of daily existence. The embrace of progressive attitudes toward nature does little in itself to change this.

Deep ecology is an *anti-class posture*; it rejects the exploitation of some by others, of nature by man, and of man by man, this being destructive to the realization of human potentials. However, sexual oppression and the social differentiation that this produces is not mentioned by Naess. Women again appear to be subsumed by the general category. Obviously the feminist ecological analysis is not "in principle" incompatible with the

anti-class posture of deep ecology. Its reservation is that in bypassing the parallel between the original exploitation of nature as object-and-commodity resource and of nurturant woman as object-and-commodity resource, the ecologist's anti-class stance remains only superficially descriptive, politically and historically static. It loses its genuinely deep structural critical edge. On the question of political praxis though, there is certainly no quarrel between the two positions. Devall's advocacy of loose activist networks, his tactics of nonviolent contestation, are cases in point.⁴ Deep ecology and feminism see change as gradual and piecemeal; the violence of revolution imposed by those who claim "to know" upon those who "do not know" is an anathema to both.

The fight against *pollution and resource depletion* is, of course, a fundamental environmental concern. And it behooves the careful activist to see that measures taken to protect resources do not have hidden or long-term environmental costs which outweigh their usefulness. As Naess observes, such costs may increase class inequalities. In this context he also comments on the "after hours" environmentalist syndrome frequently exhibited by middle-class professionals. Devall, too, criticizes what he calls "the bourgeois liberal reformist elements" in the movement – Odum, Brower, and Levins, who are the butt of this remark. A further comment that might be made in this context, however, is that women, as keepers of *oikos*, are in a good position to put a round-the-clock ecological consciousness into practice. Excluded as many still are from full participation in the social-occupational structure, they are less often compromised by the material and status rewards which may silence the activist professional. True, the forces of capitalism have targeted women at home as consumer par excellence, but this potential can just as well be turned against the systematic waste of industrialism. The historical significance of the domestic labor force in moves to recycle, boycott, and so on, has been grossly underestimated by ecologists.

At another level of analysis entirely, but again on the issue of pollution, the objectivist attitude of most ecological writing and the tacit mind-body dualism which shapes this, means that its comprehension of "pollution" is framed exclusively in external material terms. The feminist consciousness, however, is equally concerned to eradicate ideological pollution, which centuries of patriarchal conditioning have subjected us all to, women and men. Men, who may derive rather more ego gratification from the patriarchal status quo than women, are on the whole less motivated to change this system than

women are. But radical women's consciousness-raising groups are continually engaging in an intensely reflexive political process; one that works on the psychological contamination produced by the culture of domination and helps women to build new and confident selves. As a foundation for social and political change, this work of women is a very thorough preparation indeed.

The sixth premise of Naess' deep ecology is the *complexity, not complication principle*. It favors the preservation of complex interrelations which exist between parts of the environment, and inevitably, it involves a systems theoretical orientation. Naess' ideal is a complex economy supported by division, but not fragmentation of labor; worker alienation to be overcome by opportunities for involvement in mental and manual, specialized and nonspecialized tasks. There are serious problems of implementation attached to this vaguely sketched scenario, but beyond this, the supporting arguments are also weak, not to say very uncritical in terms of the stated aims of the deep ecology movement. The references to "soft future research," "implementation of policies," "exponential growth of technical skill and intervention," are highly instrumental statements which collapse back into the shallow ecology paradigm and its human chauvinist ontology. What appears to be happening here is this: the masculine sense of self-worth in our culture has become so entrenched in scientific habits of thought, that it is very hard for men to argue persuasively without recourse to terms like these for validation. Women, on the other hand, socialized as they are for a multiplicity of contingent tasks and practical labor functions in the home and out, do not experience the inhibiting constraints of status validation to the same extent. The traditional feminine role runs counter to the exploitive technical rationality which is currently the requisite masculine norm. In place of the disdain that the feminine role receives from all quarters, "the separate reality" of this role could well be taken seriously by ecologists and reexamined as a legitimate source of alternative values. As Snyder suggests, men should try out roles which are not highly valued in society; and one might add, particularly this one, for herein lies the basis of a genuinely grounded and nurturant environmentalism. As one eco-feminist has put it:

If someone has laid the foundations of a house, it would seem sensible to build on those foundations, rather than import a prefabricated structure with no foundations to put beside it.⁵

A final assumption of deep ecology described by Naess is the importance of *local autonomy and decentralization*. He points out that the more dependent a region is on resources from outside its locality, the more vulnerable it is ecologically and socially: for self-sufficiency to work, there must be political decentralization. The drive to ever larger power blocs and hierarchical political structures is an invariant historical feature of patriarchal societies, the expression of an impulse to compete and dominate the Other. But unless men can come to grips honestly with this impulse within themselves, its dynamic will impose itself over and over again on the anatomy of revolution. Women, if left to their own devices, do not like to organize themselves in this way. Rather they choose to work in small, intimate collectivities, where the spontaneous flow of communication "structures" the situation. There are important political lessons for men to learn from observing and participating in this kind of process. And until this learning takes place, notions like autonomy and decentralization are likely to remain hollow, fetishistic concepts.

Somewhat apologetically, Naess talks about his ecological principles as "intuitive formulations" needing to be made more "precise." They are a "condensed codification" whose tenets are clearly "normative"; they are "ecophilosophical," containing not only norms but "rules," "postulates," "hypotheses," and "policy" formulations. The deep ecology paradigm takes the form of "subsets" of "derivable premises," including at their most general level "logical and mathematical deductions." In other words, Naess' overview of ecosophy is a highly academic and positivized one, dressed up in the jargon of current science-dominated standards of acceptability. Given the role of this same cultural scientism in industry and policy formulation, its agency in the very production of the eco-crisis itself, Naess' stance here is not a rationally consistent one. It is a solution trapped in the given paradigm. The very term *norm* implies the positivist split between fact and value, the very term *policy* implies a class separation of rulers and ruled. Devall, likewise, seems to present purely linear solutions – "an objective approach," "a new psychology"; the language of cost-benefit analysis, "optimal human carrying capacity," and the language of science, "data on hunter gatherers," both creep back in. Again, birth "control programs" are recommended, "zoning," and "programming," the language of technocratic managerialism. "Principles" are introduced and the imperative *should* rides roughshod through the text. The call for a new epistemology is somehow dissociated in this writing from the old metaphysical presuppositions which prop up the argument itself.

In arguing for an eco-phenomenology, Devall certainly attempts to bypass this ideological noose – “Let us think like a mountain,” he says – but again, the analysis here rests on what is called “a gestalt of person-in-nature”: a conceptual effort, a grim intellectual determination “to care”; “to show reverence” for Earth’s household and “to let” nature follow “its separate” evolutionary path. The residue of specular instrumentalism is overpowering; yet the conviction remains that a radical transformation of social organization and values is imminent: a challenge to the fundamental premises of the dominant social paradigm. There is a concerted effort to rethink Western metaphysics, epistemology, and ethics here, but this “rethink” remains an idealism closed in on itself because it fails to face up to the uncomfortable psychosexual origins of our culture and its crisis. Devall points by turn to White’s thesis that the environmental crisis derives from the Judeo-Christian tradition, to Weisberg’s argument that capitalism is the root cause, to Mumford’s case against scientism and technics. But for the eco-feminist, these apparently disparate strands are merely facets of the same motive to control which runs a continuous thread through the history of patriarchy. So, it has been left to the women of our generation to do the theoretical housework here – to lift the mat and sweep under it exposing the deeply entrenched epistemological complexes which shape not only current attitudes to the natural world, but attitudes to social and sexual relations as well.⁶ The accidental convergence of feminism and ecology at this point in time is no accident.

Sadly, from the eco-feminist point of view, deep ecology is simply another self-congratulatory reformist move; the transvaluation of values it claims for itself is

quite peripheral. Even the Eastern spiritual traditions, whose authority deep ecology so often has recourse to – since these dissolve the repressive hierarchy of Man/Nature/God – even these philosophies pay no attention to the inherent Man/Woman hierarchy contained within this metaphysic of the Whole. The suppression of the *feminine* is truly an all pervasive human universal. It is not just a suppression of real, live, empirical women, but equally the suppression of the feminine aspects of men’s own constitution which is the issue here. Watts, Snyder, Devail, all want education for the spiritual development of “personhood.” This is the self-estranged male reaching for the original androgynous natural unity within himself. The deep ecology movement is very much a spiritual search for people in a barren secular age; but how much of this quest for self-realization is driven by ego and will? If, on the one hand, the search seems to be stuck at an abstract cognitive level, on the other, it may be led full circle and sabotaged by the ancient compulsion to fabricate perfectibility. Men’s ungrounded restless search for the alienated Other part of themselves has led to a society where not life itself, but “change,” bigger and better, whiter than white, has become the consumptive end. The dynamic to overcome this alienation takes many forms in the post-capitalist culture of narcissism – material and psychological consumption like karma-cola, clown workshops, sensitivity training, bio-energetics, gay lib, and surfside six. But the deep ecology movement will not truly happen until men are brave enough to rediscover and to love the woman inside themselves. And we women, too, have to be allowed to love what we are, if we are to make a better world.

Notes

- 1 John Rodman, “The Liberation of Nature?” *Inquiry* 20 (1977): 83–145; quoted by Bill Devall in “The Deep Ecology Movement,” *Natural Resources Journal* 20 (1980): 317.
- 2 Arne Naess, “The Shallow and the Deep, Long-Range Ecology Movement,” *Inquiry* 16 (1973): 95–100; Bill Devall, “The Deep Ecology Movement,” pp. 299–322.
- 3 See Ariel Kay Salleh, “Of Portnoy’s Complaint and Feminist Problematics,” *Australian and New Zealand Journal of Sociology* 17 (1981): 4–13; “Ecology and Ideology,” *Chain Reaction* 31 (1983): 20–21; “From Feminism to Ecology,” *Social Alternatives* 4 (1984): 8–12.
- 4 And on this connection, see Ariel Kay Salleh, “The Growth of Eco-feminism,” *Chain Reaction* 36 (1984): 26–28; also comments in “Whither the Green Machine?” *Australian Society* 3 (1984): 15–17.
- 5 Ann Pettitt, “Women Only at Greenham,” *Undercurrents* 57 (1982): 20–21.
- 6 Some of this feminist writing is discussed in Ariel Kay Salleh, “Contributions to the Critique of Political Epistemology,” *Thesis Eleven* 8 (1984): 23–43.

In Defense of Posthuman Dignity

Nick Bostrom

Transhumanists vs. Bioconservatives

Transhumanism is a loosely defined movement that has developed gradually over the past two decades, and can be viewed as an outgrowth of secular humanism and the Enlightenment. It holds that current human nature is improvable through the use of applied science and other rational methods, which may make it possible to increase human health-span, extend our intellectual and physical capacities, and give us increased control over our own mental states and moods.¹ Technologies of concern include not only current ones, like genetic engineering and information technology, but also anticipated future developments such as fully immersive virtual reality, machine-phase nanotechnology, and artificial intelligence.

Transhumanists promote the view that human enhancement technologies should be made widely available, and that individuals should have broad discretion over which of these technologies to apply to themselves (morphological freedom), and that parents should normally get to decide which reproductive technologies to use when having children (reproductive freedom).² Transhumanists believe that, while there are hazards that need to be identified and avoided, human enhancement technologies will offer enormous potential for deeply valuable and humanly beneficial uses. Ultimately, it is possible that such enhancements may make us, or

our descendants, ‘posthuman’, beings who may have indefinite health-spans, much greater intellectual faculties than any current human being – and perhaps entirely new sensibilities or modalities – as well as the ability to control their own emotions. The wisest approach *vis-à-vis* these prospects, argue transhumanists, is to embrace technological progress, while strongly defending human rights and individual choice, and taking action specifically against concrete threats, such as military or terrorist abuse of bioweapons, and against unwanted environmental or social side-effects.

In opposition to this transhumanist view stands a bioconservative camp that argues against the use of technology to modify human nature. Prominent bioconservative writers include Leon Kass, Francis Fukuyama, George Annas, Wesley Smith, Jeremy Rifkin, and Bill McKibben. One of the central concerns of the bioconservatives is that human enhancement technologies might be ‘dehumanizing’. The worry, which has been variously expressed, is that these technologies might undermine our human dignity or inadvertently erode something that is deeply valuable about being human but that is difficult to put into words or to factor into a cost-benefit analysis. In some cases (for example, Leon Kass) the unease seems to derive from religious or crypto-religious sentiments, whereas for others (for example, Francis Fukuyama) it stems from secular grounds. The best approach, these bioconservatives argue, is to implement global bans on swathes of promising

Nick Bostrom, “In Defence of Posthuman Dignity,” from *Bioethics*, 19/3 (2005), pp. 202–214. Reprinted by permission of John Wiley & Sons, Ltd.

human enhancement technologies to forestall a slide down a slippery slope towards an ultimately debased, posthuman state.

While any brief description necessarily skirts significant nuances that differentiate between the writers within the two camps, I believe the above characterization nevertheless highlights a principal fault line in one of the great debates of our times: how we should look at the future of humankind and whether we should attempt to use technology to make ourselves 'more than human'. This paper will distinguish two common fears about the posthuman and argue that they are partly unfounded and that, to the extent that they correspond to real risks, there are better responses than trying to implement broad bans on technology. I will make some remarks on the concept of dignity, which bioconservatives believe to be imperiled by coming human enhancement technologies, and suggest that we need to recognize that not only humans in their current form, but posthumans too could have dignity.

Two Fears about the Posthuman

The prospect of posthumanity is feared for at least two reasons. One is that the state of being posthuman might in itself be degrading, so that by becoming posthuman we might be harming ourselves. Another is that posthumans might pose a threat to 'ordinary' humans. (I shall set aside a third possible reason, that the development of posthumans might offend some supernatural being.)

The most prominent bioethicist to focus on the first fear is Leon Kass:

Most of the given bestowals of nature have their given species-specified natures: they are each and all of a given *sort*. Cockroaches and humans are equally bestowed but differently natured. To turn a man into a cockroach – as we don't need Kafka to show us – would be dehumanizing. To try to turn a man into more than a man might be so as well. We need more than generalized appreciation for nature's gifts. We need a particular regard and respect for the special gift that is our own given nature.³

Transhumanists counter that nature's gifts are sometimes poisoned and should not always be accepted. Cancer, malaria, dementia, aging, starvation, unnecessary suffering, and cognitive shortcomings are all among the presents that we would wisely refuse. Our own species-specified

natures are a rich source of much of the thoroughly unrespectable and unacceptable – susceptibility for disease, murder, rape, genocide, cheating, torture, racism. The horrors of nature in general, and of our own nature in particular, are so well documented⁴ that it is astonishing that somebody as distinguished as Leon Kass should still in this day and age be tempted to rely on the natural as a guide as to what is desirable or normatively right. We should be grateful that our ancestors were not swept away by the Kassian sentiment, or we would still be picking lice off each other's backs. Rather than deferring to the natural order, transhumanists maintain that we can legitimately reform ourselves and our natures in accordance with humane values and personal aspirations.

If one rejects nature as a general criterion of the good, as most thoughtful people nowadays do, one can of course still acknowledge that particular ways of modifying human nature would be debasing. Not all change is progress. Not even all well-intentioned technological intervention in human nature would be on balance beneficial. Kass goes far beyond these truisms, however, when he declares that utter dehumanization lies in store for us as the inevitable result of our obtaining technical mastery over our own nature:

The final technical conquest of his own nature would almost certainly leave mankind utterly enfeebled. This form of mastery would be identical with utter dehumanization. Read Huxley's *Brave New World*, read C. S. Lewis's *Abolition of Man*, read Nietzsche's account of the last man, and then read the newspapers. Homogenization, mediocrity, pacification, drug-induced contentment, debasement of taste, souls without loves and longings – these are the inevitable results of making the essence of human nature the last project of technical mastery. In his moment of triumph, Promethean man will become a contented cow.⁵

The fictional inhabitants of *Brave New World*, to pick the best known of Kass's examples, are admittedly short on dignity (in at least one sense of the word). But the claim that this is the *inevitable* consequence of our obtaining technological mastery over human nature is exceedingly pessimistic – and unsupported – if understood as a futuristic prediction, and false if construed as a claim about metaphysical necessity.

There are many things wrong with the fictional society that Huxley described. It is static, totalitarian, caste-bound; its culture is a wasteland. The brave new worlders themselves are a dehumanized and undignified lot.

Yet posthumans they are not. Their capacities are not super-human but in many respects substantially inferior to our own. Their life expectancy and physique are quite normal, but their intellectual, emotional, moral, and spiritual faculties are stunted. The majority of the brave new worlders have various degrees of engineered mental retardation. And everyone, save the ten world controllers (along with a miscellany of primitives and social outcasts who are confined to fenced preservations or isolated islands), are barred or discouraged from developing individuality, independent thinking, and initiative, and are conditioned not to desire these traits in the first place. *Brave New World* is not a tale of human enhancement gone amok, but is rather a tragedy of technology and social engineering being deliberately used to cripple moral and intellectual capacities – the exact antithesis of the transhumanist proposal.

Transhumanists argue that the best way to avoid a *Brave New World* is by vigorously defending morphological and reproductive freedoms against any would-be world controllers. History has shown the dangers in letting governments curtail these freedoms. The last century's government-sponsored coercive eugenics programs, once favored by both the left and the right, have been thoroughly discredited. Because people are likely to differ profoundly in their attitudes towards human enhancement technologies, it is crucial that no single solution be imposed on everyone from above, but that individuals get to consult their own consciences as to what is right for themselves and their families. Information, public debate, and education are the appropriate means by which to encourage others to make wise choices, not a global ban on a broad range of potentially beneficial medical and other enhancement options.

The second fear is that there might be an eruption of violence between unaugmented humans and posthumans. George Annas, Lori Andrews, and Rosario Isasi have argued that we should view human cloning and all inheritable genetic modifications as 'crimes against humanity' in order to reduce the probability that a posthuman species will arise, on grounds that such a species would pose an existential threat to the old human species:

The new species, or 'posthuman,' will likely view the old 'normal' humans as inferior, even savages, and fit for slavery or slaughter. The normals, on the other hand, may see the posthumans as a threat and if they can, may engage in a preemptive strike by killing the posthumans before they

themselves are killed or enslaved by them. It is ultimately this predictable potential for genocide that makes species-altering experiments potential weapons of mass destruction, and makes the unaccountable genetic engineer a potential bioterrorist.⁶

There is no denying that bioterrorism and unaccountable genetic engineers developing increasingly potent weapons of mass destruction pose a serious threat to our civilization. But using the rhetoric of bioterrorism and weapons of mass destruction to cast aspersions on therapeutic uses of biotechnology to improve health, longevity, and other human capacities is unhelpful. The issues are quite distinct. Reasonable people can be in favor of strict regulation of bioweapons, while promoting beneficial medical uses of genetics and other human enhancement technologies, including inheritable and 'species-altering' modifications.

Human society is always at risk of some group deciding to view another group of humans as being fit for slavery or slaughter. To counteract such tendencies, modern societies have created laws and institutions, and endowed them with powers of enforcement, that act to prevent groups of citizens from enslaving or slaughtering one another. The efficacy of these institutions does not depend on all citizens having equal capacities. Modern, peaceful societies can have large numbers of people with diminished physical or mental capacities along with many other people who may be exceptionally physically strong or healthy or intellectually talented in various ways. Adding people with technologically enhanced capacities to this already broad distribution of ability would not need to rip society apart or trigger genocide or enslavement.

The assumption that inheritable genetic modifications or other human enhancement technologies would lead to two distinct and separate species should also be questioned. It seems much more likely that there would be a continuum of differently modified or enhanced individuals, which would overlap with the continuum of as-yet unenhanced humans. The scenario in which 'the enhanced' form a pact and then attack 'the naturals' makes for exciting science fiction, but is not necessarily the most plausible outcome. Even today, the segment containing the tallest ninety percent of the population could, in principle, get together and kill or enslave the shorter decile. That this does not happen suggests that a well-organized society can hold together even if it contains many possible coalitions of people sharing some attribute such that, if they ganged up, they would be capable of exterminating the rest.

To note that the extreme case of a war between humans and posthumans is not the most likely scenario is not to say that there are no legitimate social concerns about the steps that may take us closer to posthumanity. Inequity, discrimination, and stigmatization – against, or on behalf of, modified people – could become serious issues. Transhumanists would argue that these (potential) social problems call for social remedies. One example of how contemporary technology can change important aspects of someone's identity is sex reassignment. The experiences of transsexuals show that Western culture still has work to do in becoming more accepting of diversity. This is a task that we can begin to tackle today by fostering a climate of tolerance and acceptance towards those who are different from ourselves. Painting alarmist pictures of the threat from future technologically modified people, or hurling preemptive condemnations of their necessarily debased nature, is not the best way to go about it.

What about the hypothetical case in which someone intends to create, or turn themselves into, a being of such radically enhanced capacities that a single one or a small group of such individuals would be capable of taking over the planet? This is clearly not a situation that is likely to arise in the imminent future, but one can imagine that, perhaps in a few decades, the prospective creation of superintelligent machines could raise this kind of concern. The would-be creator of a new life form with such surpassing capabilities would have an obligation to ensure that the proposed being is free from psychopathic tendencies and, more generally, that it has humane inclinations. For example, a future artificial intelligence programmer should be required to make a strong case that launching a purportedly human-friendly super-intelligence would be safer than the alternative. Again, however, this (currently) science fiction scenario must be clearly distinguished from our present situation and our more immediate concern with taking effective steps towards incrementally improving human capacities and health-span.

Is Human Dignity Incompatible with Posthuman Dignity?

Human dignity is sometimes invoked as a polemical substitute for clear ideas. This is not to say that there are no important moral issues relating to dignity, but it does mean that there is a need to define what one has in mind when one uses the term. Here, we shall consider two different senses of dignity:

- (1) Dignity as moral status, in particular the inalienable right to be treated with a basic level of respect.
- (2) Dignity as the quality of being worthy or honorable; worthiness, worth, nobleness, excellence.⁷

On both these definitions, dignity is something that a posthuman could possess. Francis Fukuyama, however, seems to deny this and warns that giving up on the idea that dignity is unique to human beings – defined as those possessing a mysterious essential human quality he calls 'Factor X'⁸ – would invite disaster:

Denial of the concept of human dignity – that is, of the idea that there is something unique about the human race that entitles every member of the species to a higher moral status than the rest of the natural world – leads us down a very perilous path. We may be compelled ultimately to take this path, but we should do so only with our eyes open. Nietzsche is a much better guide to what lies down that road than the legions of bioethicists and casual academic Darwinians that today are prone to give us moral advice on this subject.⁹

What appears to worry Fukuyama is that introducing new kinds of enhanced person into the world might cause some individuals (perhaps infants, or the mentally handicapped, or unenhanced humans in general) to lose some of the moral status that they currently possess, and that a fundamental precondition of liberal democracy, the principle of equal dignity for all, would be destroyed.

The underlying intuition seems to be that instead of the famed 'expanding moral circle', what we have is more like an oval, whose shape we can change but whose area must remain constant. Thankfully, this purported conservation law of moral recognition lacks empirical support. The set of individuals accorded full moral status by Western societies has actually increased, to include men without property or noble decent, women, and non-white peoples. It would seem feasible to extend this set further to include future posthumans, or, for that matter, some of the higher primates or human-animal chimaeras, should such be created – and to do so without causing any compensating shrinkage in another direction. (The moral status of problematic borderline cases, such as foetuses or late-stage Alzheimer patients, or the brain-dead, should perhaps be decided separately from the issue of technologically modified humans or novel artificial life forms.) Our own role in this process need not be that of passive bystanders. We can work to create

more inclusive social structures that accord appropriate moral recognition and legal rights to all who need them, be they male or female, black or white, flesh or silicon.

Dignity in the second sense, as referring to a special excellence or moral worthiness, is something that current human beings possess to widely differing degrees. Some excel far more than others do. Some are morally admirable; others are base and vicious. There is no reason for supposing that posthuman beings could not also have dignity in this second sense. They may even be able to attain higher levels of moral and other excellence than any of us humans. The fictional brave new worlders, who were subhuman rather than posthuman, would have scored low on this kind of dignity, and partly for that reason they would be awful role models for us to emulate. But surely we can create more uplifting and appealing visions of what we may aspire to become. There may be some who would transform themselves into degraded posthumans – but then some people today do not live very worthy human lives. This is regrettable, but the fact that some people make bad choices is not generally a sufficient ground for rescinding people's right to choose. And legitimate countermeasures are available: education, encouragement, persuasion, social and cultural reform. These, not a blanket prohibition of all posthuman ways of being, are the measures to which those bothered by the prospect of debased posthumans should resort. A liberal democracy should normally permit incursions into morphological and reproductive freedoms only in cases where somebody is abusing these freedoms to harm another person.

The principle that parents should have broad discretion to decide on genetic enhancements for their children has been attacked on the grounds that this form of reproductive freedom would constitute a kind of parental tyranny that would undermine the child's dignity and capacity for autonomous choice; for instance, by Hans Jonas:

Technological mastered nature now again includes man who (up to now) had, in technology, set himself against it as its master ... But whose power is this – and over whom or over what? Obviously the power of those living today over those coming after them, who will be the defenseless other side of prior choices made by the planners of today. The other side of the power of today is the future bondage of the living to the dead.¹⁰

Jonas is relying on the assumption that our descendants, who will presumably be far more technologically advanced than we are, would nevertheless be defenseless against our machinations to expand their capacities. This

is almost certainly incorrect. If, for some inscrutable reason, they decided that they would prefer to be less intelligent, less healthy, and lead shorter lives, they would not lack the means to achieve these objectives and frustrate our designs.

In any case, if the alternative to parental choice in determining the basic capacities of new people is entrusting the child's welfare to nature, that is blind chance, then the decision should be easy. Had Mother Nature been a real parent, she would have been in jail for child abuse and murder. And transhumanists can accept, of course, that just as society may in exceptional circumstances override parental autonomy, such as in cases of neglect or abuse, so too may society impose regulations to protect the child-to-be from genuinely harmful genetic interventions – but not because they represent choice rather than chance.

Jürgen Habermas, in a recent work, echoes Jonas' concern and worries that even the mere *knowledge* of having been intentionally made by another could have ruinous consequences:

We cannot rule out that knowledge of one's own hereditary features as programmed may prove to restrict the choice of an individual's life, and to undermine the essentially symmetrical relations between free and equal human beings.¹¹

A transhumanist could reply that it would be a mistake for an individual to believe that she has no choice over her own life just because some (or all) of her genes were selected by her parents. She would, in fact, have as much choice as if her genetic constitution had been selected by chance. It could even be that she would enjoy significantly *more* choice and autonomy in her life, if the modifications were such as to expand her basic capability set. Being healthy, smarter, having a wide range of talents, or possessing greater powers of self-control are blessings that tend to open more life paths than they block.

Even if there were a possibility that some genetically-modified individuals might fail to grasp these points and thus might feel oppressed by their knowledge of their origin, that would be a risk to be weighed against the risks incurred by having an unmodified genome, risks that can be extremely grave. If safe and effective alternatives were available, it would be irresponsible to risk starting someone off in life with the misfortune of congenitally diminished basic capacities or an elevated susceptibility to disease.

Why We Need Posthuman Dignity

Similarly ominous forecasts were made in the seventies about the severe psychological damage that children conceived through *in vitro* fertilization would suffer upon learning that they originated from a test tube – a prediction that turned out to be entirely false. It is hard to avoid the impression that some bias or philosophical prejudice is responsible for the readiness with which many bioconservatives seize on even the flimsiest of empirical justifications for banning human enhancement technologies of certain types but not others. Suppose it turned out that playing Mozart to pregnant mothers improved the child's subsequent musical talent. Nobody would argue for a ban on Mozart-in-the-womb on grounds that we cannot rule out that some psychological woe might befall the child once she discovers that her facility with the violin had been prenatally 'programmed' by her parents. Yet when, for example, it comes to genetic enhancements, eminent bioconservative writers often put forward arguments that are not so very different from this parody as weighty, if not conclusive, objections. To transhumanists, this looks like doublethink. How can it be that to bioconservatives almost any anticipated downside, predicted perhaps on the basis of the shakiest pop-psychological theory, so readily achieves that status of deep philosophical insight and knockdown objection against the transhumanist project?

Perhaps a part of the answer can be found in the different attitudes that transhumanists and bioconservatives have towards posthuman dignity. Bioconservatives tend to deny posthuman dignity and view posthumanity as a threat to human dignity. They are therefore tempted to look for ways to denigrate interventions that are thought to be pointing in the direction of more radical future modifications that may eventually lead to the emergence of those detestable posthumans. But unless this fundamental opposition to the posthuman is openly declared as a premise of their argument, this then forces them to use a double standard of assessment whenever particular cases are considered in isolation: for example, one standard for germ-line genetic interventions and

another for improvements in maternal nutrition (an intervention presumably not seen as heralding a post-human era).

Transhumanists, by contrast, see human and post-human dignity as compatible and complementary. They insist that dignity, in its modern sense, consists in what we are and what we have the potential to become, not in our pedigree or our causal origin. What we are is not a function solely of our DNA but also of our technological and social context. Human nature in this broader sense is dynamic, partially human-made, and improvable. Our current extended phenotypes (and the lives that we lead) are markedly different from those of our hunter-gatherer ancestors. We read and write, we wear clothes, we live in cities, we earn money and buy food from the supermarket, we call people on the telephone, watch television, read newspapers, drive cars, file taxes, vote in national elections, women give birth in hospitals, life-expectancy is three times longer than in the Pleistocene, we know that the Earth is round and that stars are large gas clouds lit from inside by nuclear fusion, and that the universe is approximately 13.7 billion years old and enormously big. In the eyes of a hunter-gatherer, we might already appear 'posthuman'. Yet these radical extensions of human capabilities – some of them biological, others external – have not divested us of moral status or dehumanized us in the sense of making us generally unworthy and base. Similarly, should we or our descendants one day succeed in becoming what relative to current standards we may refer to as posthuman, this need not entail a loss dignity either.

From the transhumanist standpoint, there is no need to behave as if there were a deep moral difference between technological and other means of enhancing human lives. By defending posthuman dignity we promote a more inclusive and humane ethics, one that will embrace future technologically modified people as well as humans of the contemporary kind. We also remove a distortive double standard from the field of our moral vision, allowing us to perceive more clearly the opportunities that exist for further human progress.

Notes

1 N. Bostrom. 2003. The Transhumanist FAQ, v. 2.1. *World Transhumanist Association*. Webpage: www.transhumanism.org/resources/FAQv21.pdf

2 N. Bostrom. Human Genetic Enhancements: A Transhumanist Perspective. *Journal of Value Inquiry*, Vol. 37, No. 4, pp. 493–506.

- 3 L. Kass. Ageless Bodies, Happy Souls: Biotechnology and the Pursuit of Perfection. *The New Atlantis* 2003; 1, pp. 9-28.
- 4 See e.g. J. Glover. 2001. *Humanity: A Moral History of the Twentieth Century*. New Haven. Yale University Press.
- 5 L. Kass. 2002. *Life, Liberty, and Defense of Dignity: The Challenge for Bioethics*. San Francisco. Encounter Books: p. 48.
- 6 G. Annas, L. Andrews & R. Isasi. Protecting the Endangered Human: Toward an International Treaty Prohibiting Cloning and Inheritable Alterations. *American Journal of Law and Medicine* 2002; 28, 2&3: p. 162.
- 7 J. A. Simpson and E. Weiner, eds. 1989. *The Oxford English Dictionary, 2nd ed.* Oxford. Oxford University Press.
- 8 F. Fukuyama. 2002. *Our Posthuman Future: Consequences of the Biotechnology Revolution*. New York. Farrar, Strauss and Giroux: p. 149.
- 9 Fukuyama, *op cit.* note 8, p. 160.
- 10 H. Jonas. 1985. *Technik, Medizin und Ethik: Zur Praxis des Prinzips Verantwortung*. Frankfurt am Main. Suhrkamp.
- 11 J. Habermas. 2003. *The Future of Human Nature*. Oxford. Blackwell: p. 23.

Part VI

Technology as Social Practice

Technology and the Lifeworld

Introduction

All the selections below make an explicit distinction, often overlooked, between two very different ways of considering technological phenomena. On the one hand, there are the effects of technology *on* our lives as these appear to outside observers (e.g., social scientists or historians); on the other, there are the experiences of what happens *to* us in our living “with” the various technologies in everyday life. The authors in this section stress the importance of the latter, experiential, perspective – the perspective, as Husserl called it, of the lifeworld. They all agree that attending to it is both crucial for – and also routinely under-appreciated in – our attempts to understand the cultural transformation technology brings.

Lynn White’s essay shows that the importance of considering the experiential perspective on technological life does begin not with the modern era. How technology mattered in the Middle Ages, especially in monastic life, tells us a great deal about the cultural transformations that were happening there, and that modern period inherited. A prominent historian of medieval technology, White is well known for his pioneering accounts of the central role of technology in medieval Europe. At the heart of his work is the thesis that many of features of the modern West – its endless technological innovation, its displacement rather than adoption of indigenous technologies, its success in gaining technological control of nature, and its military and economic domination of the rest of the world – can all be linked directly with certain key elements in medieval Christianity, perhaps most

prominently its interpretation of the world as God’s creation. For not only does this theological belief carry forward the Judeo-Christian doctrine of divine creation *ex nihilo* in a way which stresses that the world must be rationally comprehensible and amenable to human purposes, it also places this doctrine in the context of Genesis (1:28), where humanity is granted “dominion over the earth” (for a modern technocrat’s version of this view, see Mesthene, Chapter 56).

White’s views have influenced technology studies on two fronts. First, his conclusion – that the roots of the modern West’s “exploitive” attitude toward nature originate with medieval Christian theology – set off a firestorm of reaction among historians and theologians, yet with the help of White’s own later writings, it eventually found its way into ecology and technology debates, where it inspired both critiques of Christianity’s apparently formative role in the current world crisis and alternative interpretations of Christian theology enlisted to help address the crisis. Second, White’s work has also influenced the way those in technology studies conceive of technology itself. For his work appears to show that medieval theology not only helped shape the modern conception of the domination of nature, but at the same time established the “psychic foundations” for an activist and innovative attitude toward the use of technology. By implication, then, refutation of idea that technology has ever been primarily “applied *science*” lies in the Middle Ages, where the rapid growth of technological invention in Europe precedes the modern scientific revolution by several centuries (see Ihde, below).

Indeed, in contrast with Islam and even Eastern Orthodoxy, medieval Catholicism explicitly stressed human action over contemplation. The early monasteries, isolated during the barbarian invasions, were of necessity self-sufficient. Work came to be viewed as a means of redemption; manual labor, as a sort of piety; and salvation, as something to be attained by good works. Technological devices – for example, organs in church services and mechanical clocks scheduling prayers (both banned by Eastern Orthodoxy) – could thus be interpreted as furthering religious vocation; and as White notes, this meant that Eastern technologies were welcomed and used more widely than in their home countries. Joseph Needham's writings are full of examples of technologies the West received from China – not only inventions Bacon mistakenly claimed for the modern West (i.e., gunpowder, printing, and the compass), but scores of other mechanical, chemical, and medical technologies. White documents how Western Christianity fostered an attitude that made these cultural transfers possible. The linear time sequence of biblical theology – with its story of creation, subsequent history, and promise of a final judgment – stands in stark contrast to the cyclical time of East Asian religions and the ancient Greeks. And where Eastern Orthodoxy remained contemplative and enamored of the timeless, Western Catholicism did not. In Augustine, for example, human life is defined as essentially temporal. Time is therefore something precious, and labor-saving devices necessarily desirable. In contrast to the slave labor-based societies of Greece and Rome, in Catholic monastic life manual labor was not despised. Work stood alongside prayer as a means of living a holy life and glorifying God. Alexandrian Greeks in late antiquity and Byzantine emperors used mechanical devices primarily for mystifying and magical purposes (e.g., in Egypt, opening temple doors and dispensing holy water; in Constantinople, raising the emperor's throne into the air in a cloud of colored smoke and surrounded by mechanical birds to awe barbarian ambassadors). However, self-supporting Catholic monasteries used wheelbarrows, cranks, and pulleys to save labor. Western Christians developed technologies to expand agriculture and speed up the processing of food, and medieval northern Europe became the most productive agricultural area in the world. It is interesting to ponder whether technological determinism still seems as plausible in light of White's account of the religious roots of the European drive for power and control – rather like asking whether Marxist

economic determinism still seems as plausible after reading Max Weber's *The Protestant Ethic and the Spirit of Capitalism*.

As the title of his essay indicates, Carl Mitcham begins with one of Heidegger's key ideas, the famous analysis of the human condition as "being-in-the-world." Though Mitcham admits he is removing the idea from its original context in *Being and Time*, he insists that his account of how it is to "be-with" technology still "takes off" from Heidegger's basic point, namely, that it is our practical-technical engagements, not our quest for theoretical knowledge, that ordinarily predominate in life and therefore best illuminate the nature of our relationships with our surroundings and with other people. Mitcham identifies three historical-philosophical, ideal-typical attitudes toward technology – namely, ancient skepticism (think of Plato and Aristotle), Enlightenment optimism (Bacon and Comte), and Romantic uneasiness (Rousseau). Each attitude understands and articulates a fundamentally different sort of relation between ourselves and technology, and each, respectively, has been the most prominent in premodern, early modern, and (to a lesser extent) later modern times. Summarizing his results in a four-part comparative table, Mitcham explains how differently each outlook construes technology's essential character, its proper role in ethical and political affairs, the epistemological status of technological knowledge, and the metaphysical status of its artifacts. One salutary effect of his presentation is that it provides concise summaries of the outlooks taken by a number of other thinkers who appear elsewhere in this anthology.

Mitcham's main point, however, is contemporary and suggestive, not historical and analytical. He thinks the contrasts and conflicts among the three attitudes continue to echo in our own experiences with technology. So, regarding the first attitude, it is certainly true that we (in the developed West) can no longer embrace an "ancient skepticism" that appeals to myths about angered gods to express the sense that technology might be "necessary but dangerous." We are also less likely to regard all manual labor as degrading, or to hold out for a "higher wisdom" that makes practical inventiveness seem like an unworthy expression of what is genuinely "human." Yet who in our age of technical excess is not attracted to, say, Socrates' warning that neither natural philosophy nor technical expertise will ever reveal the secrets of the good life?

Unlike the ancients, early modern philosophers like Bacon often construe invention and discovery as ordained by God, and thus as offering us a way to recover

the state of purity of the Garden of Eden. As Mitcham suggests (echoing White, above), if one strips this thought of its specifically religious trappings, its core idea is certainly not dead: that scientific knowledge – far from being a distraction from the pursuit of higher wisdom – is actually the royal road to the good life. Further, as Mitcham notes, insofar as the test for scientific knowledge is success in the manipulation and control of nature, the early modern view promotes the (certainly not unfamiliar) idea that experimentation – or more generally, technoscientific engagement with the world – supplants contemplation as the definitive expression of the essential human outlook. Hence, from Bacon to Comte – and in some moods, still also for us – technology can seem to be a wholly beneficial force, promising not only dominion over nature but moral and political progress. Commerce and the crafts, more than the relatively less technological activity of agriculture, seem the practical ideals. And doesn't human inventiveness seem akin to divine creation? After all, if the world is God's artifact, and human artifacts are produced by the same "natural" principles, then aren't they just as "real" as Creation itself?

For all its initial appeal, however, there has been growing distaste for the sort of scientific positivism just described. Yet as Mitcham notes, with regard to this outlook we have typically behaved more like ambivalent Romantics than outright opponents. Romantics, too, like the early modern and Enlightenment thinkers, harbor a deep admiration for the tremendous possibilities of technological power. Yet Romanticism expresses strong misgivings about the exercise of this power, for it seems obvious that the industrial revolution which the New Science brought with it has given us not only new material wealth but environmental destruction and miserable working and living conditions for all but the few. Romantics thus reject a mechanical, rationalistic understanding of nature in favor of an organic and intuitive one; and like the ancients, they see technology as in need of restraint. While Enlightenment thinkers see nature in terms of human artifice, Romantics see human creativity as an outgrowth of nature – a talent to be used "properly." Mitcham closes with the provocative suggestion that we may actually tend to be Romantics in our hearts, but precisely because we share Romanticism's ambivalent stance between the ancients' suspicion of technology and the Enlightenment's optimistic promotion of it, we keep losing whatever power we might otherwise presume to gain by explicitly adopting a Romantic outlook.

Don Ihde's phenomenological account of technology-enhanced perception, loosely based on Husserl's *Crisis* and Heidegger's *Being and Time*, makes use of the same idea that attracted Mitcham's attention – namely, that human beings, their technologies, and the surrounding world form a structural whole, a being-in-the-world, whose experientially recognizable features merit (but often fail to receive) careful analysis. In this selection, Ihde says little about traditional and non-phenomenological interpretations of technology, but some of his criticisms of them are easy to detect between the lines. He clearly rejects, for example, the very idea that relations with our surroundings are ever a matter of "bare" perception. There is, he insists, no "simple seeing" – no initial, contextless, foundational contact with an uninterpreted world. All our relations involve both "microperception" (immediate, focused, actual seeing, hearing, etc.) and "macroperception" (simultaneous sociocultural contextualizing); and these together constitute an existential relation whose meaning can always be elaborated but never needs to be "added on" to the encounter itself. For Ihde, one reason this point is so frequently missed is that the traditional model for human–world relations has been that of a mind standing over against a world full of material things. This model, however, is inappropriate (i.e., unphenomenological) in several ways. For one thing, it ignores the fact that all I–world relations are "embodied" relations. I am engaged "with" my surroundings not just in terms of my thoughts, but through my body and my body's capacities. Moreover, the meaning of my relations with my surroundings is not simply a function of my directed, conscious awareness of this or that, but always involves "background relations" and a sociocultural understanding that contextualizes and provides "cues" for dealing with whatever happens to be in focus. Finally, the traditional model privileges direct, or what Ihde calls "unmediated," relations, perhaps in part out of epistemologically exaggerated fears of skepticism brought on by drinking too deeply from the springs of British Empiricism. Whatever the reasons, however, since technology relations are actually always embodied, richly implicit, mediated relations, the traditional model cannot in principle do them justice.

Part of Ihde's alternative account – his analysis of the microperceptual aspect of technology relations – appears below. Using the fiction of a "New Adam" in a technology-free Eden, Ihde contrasts the naïve, unmediated, "naked" apprehending of one's surroundings that would predominate in such an Eden with the mostly mediated,

technoscientifically transformed relations one experiences today. Analyzing these experiences specifically in terms of their “direct and focal” dimensions, he identifies three sets of technology relations and distinguishes them in terms of the way our embodied selves, our various technologies, and the surrounding world are meaningfully but differently configured in each. First, there are “embodiment relations,” strictly so called – relations in which technologies constitute and approximate the status of a “quasi-me” – as, for example, when we use eyeglasses or a hammer. In such cases, if the technologies do their job, we perceive *through* them, making them extensions of our own embodiment. Second, there are “hermeneutic relations” – relations in which the “readable” (i.e., interpretable) technologies *with* which we encounter the world make it accessible in ways that are impossible for naked perception – as, for example, when written language presents us with what is otherwise remote from our time and place, or a thermometer gives us a scaled and enhanced measurement of what is otherwise just some version of “hot” or “cold,” or too extreme to experience at all. Finally, there are “alterity relations” – relations in which technologies themselves become “quasi-others” *to* which we can relate – as, for example, in playing video games or interacting with robots. Though he does not use the word, Ihde makes it clear that alterity relations sometimes involve a kind of fetishizing of otherwise useful technologies. (It goes without saying, of course, that most technological mediations are mixed cases, so that Ihde’s classifications should be understood as characterizations of whichever of the three predominates.)

Ihde closes with a provocative criticism of those who would see in our ever more technologically mediated experience the dream (or nightmare) of a culture that has been utterly transformed into a kind of technological “cocoon.” Could there ever be, he asks, a kind of “New Eve” in a “Spaceship” of Total Technology, where nothing remains “natural,” and every human frailty and limitation is subject to a technoscientific fix? On this issue, Ihde sounds a much more optimistic note than most of those who have been influenced by Heidegger (e.g., Borgmann and Dreyfus). For him, an entirely artificial world – a sort of global recreational vehicle with all the amenities – is as much a fiction as the idea of a pure, non-technological Eden. It only seems like a real possibility when one forgets the world’s actual pluralism of cultures, that is, forgets that the idea of Spaceship Earth is a product of “our” distinctive history. Ihde says

nothing further about the parameters of this “our,” however, and in the end leaves the issue unsettled by asking whether, out of all the messy and unequal technological pluralism of the present, we might actually discern a “single trajectory” emerging that envisions one high-tech world culture. That, he says (but without any expectation it might be so), would make “the Marcuses, Jonases, and Elluls ... the prophets of our times.” Of course to Ihde’s earlier list, we should now also add people like the architects and engineers of the new Korean “Smart City” of Songdo and transhumanists like Nick Bostrom (see Chapter 43).

Ihde’s phenomenological approach to technology has become very popular in northern European/Scandinavian universities, research institutes, and policy planning organizations (especially those associated with the EU). In the last 15 years, and following Ihde’s own self-interpretation, adherents have come to call themselves “postphenomenologists,” in order to identify the extent to which their “empirical turn” comes after both Husserl and Heidegger, and picks up elements from pragmatist philosophy and science studies to flesh out their accounts of our lived relations with particular technological devices and experiences of technological practices. The selection from Peter-Paul Verbeek’s *What Things Do* is a good illustration of the direction technoscience studies has taken in the past two decades, especially for postphenomenologists. Although they typically are willing to acknowledge their indebtedness both to Husserl and to the “classical philosophers of technology” (meaning primarily Heidegger, but for Verbeek also Karl Jaspers), their self-descriptions mostly stress their strong sense of disagreement with their forebears. As Verbeek explains, many of those who have come after Husserl now hold that genuinely phenomenological accounts of our experience of the technoscientific “things themselves” cannot be presented in his still all-too-modern philosophical framework of methodologically prepared subjects looking for the essential features of objects – and employing the dichotomies of cognition/feeling, absolutism/relativism, and inner mind/outer world in the process. Because this framework that still plagues Husserl’s own work, postphenomenologists propose to “radicalize” it, as Verbeek says, which means beginning with pre-theoretical, technologically mediated practical existence – that is, the manner of living in which we are always already being “co-constituted” along with the things we encounter and use. The influence of Heidegger’s conception of

pre-theoretical existence, Ihde's notion of technological mediation, and Latour's emphasis on materiality are all evident here. Where Husserl seeks "essential" descriptions of a self-world correlation understood in terms of "intentional" relations between consciousness and its objects, postphenomenologists see our existence instead in terms of the way all our material technologies "act" upon our practices (i.e., have their own "technological intentionalities") at the very same time that these technologies are being engineered and variously utilized by us. Everything "is" *in relation* with our experiences of it, and vice versa; hence, who "we" are and what things or artifacts are cannot be fully disclosed apart from careful, detailed study of their interrelations.

Of course, the abstract statement that everything is related to everything else is easy to make and illuminates nothing. As postphenomenologists see it, however, part of the problem is that the whole modern philosophical tradition appeals to the negation of this abstraction in order to point away from actually studying this pre-theoretical self-technology-world relatedness – and thus condemns our "lived experience" of this relatedness to the status of something that is merely and subjectively pre-philosophical. From Descartes' *Meditations* on (and arguably back to Plato), says Verbeek, philosophers have often fallen victim to the "Orphic temptation" of believing that they could acquire the one, true, objective standpoint from which All Would Be Clear (i.e., the outlook Merleau-Ponty calls "the philosophy of the God-like survey" and analytic philosophers, the "View from Nowhere").

Hence, the label "postphenomenology" is as much the expression of a distinctive philosophical self-understanding – a pledge to acknowledge that even philosophers proceed with their work inescapably living and thinking "in the midst" of things – as it is the indication of a research program. Two of its central ideas are worth singling out here. First, there is the notion of the "multistability" of technologies, which rests on Ihde's idea of "technological mediation." Ihde, Verbeek, and other postphenomenologists argue that technological mediation, precisely in its being a mediation, involves relations with technologies that must be seen as having "intentionalities" of their own. Speed bumps, for example, "make" us slower drivers; communication and transportation technologies help shape our sense of distance; and medical technologies change our sense of being mortal. In each case, our world makes sense through and by means of these mediations. (In *Moralizing*

Technology (2011), Verbeek argues for the "morality of things," to make the point that technological intentionalities frame our sense of the good life, not just our practical affairs and quest for knowledge. So, for example, choosing not to screen for birth defects using ultrasound – where the sheer availability of the machine sets up a forced option – is a way of taking a moral position.) The general idea, of course, is to get away from the traditional picture of objects – most importantly here, technological things – sitting over against cognizing conscious subjects that are trying to figure out "the" nature that the objects simply have "intrinsically," all by themselves. Postphenomenologists do not, however, think the traditional picture is false. Indeed, it clearly isn't; cognizing things in a "Cartesian" way is, as Husserl shows, precisely that mode of intentional relation (or "existence") in which objects-with-intrinsic-properties actually "are" as they disclose themselves "for" a methodologically prepared consciousness. What postphenomenology holds against Husserl is that his standpoint cannot properly handle the fact that there are *multiple sorts of intentional relations*, running the gamut from the pre-theoretically practical to the sub-atomically oriented theoretical, and most of them do not map on his model of consciousness-and-objects. Ihde and Verbeek have frequently used the Necker cube to make this point. Which "perspective" gives us the "correct" interpretation of the cube? The trick is not to answer – that is, to realize that the figure is fully meaningful or "stable" in "multiple" ways. (Hence, notes Verbeek, postphenomenologists are philosophical "realists," but pluralistically so.)

The notion of multistability is linked to another important feature of postphenomenology, namely, its self-conception as having "two dimensions," or tasks. In Verbeek's language, it is concerned, first, with the *hermeneutical* task of interpreting how technologies "shape our access to the world," but also, second, with *existential* questions of how the whole material-technical environment shapes the way human beings "realize their existence." The first concern is framed largely in terms taken from Ihde; the latter concern is worked out in a critical appropriation of social constructivism and, more specifically, Latour's actor-network theory (see Part III). As Verbeek explains, postphenomenologists agree with Latour's claim that to understand how the technoscientific world really is, one must describe the ways people and technologies are always "acting" together (i.e., "co-constituting" each other) in a vast and complex "network." But they do not accept the social constructivists'

methodological principle of symmetry for understanding this network (see Pinch and Bijker, Chapter 24), because it bars any privileging of a “human” perspective on it. The principle of symmetry may well be acceptable to social scientists who see their mandate as one of “shifting from standpoint to standpoint,” describing everything in turn, now from the perspective of humans and now from that of various nonhumans, without “always being fixed in the human one.” Operating in this way, actor-network researchers do indeed show postphenomenology an approach for “elucidat[ing] the networks of relations that allow entities to be present.” But, adds Verbeek, postphenomenologists are philosophers, not social scientists; hence, when all is said and done, they want to understand specifically, “from the inside out,” how all of this matters for *us* and what specific modes of being-in-the-world are open to us, given the network of relations Latour helps us describe.

Robert Scharff’s essay offers a critical response to the postphenomenological movement. While he encourages its “empirical turn” insofar as it promises to shed detailed light on how it actually is (in Mitcham’s phrase) to “be-with technology,” he argues that its proponents purchase this turn with an unnecessary and costly misunderstanding of Heidegger. Typically, they (as well as Feenberg, see Chapter 31) reject Heidegger’s later critique of technology as abstract and dystopian, and try to salvage something from his earlier conception of being-in-the-world. However, Scharff argues that those who embrace this interpretation tend to weaken their own philosophical outlook by accepting it. In fact, objections to Heidegger’s alleged pessimism and dystopianism are best interpreted as evidence of a widespread tendency – found among both postpositivist and phenomenological writers about technoscience – to overestimate the degree to which they themselves have left behind a late Enlightenment or classical positivist understanding of our age.

Scharff develops this point by discussing the work of Ihde, Verbeek, and Feenberg. His main argument is that they are wrong to assume that Heidegger would force them to choose between an “empirical turn” and what Ihde calls a total, “one size fits all” condemnation of technoscientific life. The mistake is traceable to a misunderstanding

of Heidegger’s claim that he seeks a critical account of the “essence” of technology, where it is assumed that he is using the term in a traditional, or neo-Aristotelian way to mean “timeless characteristic” or “necessary property.” Scharff points out that *Wesen* in German is a verb or verbal noun, so that when Heidegger is describing technology’s essence, he is referring to how things strongly and for the most part are coming to be (“essencing”), not to how they must necessarily be. The point to see, for Heidegger, is that if the essence of technology really were a timelessly universal and necessary characteristic of all technology, then we could not currently have any experience of technology as possibly “being” otherwise. Our inherited sense of how everything arrives as already “enframed” would then simply *determine* how we understood technoscientific life. Yet in fact, as postphenomenologists and critical social theorists themselves have shown and as Heidegger agrees, we have countless experiences that do involve a lack of fit between our inherited, enframing sense of technology as “setting up” everything in an instrumental and indiscriminately manipulable way, and our current sense of many “other” (e.g., more humanizing, or discriminating, or politically productive) possibilities. To illustrate the point, Scharff quotes a passage from Hubert Dreyfus’ *On the Internet* (a partial version of which is included in this anthology, Chapter 53), and shows how one can read his account of the Web in either an essentialist and deterministic way or as descriptive of a now hegemonic, default understanding of how engaging with the Web tends to corrupt and flatten out our sense of life’s meaning. Dreyfus clearly desires to be read the second way, because like Heidegger, he wants us to focus precisely on our unsatisfying experiences of this default understanding in order to see in their “discomforting” effects on us a source of alternative possibilities. Scharff concludes that postphenomenology is not nearly as “post-” Heideggerian as it thinks it is. The next step, he says, is to get over the idea that one must choose between the concrete, technologies-focused research of the phenomenologists and critical social theorists, and Heidegger’s current reflective consideration of the current pervasive repressiveness of the developed world’s current technoscientific atmosphere. In fact, he concludes, they should be pursued together.

Cultural Climates and Technological Advance in the Middle Ages

Lynn White, Jr.

To establish facts, and the more obvious relations among facts, has never satisfied the consciences of historians. We are driven to ask not only what happened but also why it happened. Historical explanation, of course, is seldom a matter of one billiard ball striking another, of “causes” in the narrow sense. It is much more often a process of gradual illumination of the fact to be explained by gathering around it other facts that, like lamps, seem to throw light on it. At last the historian arrives at a sense that the central fact on which he is focusing has become intelligible.

In 1959 when I finished the manuscript of a book on medieval technology,¹ I was painfully aware of its greatest defect: it identifies and describes a few major aspects of the unprecedented technological activity that occurred in the medieval West, but it fails to explain the phenomenon observed. To tell the truth, I was much more sure of the *what* than the *why*. Four years later I had become bold enough to publish a preliminary inventory of possible reasons, not all of equal weight but none mutually exclusive, for medieval technological advance.² This is not, however, the sort of problem that stands still. The present state of scholarship demands a new effort to understand it.

I

There is much to be understood. The technological creativity of medieval Europe is one of the resonant facts of history.³ Beginning obscurely as early as the sixth century,

within three hundred years the northern peasantry created a novel agricultural system that, in proportion to expenditure of human labor, was probably the most productive in the world.⁴ In the eighth century the Franks revolutionized their methods of warfare, and thereafter their descendants consistently maintained the initiative in improving military technology, as distinct from military organization. From about the year 1000 onward – although the movement was foreshadowed in the ninth century – the West produced new labor-saving mechanical devices and explored new applications of power to production, thus providing the industrial basis for burgher capitalism. Starting in the sixth century, but particularly after 1200, Europe led in the development of ship design and the nautical arts.

While the medieval West’s cousinly cultures, Byzantium and Islam, long remained more sophisticated in most other respects, in technology they were laggards as compared with Europe. Only contemporary China – from which the West borrowed much⁵ – could compare with Europe in inventiveness and eagerness for useful novelties. The emergence of the mechanical clock in the second quarter of the fourteenth century, however, by enlarging the number of craftsmen skilled in making and correlating moving metal parts in machines, led in Europe to heightened activity that soon gave to the Occident a clear technical superiority even over China.

Romans had been no less predatory than were Europeans of the late Middle Ages, but the Caesars were

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so ill equipped that they could not extend their rapacity greatly beyond the basin of the Mediterranean. By 1492, however, Europe had developed an agricultural base, an industrial capacity, a superiority in arms, and a skill in voyaging the ocean which enabled it to explore, conquer, loot, and colonize the rest of the globe during the next four centuries and more. This unification of world history was a unique event. Its implementation, and that of the Imperialist Age, 1500–1950, was provided largely by the Middle Ages.

Moreover, modern technology is the extrapolation of that of the Western Middle Ages not merely in detail but also in the spirit that infuses it. The later thirteenth century in Europe marks the moment of crisis in the history of mankind's relation to the natural environment: it produced "the invention of invention" of which the practical effects were soon felt. The earlier record of technology around the globe is scattered and often lacking in continuity; it recounts a generally slow accumulation of isolated specific inventions, their spread and elaboration. But in the Middle Ages, in Europe alone, invention became a total and coherent project.⁶ From the later Middle Ages onward, world technology was increasingly European technology.

Technicians at that time in large numbers⁷ began to consider systematically all the imaginable ways of solving a problem. About 1260, the Franciscan Roger Bacon, pondering transportation, confidently prophesied an age of automobiles, submarines, and airplanes.⁸ Since arrow wounds were then a medical problem, about 1267 Theodoric, successively bishop of Bitonto and Cervia, in his treatise on surgery noted that for the extraction of arrows "quotidie enim instrumentum novum, et modus novus, solertia et ingenio medici invenitur."⁹ Clocks were a great problem, and proposals for their improvement were frequent before the solution was found. On the basis of the recently introduced Chinese mariner's compass, and inspired by the novel Hindu concept of perpetual motion, in 1269 Roger Bacon's friend, the military engineer Peter of Maricourt, proposed a magnetic clock to replace all others.¹⁰ In 1271 Robert the Englishman, talking about plans for a weight-driven clock, admitted that the problem of the escapement had not been entirely conquered, but he was confident that it would be.¹¹ Almost at the same moment, at the court of Alfonso el Sabio of Castile, Rabbi Isaac ben Sid of Toledo described not only new kinds of waterclocks, which he claimed to be much better than any earlier models; he also depicted as an absolute novelty a weight-driven clock with a mercury

brake.¹² Indeed, this was a fairly practical solution for the escapement, as a subsequent tradition of such clocks shows.¹³ Before 1313 someone invented the sandglass.¹⁴ But technicians labored from the 1260s until the 1330s before the true mechanical clock was invented.¹⁵

In a sermon on repentance preached at Santa Maria Novella in Florence on 23 February 1306, the Dominican Fra Giordano of Pisa, while providing our best evidence of the invention of eyeglasses in the 1280s, incidentally sang the praises of the recent invention of invention. "Not all the arts," he said, "have been found; we shall never see an end of finding them. Every day one could discover a new art ... indeed they are being found all the time. It is not twenty years since there was discovered the art of making spectacles which help you to see well, and which is one of the best and most necessary in the world. And that is such a short time ago that a new art, which never before existed, was invented ... I myself saw the man who discovered and practiced it, and I talked with him."¹⁶

By the early fourteenth century, then, Europe showed not only an unmatched dynamism in technology: it also arrived at a technological attitude toward problem solving which was to become of inestimable importance for the human condition. The profound contrast between this aspect of the Occident and the relative passivity toward technology in the Near East is the more significant because Byzantium, Islam, and the Western world were related societies, all in great measure, but in varying proportions, built of elements found in the Greek and Semitic legacies from Antiquity. The fact that thirteenth-century theologians in Cairo, Constantinople, and Paris were all commenting on Aristotle helps us to grasp the unity of the triune Middle Ages. The fact that in the time of Saint Thomas Aquinas labor-saving machinery was little developed in the Near East and concern for invention was minimal, whereas in the West a new sort of engineering¹⁷ was being pursued with an enthusiasm amounting to passion, helps us to understand why the Occidental third of the Middle Ages generated what we call the modern world.

[...]

IV

The most thoughtful analysis of the presuppositions of Western technology has been provided by a medieval historian, Ernst Benz¹⁸ of the University of Marburg. Study of Buddhism and personal experience of it in Japan – especially of the anti-technological impulses in

Zen¹⁹ – led him to find the genesis of Europe’s technological advance in Christian beliefs and attitudes. The Christian Creator God, the architect of the cosmos and the potter who shaped man from clay in his own image, commands man to rule the world and to help to fulfill the divine will in it as a creative cooperator with him. History, far from being cyclical as it is in most religions, in Christianity is unique and unilinear; it is accelerating toward a spiritual goal; there is no time to lose; therefore, work, including manual work, is an essential and pressing form of worship. Moreover, matter was created for a spiritual purpose and it is neither to be transcended nor despised: the dogmas of the incarnation and of the resurrection of the flesh vouch for this. The sense that intelligent craftsmanship is shown in the world’s design, and that we participate in the divine by being ourselves good artisans; the conviction that we follow God’s example when we use substance for righteous ends, that time must be saved because every moment is a unique psychic opportunity: these are characteristics of the Judeo-Christian view of reality and of destiny. They are alien to all the other major religions except Islam, which belongs to the same spiritual phylum, and possibly Zoroastrianism, a related species. Since in Hellenistic times and in China there were notable and sometimes rapid advances in engineering, Christianity obviously is not essential to technological dynamism. What Benz suggests, nevertheless, is that Christianity provided, historically in Europe, a set of assumptions, a cultural climate, unusually favorable to technological advance.

One may expand Benz’s thesis somewhat. In 1956 Robert Forbes²⁰ of Leyden and Samuel Sambursky²¹ of Jerusalem simultaneously pointed out that Christianity, by destroying classical animism, brought about a basic change in the attitude toward natural objects and opened the way for their rational and unabashed use for human ends. Saints, angels and demons were very real to the Christian, but the *genius loci*, the spirit inherent in a place or object, was no longer present to be placated if disturbed.

Undoubtedly also, there has been an element of Christian compassion motivating the development of power machinery and labor-saving devices: as early as the sixth century an abbot in Gaul, troubled by the sight of his monks grinding grain in querns, built a water mill, “hoc opere laborem monachorum relevans.”²² Pity, however, is not exclusively a Christian virtue: Antipater’s pagan poem, which is our second document for the existence of water mills in the ancient Mediterranean,

celebrates the new machine as harnessing the water nymphs to save the aching backs of slave women.²³

Benz has pointed a direction by which historians can make intelligible the technological dynamism of the Middle Ages. His hypothesis, however, is defective because he fails to recognize that the Greek church held the fundamentals of the Christian faith as ardently as did the Latin, yet after Kallinikos’s invention of Greek fire just before 673²⁴ the highly civilized regions dominated by Eastern Orthodoxy were unadventurous in technology. If, as Benz believes, the vigor of Western medieval technology is an expression of religion, the sources of that dynamism must be found less in the broader aspects of Christianity than in the distinctive qualities and moods that differentiate Occidental from Byzantine Christian piety.

It may seem ludicrous to claim that the distillation of alcohol,²⁵ the trebuchet,²⁶ the functional button,²⁷ the suction pump,²⁸ the wire-drawing mill,²⁹ and the myriad other medieval inventions are ultimately *gesla Christi* where Christ was worshiped with a Latin accent. Nevertheless, the processes of the human mind are so curious that our judgment of the forces that produced Western technology must be based upon what appear to be the relevant facts even when the result contains elements of irony. Since people are often comic, so also history may be.

Historians of spirituality have long been aware of a basic contrast of tonality between the two great segments of Christendom which surely affected the development of their respective technologies. The Greeks have generally held that sin is ignorance and that salvation comes by illumination. The Latins have asserted that sin is vice, and that rebirth comes by disciplining the will to do good works. The Greek saint is normally a contemplative; the Western saint, an activist.

This difference, largely subliminal, emerges clearly in the iconography of the Creator God. During the first Christian millennium, in both East and West, God at the moment of creation is represented in passive majesty, actualizing the cosmos by pure power of thought, Platonically. Then, shortly after the year 1000, a Gospel book was produced at Winchester which made a great innovation: inspired by Wisdom 11.20, “Omnia in mensura et numero et pondere disposuisti,” the monastic illuminator showed the hand of God – now the master craftsman – holding scales, a carpenter’s square, and a pair of compasses.³⁰ This new representation spread and, probably under the influence of Proverbs 8.27, “certe

lege et gyro vallabat abyssus,” the scales and square were eliminated leaving only the compasses – the normal medieval and renaissance symbol of the engineer – held in God’s hand. This tradition, which culminated in William Blake’s “Ancient of Days,”³¹ was never adopted in the Eastern Church. It was the perfect expression of Western voluntarism, but it violated Greek intellectualist sensibilities about God’s nature.

As medieval machine design became more intricate, God the builder developed into God the mechanic. The term “machina mundi” is at least as old as Lucretius, but was rejected on religious grounds by Arnobius Afer. By the thirteenth century, however, it was commonly used by Latin clerical scientists and had strongly affirmative overtones.³² The first to foreshadow the Deist concept of the clockmaker God was Nicole Oresme who died as bishop of Lisieux in 1382. He proposed that, to prevent the celestial spheres from accelerating as they turned, the Creator had provided the equivalent of a clock’s escapement mechanism to keep them rotating at a constant speed.³³ The subsequent success of the simile indicates the direction of Europe’s thought about God, nature and man.

Students of the history of scriptural exegesis are as helpful as art historians in laying bare structures of values that lie so deep that they are not often verbalized explicitly. For our purposes the varying treatments of Luke 10.38–42, the Mary–Martha episode, are full of meaning. Since the time of Origen at least, the Greek East has invariably assumed that Martha represents the active and Mary the contemplative life, and that Christ’s rebuke to Martha validates the superiority of the contemplative over the active.³⁴ In the West, however, a quite different style of exegesis emerges early. Saint Ambrose, once himself a Roman official and now a bishop, feels that the sisters of Bethany are symbols of *actio* and *intentio*: both are essential, and one cannot rightly be considered better than the other.³⁵ Then Saint Augustine, a revolutionary in so many ways, entirely subverts the Greek exegesis, the structure of values inherent in it, and, one must add, the literal meaning of Christ’s words. To him, Mary and Martha represent two stages in the perfect life: Martha, the life of the soul in time and space; Mary, in eternity. “In Martha erat imago praesentium, in Maria futurorum. Quod agebat Martha, ibi sumus; quod agebat Maria, hoc speramus.”³⁶ Yet, since we mortals dwell in time and not eternity, we must be Marthas, troubled about many things, rather than Marys.

The Middle Ages grew increasingly restless over this pericope. In the middle of the twelfth century Richard of Saint Victor, while acquiescing in Christ’s praise of Mary’s choice on the Augustinian ground that contemplation anticipates our heavenly condition, nevertheless shows by his phrasing where his own sympathies lie: “Intenta erat Maria quomodo pascetur a Domino; intenta erat Martha quomodo pasceret Dominum. Haec convivium parat Domino; in convivio Domini ilia jam delectatur.”³⁷ Two hundred years later the European affirmation of the primacy of action reaches almost absurd heights in one of Meister Eckhart’s vernacular sermons on this text.³⁸ Martha, the older and wiser sister, fears lest the adolescent Mary may become so ecstatic in contemplation that she will not mature spiritually by realizing that action is essential to holiness. Christ’s apparent rebuke to Martha and praise for Mary are, in Eckhart’s opinion, the exact reverse: they are his way of telling the perceptive Martha not to be troubled by Mary’s sentimental condition; she will grow out of it. The Greek Church could not have produced, much less tolerated, such a sermon. The mood of activism which Eckhart reflects surely fostered technological growth in the West.

Some degree of respect for manual labor is, along with activism, integral to massive technological development. It was generally lacking, at least among the literate classes, in the Greco–Roman world.³⁹ The Jews, however, considered God’s command to labor six days of the week to be as binding as that to rest on the seventh.⁴⁰ In the late third century, massive conversions of pagans to Christianity around the eastern Mediterranean threatened to corrupt the Church, and quite naturally a few zealots tried to purify it by returning to its primitive, that is Jewish, tradition. One result was monasticism, which from the beginning asserted the originally Jewish thesis that work is worship, indeed, that it is an essential kind of worship. With considerable constancy the monks of both East and West continued through the Middle Ages to work with their hands.⁴¹ Many of them likewise were well read; indeed, for centuries monks were the most learned men of the West. This combination of education with practical work would seem theoretically, by joining head and hand, to provide communities in the monasteries where technological innovation would thrive. Yet the contrast in this respect between the sons of Saint Basil and those of Saint Benedict is notable.

One voice of dissent in the West may illuminate the basic situation. The sole instance in Christian monasticism of an antipathy toward the mechanic arts appears in

Scholica graecarum glossarum by Martin of Laon (died 875) who derives *mechanicus* not from *μηχανικός* but from *μοιχός* “adulterer”: “Moechus est adulter alterius thorum furtim polluens. Inde a maecho dicitur mechanica ars, ingeniosa atque subtilissima et paene quomodo facta vel administrata sit invisibilis in tantum, ut etiam visum conspicientium quodam modo furetur, dum non facile penetratur eius ingeniositas.”⁴² Martin was an immigrant Irish monk. The rule of Saint Columba is the only monastic code of East or West in which manual labor is regarded as pure penance for sin, unconnected with prayer and praise.⁴³ Moreover this etymology offered by Martin is the only Western occurrence of the Heronic concept of technology as primarily producing machines to deceive and awe the populace: one among several indications of connections between early Christian Ireland and the Greek culture of Alexandria.⁴⁴ Yet this Irish mediation of Greek secular alienation from labor and technology was to have small influence in the West.

Part of the reason for this differential development between Latin and Greek monasticism lies in the fact that in the Byzantine world a literate laity continued to preserve the worldly aspects of high culture, with the result that Greek monks felt able to devote themselves more exclusively to sacred studies. In the West, the level of civilization for a time sank so disastrously that the monks assumed almost sole responsibility for preserving and encouraging all aspects of culture, profane as well as churchly.⁴⁵ Thus in the Occident monks tended to be more deeply involved in secular matters than in the East. The Slavic and Germanic regions into which the missionary monks of each Church penetrated were equally primitive. The Greek evangelists were very theological in their emphasis, and their labors were almost entirely religious. The Benedictines, however, concerned themselves less with doctrine than with ethics, and carried with them not merely a new religion but also new practical arts.⁴⁶

This monastic technical tradition finds its greatest written expression in *De diversis artibus* produced by a theologically sophisticated and technologically learned German Benedictine, Theophilus, in 1122–1123.⁴⁷ It is a religiously motivated codification of all the skills available for the embellishment of a church, from the enameling of chalices and the painting of shrines to the making of organ pipes and the casting of great bells for the tower. In Theophilus’s mechanisms the first fly-wheels appear; he is the first to record a new and cheaper way of making glass, which largely accounts for the expansion of glazed windows in his time; he is the first to mention

a wire-drawing plate and likewise the first to describe the tinning of iron by immersion,⁴⁸ a technique that continued in use until the Japanese capture of Malaya in 1941 caused such a scarcity of tin elsewhere that the electrolytic process was developed.

Theophilus was not exceptional in his interests. In his contemporary life of Saint Bernard, Abbot Arnold of Bonneval pictures the rebuilding of Clairvaux in 1136 without mentioning the church but with a delighted account of all the abbey’s waterpowered machines for milling, fulling, tanning, blacksmithing, and other industries.⁴⁹ Another quite independent monastic description of Clairvaux in the same period shows the same enthusiasms: the author is particularly taken by an automatic flour sifter attached to the flourmill; he makes a little monkish joke, saying that the stamps of the fulling mill have remitted the penalty for the sins of the fullers; then he thanks God that such machines can alleviate the oppressive labors of both man and beast; and at last he offers a picture of the abstract power of water flowing through the abbey seeking every task: “coquendis, cribrandis, vertendis, terendis, rigandis, lavandis, molendis, molliendis, suum sine contradictione praestans obsequium.”⁵⁰

Nor was the commitment of Western ascetics to holy labor confined to crafts and mechanized industry: it extended to major engineering. In 1248, for example, while giving the decayed abbey of Lorsch to a community of Premonstratensian canons, the archbishop of Mainz says of them: “Invenimus viros iuxta cor nostrum . . . Hii etenim non tantum religionis immaculate et vite habent testimonium sancte sed etiam in viis parandis, aqueductibus extruendis, paludibus exsiccandis, quibus monasterium in illa vicina nimum pergravatur, et generaliter in arte mechanica exercitati sunt non modicum et periti.”⁵¹ Thus far no similar documents have been produced from the entire Orthodox Church.

The 1120s, in which Theophilus produced his *De diversis artibus*, witnessed a moment of change in Europe’s attitude towards manual labor and technology. Theophilus himself was concerned solely with the dignity of the technical arts in the life of a monk. Some of his ascetic contemporaries made labor the prime act of religion: Abbot Rupert of Deutz (died 1130) rebukes fanatics who spurn liturgical worship and “qui in opere manuum fere totam spem suam ponunt.”⁵² But at that time the concept of “religion” was broadening and spreading from the monastic to the lay life, particularly through channels provided by the newly vitalized groups of regular canons.⁵³

It was spiritually essential to transfer dignity explicitly from monastic labor to labor in the world outside the cloister.

This task was undertaken by the Victorines in Paris.⁵⁴ At the end of *De civitate Dei*, Saint Augustine discusses technology in a mood of complete ambivalence: he exclaims over the ingenuity and variety of the arts, but considers many of them “superfluas, immo et periculosas perniciosasque”; medicaments and skills of healing are cancelled by “tot genera venenorum, tot armorum, tot machina-mentorum.”⁵⁵ In the face of Augustine’s vast authority, Hugh of Saint Victor, one of the most original minds of the Middle Ages and, like Theophilus, a German, very deliberately developed a new and affirmative attitude toward technology.

His first effort was made in the early 1120s in the form of a curious dialogue on the nature and scope of philosophy in which Hugh’s alter ego is none other than Dindimus, the leader of the Indian Brahmins who had long been regarded in the West as “instinctive” Christians, living saintly lives without the grace of revelation.⁵⁶ His intent is clear: to provide a secular schematization of all human knowledge which, for the first time, includes the mechanic arts. On Hugh’s behalf Dindimus argues vehemently against the purists who would narrow the concept of philosophy to exclude not only mechanics but also grammar and logic: “conati sunt scindere et lacerare corpus universum [philosophie] ne membra sibi coherent, quia pulchritudinem totius non viderunt.”⁵⁷ The unity of philosophy arises from its function of remedying man’s three basic defects: ignorance, vice, and physical weakness. Speculation provides truth; ethics aids virtue; technology supports our bodily needs; recently logic or semantics (including grammar) has been added to philosophy to give it clarity and elegance of expression.⁵⁸ Of these, *mechanica* is the least in dignity; yet it is integral to philosophy not as regards its practice but because of the wisdom inherent in it.⁵⁹

In the later 1120s Hugh expanded and elaborated his concept of the nature and elements of philosophy in his influential *Didascalicon*: at least 88 manuscripts of it are extant, of which not fewer than 50 are of the twelfth and thirteenth centuries.⁶⁰ Between 1153 and 1162 Richard of Saint Victor, probably a Scot, in his widely read *Liber exceptionum*, repeated and reinforced Hugh’s fourfold division of the intellectual life.⁶¹ Naturally both Hugh and Richard recognized that, in the hierarchical society of their day, inclusion of the mechanic arts in a total scheme of knowledge might not be cordially received, so

they disclaimed any revolutionary intent. Things like architecture and agriculture are proper topics for theorizing by a philosopher, but the doing of them is different: “agriculturae ratio philosophi est, administratio rustici.”⁶² Nevertheless, by giving an unprecedented psychic dignity and speculative interest to the mechanic arts, the Victorines provided one of the theses for an egalitarian movement which, centuries later, spread eastward to destroy a great part of the less flexible Orthodox Church.

A development akin to the Benedictine and Victorine sense of the significance of technology was the increasing Western acceptance of mechanisms as aids to the spiritual life. The Church Fathers, both Greek and Latin, had passionately opposed the use of all musical instruments, including the organ.⁶³ While in Byzantium organs habitually graced secular ceremonies, the Greek Church forbade them in its liturgies, insisting that only the unaccompanied human voice can worthily praise God.⁶⁴ Yet in the later tenth century, in the cathedral at Winchester where, about the same time, the iconography of the Creator God holding scales, square, and compasses appeared, Benedictines installed the first giant organ: 70 men pumped 26 bellows supplying 400 pipes.⁶⁵ Before the invention of the mechanical clock the organ was the most complex machine. In sharp contrast to the East, great organs became integral in the West first to processions, interludes, and the like, but, by the middle of the twelfth century, they were admitted to the central act of divine service, the Mass.⁶⁶ A hundred years later, in the mystery plays that by that time were presented outside the churches, an organ was the indispensable accompaniment of any representation of Paradise,⁶⁷ indeed, it became almost a symbol of Heaven.

In a separate building outside Hagia Sophia, Justinian placed a clepsydra and sundials,⁶⁸ but clocks were never permitted within or on Eastern churches: to place them there would have contaminated eternity with time. As soon, however, as the mechanical clock was invented in the West, it quickly spread not only to the towers of Latin churches but also to their interiors, often as astronomical planetaria designed to demonstrate visually the godly order of the cosmos.⁶⁹ Clearly, by the later Middle Ages, Western men felt psychically compatible with machines.

And not simply in religious contexts: the *Mittelalterliche Hausbuch*, a German manuscript of circa 1480, shows a garden enclosed in which garlanded youths and maidens are sporting about a fountain, while at the right, quite unobscured, appears the waterpowered force-pump that operates the fountain.⁷⁰ To the Middle Ages

all the arts, including the mechanic arts, were a part of the good life – *teste* Leonardo. Modern suspicion of technology is a reversion to the ambivalence of Saint Augustine.

The earliest indication that men thought advancing technology to be an aspect of Christian virtue appears in the Utrecht *Psalter*, illuminated near Rheims *circa* 830, almost certainly by a Benedictine monk. The illustration of Psalm 63 (64) shows an armed confrontation between a small body of the Righteous, led by King David himself, and a distressingly larger host of the Ungodly. In each camp a sword is being sharpened conspicuously. The Evildoers are content to use an old-fashioned whetstone. The Godly, however, are employing the first crank recorded outside China to rotate the first grindstone known anywhere.⁷¹ Obviously the artist is telling us that technological advance is God's will.

About 1450 European intellectuals began to become aware of technological progress not as a project (as indicated above, this came in the late thirteenth century) but as an historic and happy fact, when Giovanni Tortelli, a humanist at the papal court, composed an essay listing, and rejoicing over, new inventions unknown to the ancients.⁷² At almost that moment the artists of Burgundy reaffirmed the thesis of the illuminator of the Utrecht *Psalter* that an advancing technology is morally salutary: they clothed Temperance, who had displaced Charity as the chief Virtue, with major symbols of late medieval inventiveness. On her head she wore a mechanical clock, produced some 120 years earlier; in her right hand she held eyeglasses, invented, as we have noted in the 1280s as the greatest boon to the mature and presbyopic intellectual; she stood on a tower windmill, which first appeared in the 1390s and which was the most spectacular power machine of that era.⁷³ To the artists who painted those pictures, and to their patrons – clerical, aristocratic and burgher – it was axiomatic that man was serving God by serving himself in the technological mastery of nature. Because medieval men believed this, they devoted themselves in great numbers and with enthusiasm to the process of invention.

Probably there were forces other than the religious which stimulated technological progress during the Middle Ages. The tradition of illustrated calendars has been secular. Their usual pattern from Roman times until the ninth century showed the months as static personifications holding symbolic attributes. This convention continued unbroken in Byzantium. Among the Franks, however, by 830 a new form appeared which set

the style for the rest of the Middle Ages in the West. The pictures now show active scenes: plowing, haying, the harvesting of grain, wood chopping, men knocking acorns from oaks so that pigs can eat them, pig slaughtering.⁷⁴ The new illustrations breathe a coerciveness towards nature which is, indeed, consonant with Christianity but which may have arisen independently. Man and nature are two things, and man is master. Technological aggression, rather than reverent coexistence, is now man's posture toward nature.

Such aggression is the normal Western Christian attitude toward nature.⁷⁵ It may be that the emergence of this stance in the Carolingian age can be explained apart from religion. Slightly before that time a basic change in agricultural methods had occurred in Northern Europe,⁷⁶ especially between the Loire and the Rhine, the heartland of the Frankish Empire. As early as the sixth century a new heavy plow began to spread from the Slavic East. It was far more efficient than the earlier light plow, but in place of a pair of oxen it normally required as many as eight, at least in newly cleared or sticky soil. No peasant owned eight oxen. The only way to power such a plow was to organize several peasants to pool their oxen, and to distribute plowed strips to them in proportion to their contribution. Previously land had been parceled to peasants in allotments sufficient to support a family equipped with two oxen and a light plow. The assumption was subsistence farming, plus enough surplus to pay rent. Now, however, with the heavy plow and the pooling of oxen the standard of land division was not human need but rather the capacity of a new power machine to till the soil. No more profound reversal of the peasant's relation to the land can be imagined. Formerly he had been part of nature; now he became an exploiter of nature. This alteration of attitudes might be guessed from the heavy plow itself. The iconography of the new calendars confirms the change. Neither the heavy plow nor the new style of calendar was known in Byzantium. In historical analysis, even of a very religious era, we cannot credit to religion, any more than to social relations or to any other single element in culture, absolute sovereignty over every aspect of life.

Nevertheless, it can scarcely be coincidence that the miniature in the Utrecht *Psalter* (816–834) which announces the morality of technological advance appeared simultaneously with, and in the same region as, the new style of calendar illustration (shortly before 830). It can scarcely be coincidence that in 826 Louis the Pious, who, as a contemporary remarks, was always eager

to introduce to his realm “illa quae ante se inusitata erant,”⁷⁷ commissioned a Venetian priest named George, who had learned his skills presumably in Byzantium, to construct the first organ built in the medieval West for secular use in his palace,⁷⁸ and that from Aachen organs spread so quickly among the churches of South Germany that in 873 Pope John VIII wrote to Freising to secure both an organ and an organist.⁷⁹ Many forces shaped the Middle Ages, but of these the most powerful was religion.

The Semitization of the Greco-Roman *oikoumene*, which was accomplished in the fourth century by the victory of Christianity, marks the most drastic change of world view, both among intellectuals and among the common people, that, before our own time, has ever been experienced by a major culture. In China the indigenous Confucian-Taoist symbiosis was supplemented, not displaced, by India Buddhism. In India itself, Vedic Brahmanism slowly broadened and diversified to engulf all rivals except the Islamic intrusion that was totally unassimilable and which produced two societies in tragic confrontation. The Muslim annexation of the southern shores of the Mediterranean had no such result because, as Dante rightly saw (*Inferno* 28.22–31), Muhammad was a Judeo-Christian schismatic, not the founder of a new religion. In the regions thus overrun, the faith of the *Koran* confirmed basic Jewish views of the nature of time, the cosmos, and destiny which had already been spread at all levels of society by Christianity, Judaism’s daughter.

The historians’ habit of terminating what we call ancient history with the chaos of the third and early fourth centuries in which Christianity rose to dominance is not arbitrary: it recognizes a major alteration in the cultural climate of classical civilization. During the Middle Ages, both Eastern and Western, this new religion was the essential novelty and stimulus to innovation as well as to the decay of some forms of creativity which had thrived in the Greco-Roman world. It is, therefore, not surprising that so many religious and parareligious phenomena illuminate both the high rate of technological advance in the West, and, by contrast, its slow pace in the Byzantine world.

No great religion is an entirely uniform species. As Christianity spread it accommodated to local circumstances but it likewise developed spontaneous genetic mutations which as yet cannot be explained by Lamarckian adaptation to preexisting cultural climates: to an extraordinary degree, medieval religion created the climate of its environment. Part of the fascination of the Middle Ages lies in the observation, within an essential unity extending from Greenland to the Jaxartes, of the variety of cultural subclimates that can often be interpreted according to regional variants in the temper of religion. The slight but significant differences between Greek and Latin piety in this period help not only to make historically intelligible the accomplishment of the medieval West in technology but likewise to expose the psychic foundations of our modern technology which rests on that achievement.

Notes

- 1 *Medieval Technology and Social Change* (Oxford 1962), hereafter *Med. Techn.*
- 2 “What Accelerated Technological Progress in the Western Middle Ages?” in *Scientific Change*, ed. Alistair C. Crombie (London 1963) 272–291.
- 3 The most comprehensive survey of medieval European technology is that by Bertrand Gille in *Histoire générale des techniques*, ed. Maurice Daumas, 1 (Paris 1962) 429–598, and 2 (1965) 2–139. See also Friedrich Klemm, *Der Beitrag des Mittelalters zur Entwicklung der abendländischen Technik (Beiträge zur Geschichte der Wissenschaft und der Technik* 2, Wiesbaden 1961), and my “The Expansion of Technology, 500–1500 A. D.” in *The Fontana Economic History of Europe* ed. Carlo M. Cipolla, 1, chapter 4 (London 1969 issued as pamphlet).
- 4 The salutary effect of this upon the standards of living among German peasants in the eleventh century is shown in my “The Life of the Silent Majority,” in *Life and Thought in the Early Middle Ages* ed. Robert S. Hoyt (Minneapolis 1967) 85–100.
- 5 No student of European technology can neglect Joseph Needham, *Science and Civilization in China*, 4 vols. in 6 to date (Cambridge, Eng. 1954–1970).
- 6 For a complex example of this coherence, see an inventory of the ways, between ca. 1010 and ca. 1480, in which Western technicians utilized the velocity, resistance and pressure of air, in my “The Invention of the Parachute,” *Technology and Culture* 9 (1968) 462–467, and “Medieval Uses of Air,” *Scientific American* 222 (Aug. 1970) 92–100.
- 7 About 1235 Villard of Honnecourt, and in 1269 Peter of Maricourt, independently inform us that many men are arguing and laboring to the point of exhaustion to produce *perpetua mobilia*; *Villard de Honnecourt: Kritische Gesamtausgabe*,

- ed. H. R. Hahnloser (Vienna 1935) pl. 9; Peter of Maricourt, *Epistola de magnete* in *Rara magnetica 1269–1559*, ed. Gustave Hellmann (Berlin 1896) 11.
- 8 *De secretis operibus*, chap. 4, in *Opera quaedam hactenus inedita*, ed. J. S. Brewer (London 1859) 533.
 - 9 *Chirurgia* 1.22, appended to Guy de Chauliac, *Ars chirurgica* (Venice 1546) fol. 143.
 - 10 See my "Tibet, India and Malaya as Sources of Western Medieval Technology," *American Historical Review* 65 (1960) 522–526.
 - 11 Lynn Thorndike, "Invention of the Mechanical Clock about 1271 A. D.," *Speculum* 16 (1941) 242–243.
 - 12 *Libros del saber de astronomia del rey D. Alfonso de Castilla*, ed. M. Rico y Sinobas (Madrid 1866) 4.67–76.
 - 13 Silvio A. Bedini, "The Compartmented Cylindrical Clepsydra," *Technology and Culture* 3 (1962) 115–141.
 - 14 *Med. Techn.* 165–166.
 - 15 The intensity and diversity of the search is indicated by the fact that, almost simultaneously, inventors reached two related solutions: the verge and the wheel escapement; Ernst Zinner, *Die ältesten Räderuhren* (Bamberg 1939) 26. The use of geared weight-operated striking trains in clepsydras by the thirteenth century, and the assimilation of the vocabulary of the water clock to the mechanical clock, make difficult exact dating of the invention of the latter; cf. *Med. Techn.* 124. The earliest firm date is 1341 when Galvano Fiamma, *De gestis Azonis vicecomitis*, ed. L. A. Muratori, *Rerum italicarum scriptores* 12 (Milan 1728) 1038, tells of the invention in Milan of mills run neither by water nor by wind "sed per pondera contra pondera sicut fieri solet in horologiis. Et sunt ibi rotae multae, et non est opus, nisi unius pueri . . . Nec umquam in Italia tali opus fuit adinventum, licet per multos exquisitum" (italics added). The middle 1330s however, seem indicated by the fact that in 1338 a party of six Venetian merchants left for India taking a clock and an automatic fountain as their most valuable merchandise. In Delhi the Muslim Sultan paid to them the fantastic sum of 200,000 bezants "tam pro rellogio quam pro fontanella et aliis rebus dicte societatis"; Robert A. Lopez, "L'extrême frontière du commerce de l'Europe médiévale," *Moyen âge* 69 (1963) 488 n. 16. To command such a price, this clock must have been a great novelty, almost certainly weight-driven and escapement-controlled, since Islam was entirely familiar with elaborate water clocks, as is shown by Eilhard Wiedemann and F. Hauser, "Über die Uhren im Bereich der islamische Kultur," *Nova acta* (Halle) 100.5 (1915) 1–272.
 - 16 Enrico Narducci, *Tre prediche inedite del b. Giordano da Rivalto* (Rome 1857) 59–60, an offprint from *Giornale arcadico di scienze, lettere ed arti* 146 (1857) 125–126. Edward Rosen, "The Invention of Eye-glasses," *Journal of the History of Medicine and Allied Sciences* 11 (1956) 13–46, 183–218, clarifies the context.
 - 17 The word "engineer" first appears in 1170 and is very common in the thirteenth century; see *Med. Techn.* 160.
 - 18 "Fondamenti cristiani della tecnica occidentale," in *Tecnica e casistica*, ed. Enrico Castelli (Rome 1964) 241–263. A more popular presentation of his thesis is contained in the chapter, "The Christian Expectation of the End of Time and the Idea of Technical Progress," in his *Evolution and Christian Hope: Man's Concept of the Future from the Early Fathers to Teilhard de Chardin* (Garden City 1966) 121–142.
 - 19 More research is needed on the relations of Buddhism to technology: the former is divided into many sects, which may have different influences. In the sixteenth century the Japanese were eager and metallurgically equipped to adopt European types of firearms from the Dutch and Portuguese. In sharp contrast to the Chinese, in the nineteenth century they rapidly absorbed Western technology. Both in the sixteenth and the nineteenth centuries Buddhism would seem to have played a greater psychic role in Japan than in China. The considerable literature on the differential reactions of China and Japan towards Western technology (see particularly the thoughtful essay of Marlon J. Levy, Jr., "Contrasting Factors in the Modernization of China and Japan," *Economic Development and Cultural Change* 2 [1953] 236–253) generally concludes that the essence of the divergence lies in the mentality of the aggressive feudal aristocracy of Japan as compared to that of the Confucian bureaucracy of China. Confucianism, however, cannot be considered inherently anti-technological: the Sung dynasty, the great age of Neo-Confucianism, produced achievements in engineering in which Confucian scholars participated; cf. Joseph Needham, Wang Ling, and Derek J. Price, *Heavenly Clockwork: The Great Astronomical Clocks of Medieval China* (Cambridge, Eng. 1960) esp. 129–130.
 - 20 "Power," in *History of Technology*, ed. Charles Singer et al. (Oxford 1956) 2.606.
 - 21 *The Physical World of the Greeks* (New York 1956) 241. As is emphasized by W. J. Verdenius, "Science grecque et science moderne," *Revue philosophique* 152 (1962) 329–331, lower-class animism was sophisticated into a deification of the cosmos among the educated which made intellectuals as reluctant as artisans to use mechanics to compel nature to submit to human wishes.
 - 22 Gregory of Tours, *Vitae patrum* 18.2, ed. B. Krusch, *MGH Script, rer. merov.* 1 (Hanover 1885) 735.
 - 23 *Anthologia palatina graeca*, 9.418, ed. H. Stadtmueller (Leipzig 1906) 3.402–403.
 - 24 M. Mercier, *Le feu grégois* (Paris 1952) 14.
 - 25 Ca. 1150, in Italy; cf. Robert J. Forbes, *A Short History of the Art of Distillation* (Leyden 1948) 87–89.
 - 26 Ca. 1199; *Med. Techn.* 102 n. 5.
 - 27 Some buttons were used in Central Asia, Iran, and Greece in Antiquity for ornament, but apparently not for warmth.

- The functional button, fastening overlapping edges of cloth, is first found ca. 1235 on the "Adamsporte" of Bamberg cathedral, and in 1239 on a closely related relief at Bassenheim; cf. Erwin Panofsky, *Deutsche Plastik des 11. bis 13. Jahrhundert* (Munich 1924) pl. 74; H. Schnitzler, "Ein unbekanntes Reiterrelief aus dem Kreise des Naumburger Meisters," *Zeitschrift des Deutschen Vereins für Kunstwissenschaft* 1 (1935) 413 fig. 13.
- 28 Ca. 1440, in Italy; Sheldon Shapiro, "The Origin of the Suction Pump," *Technology and Culture* 5 (1964) 566–574.
- 29 The first secure evidence is a drawing, 1489–1494, by Dürer; Friedrich Lippmann, *Zeichnungen von Albrecht Dürer* 1 (Berlin 1873) pl. 4.
- 30 Erwin Panofsky and Fritz Saxl, *Dürer's "Melencolia I"* (Leipzig 1923) 67 n. 3.
- 31 A. Blunt, "Blake's 'Ancient Days': The Symbolism of the Compass," *Journal of the Warburg Institute* 2 (1938–39) 53–63.
- 32 *Med. Techn.* 174.
- 33 Nicole Oresme, *Le livre du ciel et du monde* 2.2, ed. Albert D. Menut and Alexander L. Denomy (Madison 1968) 288.
- 34 T. Camelot, "Action et contemplation dans la tradition chrétienne," *La vie spirituelle* 78 (1948) 275. That the cultural climate of Semitic Christianity was in this particular closer to that of the West than of the Greek world is indicated by the fact that Saint Ephraem Syrus, writing in Syriac and almost uninfluenced by Platonic prejudices, adopts elaborate stratagems to avoid valuing Martha's activism below Mary's contemplation: see I. Hausherr, "Utrum sanctus Ephraem Mariam plus aequo anteposuerit," *Orientalia christiana* 30 (1933) 153–163.
- 35 D. A. Csányi, "Otima pars," *Studia monastica* 2 (1960) 56–57.
- 36 Saint Augustine, *Sermo* 104.4, cited by A. M. de la Bonnardiére, "Marthe et Marie, figures de l'église d'après saint Augustin," *La vie spirituelle* 86 (1952) 425.
- 37 Richard of Saint Victor, *Liber exceptionum* 2.14.5, ed. Jean Chatillon (Paris 1958) 504.
- 38 *Deutsche Predigten und Traktate*, ed. and trans. Josef Quint (Munich 1955) 280–289.
- 39 Cf. Moses I. Finley, "Technical Innovation and Economic Progress in the Ancient World," *Economic History Review* 18 (1965) 44. Before the impact of the monastic ethic was fully felt, moral aversion to hard work was still found in the Christian West; see my "The Iconography of *Temperantia* and the Virtuousness of Technology" in *Action and Conviction in Early Modern Europe: Essays in Memory of E. H. Harbison*, ed. T. K. Rabb and J. E. Seigel (Princeton 1969) 198–199.
- 40 S. Kalischer, "Die Wertschätzung der Arbeit in Bibel und Talmud," in *Judaica: Festschrift zu Hermann Cohens siebzigstem Geburtstag* (Berlin 1912) 583.
- 41 The Greek ascetics may, in fact, have been even more steadily devoted to manual labor than the Latin: see P. McNulty and B. Hamilton, "Orientale lumen et magistra latinitas: Greek Influences on Western Monasticism (900–1100)," in *Le millénaire du Mont Athos, 963–1963* (Chevetogne 1963) esp. 187, 192, 212. One reason for this was that monastic reform movements in the West, combating what was regarded as corruption arising from wordly entanglements, elaborated Benedictine liturgies from the ninth century onward to the point where there was little time left for labor; cf. P. Schmitz, "L'influence de saint Benolt d'Aniane dans l'histoire de l'Ordre de saint Benolt," *Settimane di studio del Centro Italiano di Studi sull'Alto Medioevo* 5: *Il monachesimo* (Spoleto 1957) 401–415. The result was the development of *conversi*, lay brothers designated primarily for manual labor and distinguished from the choir monks whose prime duty was *opus Dei*. K. Hallinger, "Woher kamen die Laienbrüder?," *Analecta sacri ordinis cisterciensis* 12 (1956) 38, shows that such *conversi* were found in many Western abbeys in the eleventh century, but not at Cluny before 1100. Greek monasticism never developed such specialized worker monks; cf. P. de Meester, *De monachico statu iuxta disciplinam byzantinam* (Vatican 1942) 93–95.
- 42 Max L. W. Laistner, "Notes on Greek from the Lectures of a Ninth-Century Monastery Teacher," *Bulletin of the John Rylands Library* 7 (1922–1923) 439. Martin's etymology was remembered by Hugh of Saint Victor, *Epitome Dindimi in philosophiam*, ed. Roger Baron, *Traditio* 11 (1955) 112, who speaks of *mechanica* as "adulterina" but notes (p. 111) that "de interpretationibus vero nominum pauca deducimus."
- 43 E. Delaruelle, "Le travail dans les règles monastiques occidentales du IV^e au IX^e siècle," *Journal de psychologie normale et pathologique* 41 (1948) 61.
- 44 Early in the seventh century an Alexandrian merchant took a ship loaded with grain to Christian Celtic Cornwall and returned to Egypt with a cargo of tin: Leontius, *Vita sancti Joannis Eleemosynarii* (d. 616), PG 93.1624–1625. About 800 the *Martyrology of Oengus the Culdee*, ed. Whitley Stokes (London 1905) 86, 80, remembers an Egyptian monk, who from the context seems to have died in Ireland. A litany of the tenth–eleventh century remembers seven Egyptian monks buried at Disert Uilaig; Charles Plummer, *Irish Litanies* (London 1925) 64. These were presumably part of the massive emigration of the Greek Orthodox elite from Egypt resulting from the Persian and Muslim conquests in the early seventh century, on which see my *Latin Monasticism in Norman Sicily* (Cambridge, Mass. 1938, repr. 1968) 16–26. Most commentators on Egyptian influence in Ireland have supposed that it was transmitted at second hand through abbeys in southern Gaul. However, Margaret Schlauch, "On Conall Core and the Relations of Old Ireland with the Orient," *Journal of Celtic Studies* 1 (1950) 152–166, has collected literary materials known from Coptic, Ethiopic, and Christian Arabic sources, but resting on vanished Greek writings, which appear in Ireland long before they are found elsewhere in Europe. Miss Schlauch misunderstands the nature of the seventh-century migration from Egypt: it consisted not of Monophysite Copts, who would have

- found the West inhospitable, but of Melchite Greeks fleeing Coptic hatred.
- 45 Benedictine libraries often contained a considerable group of secular works; cf. C. L. W. Laistner, *Thought and Letters in Western Europe, A. D. 500 to 900* (Ithaca 1957) 228–235. The only regional survey of Greek monastic libraries known to me – that made in 1457 of the seventy-eight foundations in Calabria before there is any indication that their holdings were being looted by neo-Hellenic enthusiasts from the North – lists some sixteen hundred MSS of which only five are secular; two Homers (one a fragment), the *Hecuba* of Euripides, a part of Aristophanes, and Galen's treatise on medications; moreover, of these the four literary MSS are found in two abbeys, Seminara and Mesiano, which were no more than twenty miles apart; see *Le "Liber visitationis" d'Athanasie Chalkeopoulos (1457–1458)*, ed. M. H. Laurent and A. Guillou, *Studi e testi* 206 (Vatican 1960) 47, 107, 111.
- 46 See the provocative essay of Richard E. Sullivan, "Early Medieval Missionary Activity: A Comparative Study of Eastern and Western Methods," *Church History* 22 (1954) 17–35. Byzantine lack of interest in technological advance infected the waters with which their Slavic converts were baptized. Novgorod, for example, was a great and free republic of merchants in constant commerce with the west; one might expect, on sociological grounds, technological movement there. Yet, on the basis of recent excavations in the city, Michael W. Thompson, *Novgorod the Great* (London 1967) xvii, remarks that "In the tenth century there was perhaps little to choose between the two, but already in the twelfth century Russian and western societies were widely separated, because the former avoided innovation and the latter welcomed it. We do not appreciate how innovating western medieval society was until we can put it beside a part of Europe which was virtually static." The judgement is just in relation to technology, but Novgorod proved itself very original in painting and the forms, as distinct from the structural methods, of architecture.
- 47 *De diversis artibus*, ed. C. R. Dodwell (London 1961). Cyril Stanley Smith and John G. Hawthorne, *On Divers Arts: The Treatise of Theophilus* (Chicago 1963) have provided an excellent English translation and learned notes on the basis of Dodwell's revised text. For the date, see my "Theophilus redivivus," *Technology and Culture* 5 (1964) 226–230. Benoit Lacroix, "Travailleurs manuels du moyen âge roman: leur spiritualité," in *Mélanges Crozet*, 1.523–529, believes that in the twelfth century the Benedictine sense of religious dedication in labor – at least in the building of churches – spread to the laity. There is danger of exaggeration: there is exhilaration simply from participating in great works. A quatrain of 1110–1120 inscribed on the sarcophagus of Buschetto, architect of the new cathedral at Pisa (which was as much a product of civic pride as of faith) indicates that Buschetto was admired more for his engineering skill than for his pious construction or its beauty:
- Quod vix mille boum possent iuga iuncta movere,
Et quod vix potuit per mare ferre ratis,
Busketi nisu quod erat mirabile visu,
Dena puellarum turba levabit onus.
- Cited by Craig B. Fisher, "The Pisan Clergy and the Awakening of Historical Interest in a Medieval Commune," *Studies in Medieval and Renaissance History* 3 (1966) 177 n. 92.
- 48 Ernest S. Hedges, *Tin in Social and Economic History* (New York 1964) 107, 161.
- 49 *S. Bernardi vita prima* 2.5.31, PL 185:285.
- 50 *Descriptio positionis seu situationis monasterii Claravallensis*, PL 185:570–571.
- 51 *Acta imperii inedita*, ed. E. Winkelmann, 2 (Innsbruck 1885) 724 no. 1041.
- 52 *In s. Benedicti regulam* 3.10, PL 170:517.
- 53 See M. D. Chenu, "Moines, clercs, laïcs au carrefour de la vie évangélique (xii^e siècle)," *Revue d'histoire ecclésiastique* 49 (1954) 59–89.
- 54 Peter Sternagel, *Die artes mechanicae im Mittelalter: Begriffs- und Bedeutungsgeschichte bis zum Ende des 13. Jahrhunderts* (Regensburg 1966). In disagreement with Benz, Maurice de Gandillac, "Place et signification de la technique dans le monde médiéval," in *Técnica e casística*, ed. Enrico Castelli (Rome 1964) 273 n. 7, correctly asserts the contrast between Saint Augustine's and the Victorines' positions toward technology.
- 55 Augustini, *De civ. Dei* 22.24, *Corpus christianorum, series latina* 48 (Turnholt 1955) 848–849.
- 56 Cf. George Boas, *Essays in Primitivism and Related Ideas in the Middle Ages* (Baltimore 1947) 140–151.
- 57 Hugh of Saint Victor, ed. Baron (n. 42 above) 113, 115–116. It is significant that Dindimus is likewise Hugh's spokesman in his *De grammatica* (*ibid.* 92).
- 58 *Ibid.* 110.
- 59 *Ibid.* 111.
- 60 Ed. Buttimer, viii. For the study of this text the annotations by Jerome Taylor in his translation (New York 1961) are fundamental.
- 61 Richard of Saint Victor (n. 37 above) 105–106.
- 62 Hugh of Saint Victor, *Didascalicon* 1.4, 11; cf. Richard of Saint Victor, *Liber exceptionum* 4.23 (n. 37 above) 111.
- 63 James McKinnon, "The Meaning of the Patristic Polemic against Musical Instruments," *Current Musicology* (1965) 69–82.
- 64 Egon Wellesz, *History of Byzantine Music and Hymnography*, ed. 2 (Oxford 1961) 105–108; 366; cf. Jean Perrot, *L'orgue de ses origines hellénistiques à la fin du XIII^e siècle* (Paris 1965) 211 n. 5, 215.
- 65 *Friihogodi monachi Breviloquium vilae beati Wilfredi, et Wulfstani cantoris Narratio metrica de sancto Swithuno* ed. Alistair Campbell (Zurich 1950) 69–70, lines 141–170.

- 66 Edmund A. Bowles, "The Organ in the Medieval Liturgical Service" *Revue beige de musicologie* 16 (1962) 13–29. Even in the West no instrument save the organ was admitted to the Mass until the fifteenth century when trumpets began to announce the elevation of the Host; *idem*, "Were Musical Instruments Used in the Liturgical Service during the Middle Ages?," *Galpin Society Journal* 10 (1957) 40–56. This would indicate that, to the West, a higher degree of mechanization involved higher spirituality.
- 67 Henri Lavoix, "La musique au siècle de Saint Louis," in Gaston Raynaud, *Recueil de motets français des XII^e et XIII^e siècles* (Paris 1883) 2.351.
- 68 E. H. Swift, *Hagia Sophia* (New York 1940) 180.
- 69 *Med. Techn.* 124–125.
- 70 *Das Mittelalterliche Hausbuch*, ed. H. T. Bossert and W. F. Storck (Leipzig 1912) pl. 31–32. Edgar Wind, *Pagan Mysteries in the Renaissance* (London 1958) 96, notes that renaissance emblem books place "next to the classical columns and sirens, diamonds and laurels, salamanders, porcupines and unicorns ... the new waterwheels, bellows, catapults, rockets, bombards and barbicanes Nature is man writ large; hence if forces in nature produce miraculous effects when they are harnessed, collected and propitiously released, they can set an example for the forces in man."
- 71 *The Utrecht Psalter*, ed. Ernest De Wald (Princeton, 1932) pl. 58. I am grateful to Bruce Spiegelberg of Colby College for introducing me in 1966 to the total implication of this miniature, although as early as *Speculum* 15 (1940) 153 I had noted its purely mechanical novelties.
- 72 Alex G. Keller, "A Renaissance Humanist Looks at 'New' Inventions: the Article 'Horologium' in Giovanni Tortelli's *De orthographia*," *Technology and Culture* 11 (1970) 345–365.
- 73 See my "Iconography of *Temperantia*" (n. 39 above).
- 74 Henri Stern, *Le calendrier de 354* (Paris 1953) 356–357, and his "Poésies et représentations carolingiens et byzantins des mois," *Revue archéologique* 46 (1955) 164–166.
- 75 The brief effort of Saint Francis to institute a democracy of all creatures was quickly terminated; cf. my "The Historical Roots of Our Ecologic Crisis," *Science* 155 (1967) 1203–1207, reprinted in my *Machina ex Deo: Essays in the Dynamism of Western Culture* (Cambridge, Mass. 1968).
- 76 *Med. Techn.* 39–78.
- 77 *Vita Hludovici imperatoris* 40, ed. G. H. Pertz in MGH Script. 2.629.
- 78 Perrot (n. 64 above) 276 seq.
- 79 *Epp. Johannis VIII*, ed. E. Caspar, in MGH Epistolae Karolini aevi 5.287.

Three Ways of Being-With Technology

Carl Mitcham

In any serious discussion of issues associated with technology and humanity there readily arises a general question about the primary member in this relationship. On the one hand, it is difficult to deny that we exercise some choice over the kinds of technics with which we live – that is, that we control technology. On the other, it is equally difficult to deny that technics exert profound influences on the ways we live – that is, structure our existence. We build our buildings, Winston Churchill once remarked (apropos a proposal for a new Parliament building), then our buildings build us. But which comes first, logically if not temporally, the builder or the buildings? Which is primary, humanity or technology?

This is, of course, a chicken-and-egg question, one not subject to any straightforward or unqualified answer. But it is not therefore insignificant, nor is it enough to propose as some kind of synthesis that there is simply a mutual relationship between the two, that humanity and technology are always found together. Mutual relationship is not some one thing; mutual relationships take many different forms. There are, for instance, mutualities of parent and child, of husband and wife, of citizens, and so forth. Humanity and technology can be found together in more than one way. Rather than argue the primacy of one or the other factor or the cliché of mutuality in the humanity-technology relationship, I propose to outline three forms the relationship itself can take, three ways of being-with technology.

To speak of three ways of being-with technology is necessarily to borrow and adapt a category from Martin Heidegger's *Being and Time* (1927) in a manner that deserves some acknowledgment. In his seminal work Heidegger proposes to develop a new understanding of being human by taking the primordial human condition, being-in-the-world, and subjecting this given to what he calls an existential analysis. The analysis proceeds by way of elucidating three equiprimordial aspects of this condition of being human: *the world* within which the human finds itself, the *being-in* relationship, and the *being* who is in the relationship – all as a means of approaching what, for Heidegger, is the fundamental question, the meaning of Being.

The fundamental question need not, on this occasion, concern us. What does concern us is the central place of technics in Heidegger's analysis and the disclosure of being-with as one of its central features. For Heidegger the worldhood of the world, as he calls it, comes into view through technical engagements, which reveal a network of equipment and artifacts ready-to-hand for manipulation, and other human beings likewise so engaged. These others are neither just technically ready-to-hand (like tools) nor even scientifically present-at-hand (like natural objects); on the contrary, they are *like* the very human being who notices them in that "*they are there too, and there with it.*"¹

The being-with relationship thus disclosed through technical engagements is, for Heidegger, primarily

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social in character; it refers to the social character of the world that comes to light through technical practice. Such a world is not composed solely of tools and artifacts, but of tools used with others, and artifacts belonging to others. Technical engagements are not just technical but have an immediately and intimately social dimension. Indeed, this is all so immediate that it requires some labored stepping back even to recognize and state – the processes of distancing and articulation that are in part precisely what philosophy is all about.

The present attempt to step back and examine various ways of being-with technology rather than being-with others (through technology) takes off from but does not proceed in the same manner as Heidegger's social analysis of the They and the problem of authenticity in the technological world. For Heidegger, being-with refers to an immediate personal presence in technics. Social being-with can manifest itself, however, not just on the level of immediate or existential presence but also in ideas. Indeed, the social world is as much, if not more, a world of ideas as of persons. Persons hold ideas and interact with others and with things on the basis of them. These ideas can even enclose the realm of technics – that is, become a language or *logos* of technics, a “technology.”

The idea of being-with technology presupposes this “logical” encompassing of technics by a society and its philosophical or protophilosophical articulation. For many people, however, the ideas that guide their lives may not be held with conscious awareness or full articulation. They often take the form of myth. Philosophical argument and discussion then introduces into such a world of ideas a kind of break or rupture with the immediately given. This break or rupture need not require the rejection or abandoning of that given, but it will entail the bringing of that given into fuller consciousness or awareness – from which it must be accepted (or rejected) in a new way or on new grounds.

Against this background, then, I propose to develop historico-philosophical descriptions, necessarily somewhat truncated, of three alternative ways of being-with technology. The first is what may be called ancient skepticism; the second, Renaissance and Enlightenment optimism; and the third, romantic ambiguity or uneasiness. Even in the somewhat simplified form of ideal types in which they will be presented here, consideration of the issues that divide these three ways of being-with

technology may perhaps illuminate the difficulties we face in trying to live with modern technology and its manifest problems.

Ancient Skepticism

The original articulation of a relationship between humanity and technics, an articulation that is in its earliest forms coeval with the appearance of recorded history, can be stated boldly as “technology is bad but necessary” or, perhaps more carefully, as “technology (that is, the study of technics) is necessary but dangerous.” The idea is hinted at by a plethora of archaic myths, such as the story of the Tower of Babel or the myths of Prometheus, Hephaestus, or Daedalus and Icarus. Certainly the transition from hunting and gathering to the domestication of animals and plants introduced a profound and profoundly disturbing transition into culture. Technics, according to these myths, although to some extent required by humanity and thus on occasion a cause for legitimate celebration,² easily turn against the human by severing it from some larger reality – a severing that can be manifest in a failure of faith or shift of the will, a refusal to rely on or trust God or the gods, whether manifested in nature or in providence.³

Ethical arguments in support of this distrust or uneasiness about technical activities can be detected in the earliest strata of Western philosophy. According to the Greek historian Xenophon, for instance, his teacher Socrates (469–399 B.C.) considered farming, the least technical of the arts, to be the most philosophical of occupations. Although the earth “provides the good things most abundantly, farming does not yield them up to softness but ... produces a kind of manliness Moreover, the earth, being a goddess, teaches justice to those who are able to learn” (*Oeconomicus* 5.4 and 12). This idea of agriculture as the most virtuous of the arts, one in which human technical action tends to be kept within proper limits, is repeated by representatives of the philosophical tradition as diverse as Plato,⁴ Aristotle,⁵ St. Thomas Aquinas,⁶ and Thomas Jefferson.⁷

Elsewhere Xenophon notes Socrates' distinction between questions about *whether* to perform an action and *how* to perform it, along with another distinction between scientific or technological questions concerning the laws of nature and ethical or political questions about what is right and wrong, good and bad, pious and impious, just and unjust. In elaborating on the first distinction, Socrates

stresses that human beings must determine for themselves *how* to perform their actions – that they can take lessons in “construction (*tektonikos*), forging metal, agriculture, ruling human beings, and . . . calculation, economics, and military strategy,” and therefore should not depend on the gods for help in “counting, measuring, or weighing”; the ultimate consequences of their technical actions are nonetheless hidden. His initial example is even taken from agriculture: the man who knows how to plant a field does not know whether he will reap the harvest. Thus whether we should employ our technical powers is a subject about which we must rely on guidance from the gods.⁸

At the same time, with regard to the second distinction, Socrates argues that because of the supreme importance of ethical and political issues, human beings should not allow themselves to become preoccupied with scientific and technological pursuits. In the intellectual autobiography attributed to him in the *Phaedo*, for instance, Socrates relates how he turned away from natural science because of the cosmological and moral confusion it tended to engender.⁹ In the *Memorabilia* it is similarly said of Socrates that

He did not like others to discuss the nature of all things, nor did he speculate on the “cosmos” of the sophists or the necessities of the heavens, but he declared that those who worried about such matters were foolish. And first he would ask whether such persons became involved with these problems because they believed that their knowledge of human things was complete or whether they thought they were obligated to neglect human things to speculate on divine things. (*Memorabilia* 1.1.11–12)

Persons who turn away from human things to things having to do with the heavens appear to think “that when they know the laws by which everything comes into being, they will, when they choose, create winds, water, seasons, and anything else like these that they may need” (*Memorabilia* 1.1.15).¹⁰ As “the first to call down philosophy from the heavens and place it in the city and . . . compel it to inquire about life and morality and things good and bad,”¹¹ Socrates’ own conversation, however, is described as always about human things: What is pious? What is impious? What is good? What is shameful? What is just? What is unjust? What is moderation? For, as Xenophon says on another occasion, Socrates “was not eager to make his companions orators and businessmen and inventors, but thought that they should first possess moderation [*sophrosune*]. For he believed that without moderation those abilities only

enabled a person to become more unjust and to work more evil (*Memorabilia* 4.3). The initial distinction grants technical or “how-to” questions a realistic prominence in human affairs but recognizes their ambiguity and uncertainty; the subsequent distinction subordinates any systematic pursuit of technical knowledge to ethical and political concerns.

Such uneasiness before the immoderate possibilities inherent in technological powers is further elaborated by Plato. Near the beginning of the *Republic*, after Socrates outlines a primitive state and Glaucon objects that this is no more than a “city of pigs,” Socrates replies

The true state is in my opinion the one we have described – a healthy state, as it were. But if you want, we can examine a feverish state as well For there are some, it seems, who will not be satisfied with these things or this way of life; but beds, tables, and other furnishings will have to be added, and of course seasonings, perfume, incense, girls, and sweets – all kinds of each. And the requirements we mentioned before can no longer be limited to the necessities of houses, clothes, and shoes; but [various *technai*] must also be set in motion The healthy state will no longer be large enough either, but it must be swollen in size by a multitude of activities that go beyond the meeting of necessities (372d–373b)

As this passage indicates, and as can be confirmed by earlier references to Homer and other poets, certain elements of classical Greek culture had a distrust of the wealth and affluence that the *technai* or arts could produce if not kept within strict limitations. For according to the ancients such wealth accustoms men to easy things. But *chalepa ta kala*, difficult is the beautiful or the perfect; the perfection of anything, including human nature, is the opposite of what is soft or easy. Under conditions of affluence human beings tend to become accustomed to ease, and thus tend to choose the less over the more perfect, the lower over the higher, both for themselves and for others. With no art is this more prevalent than with medicine. Once drugs are available as palliatives, for instance, most individuals will choose them for the alleviation of pain over the more strenuous paths of physical hygiene or psychological enlightenment. The current (*techné*) of medicine, Socrates maintains to Glaucon later in the third book of the *Republic*, is an education in disease that “draws out death” (406b); instead of promoting health it allows the unhealthy to have “a long and wretched life” and “to produce offspring like themselves” (407d). That Socrates’ description applies even more strongly to modern medical technology than it did to that in classical Athens scarcely needs to be mentioned.

Another aspect of this tension between politics and technology is indicated by Plato's observations on the dangers of technical change. In the words of Adeimantus, with whom Socrates in this instance evidently agrees, once change has established itself as normal in the arts, "it overflows its bounds into human character and activity and from there issues forth to attack commercial affairs, and then proceeds against the laws and political orders" (424d–e). It is desirable that obedience to the law should rest primarily on habit rather than force. Technological change, which undermines the authority of custom and habit, thus tends to introduce violence into the state. Surely this is a possibility that the experience of the twentieth century, one of the most violent in history, should encourage us to take seriously.

This wariness of technological activity on moral and political grounds can be supplemented by an epistemological critique of the limitations of technological knowledge and a metaphysical analysis of the inferior status of technical objects. During a discussion of the education of the philosopher-king in the seventh book of the *Republic*, Socrates considers what kind of teaching most effectively brings a student "into the light" of the highest or most important things. One conclusion is that it is not those *technai* that "are oriented toward human opinions and desires or concerned with creation and fabrication and attending to things that grow and are put together" (533b). Because it cannot bring about a conversion or emancipation of the mind from the cares and concerns of the world, technology should not be a primary focus of human life. The orientation of technics, because it is concerned to remedy the defects in nature, is always toward the lower or the weaker (342c–d). A physician sees more sick people than he does healthy ones. *Eros* or love, by contrast, is oriented toward the higher or the stronger; it seeks out the good and strives for transcendence. "And the person who is versed in such matters is said to have spiritual wisdom, as opposed to the wisdom of one with *technai* or low-grade handicraft skills," Diotima tells Socrates in the *Symposium* (203a).

Aristotle agrees, but for quite different, more properly metaphysical reasons. According to Aristotle and his followers, reality or being resides in particulars. It is not some abstract species *Homo Sapiens* (with capital H and capital S) that *is* in the primary sense, but Socrates and Xanthippe. However, the reality of all natural entities is dependent on an intimate union of form and matter, and the *telos* or end determined thereby. The problem with

artifacts is that they fail to achieve this kind of unity at a very deep level, and are thus able to have a variety of uses or extrinsic ends imposed upon them. "If a bed were to sprout," says Aristotle, "not a bed would come up but a tree" (*Physics* 193b. 10). Insofar as it truly imitates nature, art engenders an inimitable individuality in its products, precisely because its attempt to effect as close a union of form and matter as possible requires a respect for or deference to the materials with which it works. In a systematized art or technology, matter necessarily tends to be overlooked or relegated to the status of an undifferentiated substrate to be manipulated at will.¹² Indeed, in relation to this Aristotle suggests a distinction between the arts of cultivation (e.g., medicine, education, and agriculture, which help nature to produce more abundantly things that it can produce of itself) from those of construction or domination (arts that bring into existence things that nature would not).¹³

The metaphysical issue here can be illustrated by observing the contrast between a handcrafted ceramic plate and Tupperware dishes. The clay plate has a solid weight, rich texture, and explicit reference to its surroundings not unlike that of a natural stone, whereas Tupperware exhibits a lightness of body and undistinguished surface that only abstractly engages the environment of its creation and use. According to a Mobil Oil Company advertisement from the early 1980s, synthetic products are actually "better than the real thing," so the word "synthetic," which implies a "pallid imitation," ought to be discarded. But whether this is true or not depends heavily on a prior understanding of what is real in the first place. For Aristotle there is a kind of reality that can only be found in particulars and is thus beyond the grasp of mass-production, function-oriented, polymer technology.

For Plato and the Platonic tradition, too, artifice is less real than nature. Indeed, in the tenth book of the *Republic* there is a discussion of the making of beds (to which Aristotle's remarks from the *Physics* may allude) by god or nature, by the carpenter or *tekton*, and by painter or artist. Socrates' argument is that the natural bed, the one made by the god, is the primary reality; the many beds made in imitation by artisans are a secondary reality; and the pictures of beds painted by artists are a tertiary reality. *Techné* is thus creative in a second or "third generation" sense (597e) – and thus readily subject to moral and metaphysical guidance.

In moral terms artifice is to be guided or judged in terms of its goodness or usefulness. In metaphysical terms

the criterion of judgment is proper proportion or beauty. One possible disagreement between Platonists and Aristotelians with regard to one or another aspect of making is whether the good or the beautiful, ethics or aesthetics, is the proper criterion for its guidance. Such disagreement should nevertheless not be allowed to obscure a more fundamental agreement, the recognition of the need to subject *poesis* and *technai* to certain well-defined limitations. Insofar as technical objects or activities fail to be subject to the inner guidance of nature (*phusis*), nature must be brought to bear upon them consciously, from the outside (as it were) by human beings. Again, the tendency of contemporary technical creations to bring about environmental problems or ecological disorders to some extent confirms the premodern point of view.

The ancient critique of technology thus rests on a tightly woven, fourfold argument: (1) the will to technology or the technological intention often involves a turning away from faith or trust in nature or providence; (2) technical affluence and the concomitant processes of change tend to undermine individual striving for excellence and societal stability; (3) technological knowledge likewise draws the human being into intercourse with the world and obscures transcendence; (4) technical objects are less real than objects of nature. Only some necessity of survival, not some ideal of the good, can justify the setting aside of such arguments. The life of the great Hellenistic scientist Archimedes provides us (as it did antiquity) with a kind of icon or lived-out image of these arguments. Although, according to Plutarch, Archimedes was capable of inventing all sorts of devices, he was too high minded to do so except when pressed by military necessity – yet even then he refused to leave behind any treatise on the subject, because of a salutary fear that his weapons would be too easily misused by humankind.¹⁴

Allied with the Judeo-Christian-Islamic criticism of the vanity of human knowledge and of worldly wealth and power,¹⁵ this premodern distrust of technology dominated Western culture until the end of the Middle Ages, and elements of it can be found vigorously repeated in numerous figures since – from Samuel Johnson's neo-classicist criticism of Milton's promotion of education in natural science¹⁶ to Norbert Wiener who in 1947, like Archimedes twenty-three hundred years before, vowed not to publish anything more that could do damage in the hands of militarists.¹⁷ In one less well-known allusion to another aspect of the classical moral argument, John

Wesley (1703–91), in both private journals and public sermons, ruefully acknowledges the paradox that Christian conversion gives birth to a kind of self-discipline that easily engenders the accumulation of wealth – which wealth then readily undermines true Christian virtue. “Indeed, according to the natural tendency of riches, we cannot expect it to be otherwise,” writes Wesley.¹⁸

With regard to other aspects of the premodern critique, Lewis Mumford, for instance, has criticized the will to power manifested in modern technology, and Heidegger, following the lead of the poet Rainer Maria Rilke, has invoked the metaphysical argument by pointing out the disappearance of the thinghood of things, the loss of a sense of the earth in mass-produced consumer objects. From Heidegger's point of view, nuclear annihilation of all things would be “the mere final emission of what has long since taken place, has already happened.”¹⁹

From the viewpoint of the ancients, then, being-with technology is an uneasy being-along-side-of and working-to-keep-at-arm's-length. Phrased in terms of the contemporary discipline of technology assessment, this premodern attitude looks upon technics as dangerous or guilty until proven innocent or necessary – and in any case, the burden of proof lies with those who would favor technology, not those who would restrain it.

Enlightenment Optimism

A radically different way of being-with technology – one that shifts the burden of proof from those who favor to those who oppose the introduction of inventions – argues the inherent goodness of technology and the consequent accidental character of all misuse. Aspects of this idea or attitude are not without premodern adumbration. But in comprehensive and persuasive form arguments to this effect are first fully articulated in the writings of Francis Bacon (1561–1626) at the time of the Renaissance, and subsequently become characteristic of the Enlightenment philosophy of the eighteenth century.

Like Xenophon's Socrates, Bacon grants that the initiation of human actions should be guided by divine counsel. But unlike Socrates, Bacon maintains that God has given humanity a clear mandate to pursue technology as a means for the compassionate alleviation of the suffering of the human condition, of being-in-the-world. Technical know-how is cut loose from all doubt about the consequences of technical action. In the choice between ways of life devoted to scientific-technological

or ethical-political questions, Bacon further argues that Christian revelation directs men toward the former over the latter.

For it was not that pure and uncorrupted natural knowledge whereby Adam gave names to the creatures according to their propriety, which gave occasion to the fall. It was the ambitious and proud desire of moral knowledge to judge of good and evil, to the end that man may revolt from God and give laws to himself, which was the form and manner of the temptation.²⁰

Contrary to what is implied by the myth of Prometheus or the legend of Faust, it was not scientific and technological knowledge that led to the Fall, but vain philosophical speculation concerning moral questions. Formed in the image and likeness of God, human beings are called upon to be creators; to abjure that vocation and to pursue instead an unproductive discourse on ethical quandaries brings about the just punishment of a poverty-stricken existence. "He that will not apply new remedies must expect new evils."²¹ Yet "the kingdom of man, founded on the sciences," says Bacon, is "not much other than ... the kingdom of heaven."²²

The argument between Socrates and Bacon is not, it is important to note, simply one between partisans either against or in favor of technology. Socrates allows technics a legitimate but strictly utilitarian function, then points out the difficulty of obtaining a knowledge of consequences upon which to base any certainty of trust or commitment. Technical action is circumscribed by uncertainty or risk. Bacon, however, although he makes some appeals to a consequentialist justification, ultimately grounds his commitment in something approaching deontological principles. The proof is that he never even considers evaluating individual technical projects on their merit, but simply argues for an all-out affirmation of technology in general. It is right to pursue technological action, never mind the consequences. Intuitions of uncertainty are jettisoned in the name of revelation.

The uniqueness of the Baconian (or Renaissance) interpretation of the theological tradition is also to be noted. For millennia the doctrines of God as creator of "the heavens and the earth" (Gen. 1.1) and human beings as made "in the image of God" (Gen. 1.27) exercised profound influence over Jewish and later Christian anthropology, without ever being explicitly interpreted as a warrant for or a call to technical activity. Traditional or premodern interpretations focus on the soul, the

intellect, or the capacity for love as the key to the *imago Dei*.²³ The earliest attribution to this doctrine of technological implications occurs in the early Renaissance.²⁴ The contemporary theological notion of the human as using technology to prolong creation or cocreate with God depends precisely on the reinterpretation of Genesis adumbrated by Bacon.

The Enlightenment version of Bacon's religious argument is to replace the theological obligation with a natural one. In the first place, human beings simply could not survive without technics. As D'Alembert puts it in the "Preliminary Discourse" to the *Encyclopedia* (1751), there is a prejudice against the mechanical arts that is a result of their accidental association with the lower classes.

The advantage that the liberal arts have over the mechanical arts, because of their demands upon the intellect and because of the difficulty of excelling in them, is sufficiently counterbalanced by the quite superior usefulness which the latter for the most part have for us. It is their very usefulness which reduced them perforce to purely mechanical operations in order to make them accessible to a larger number of men. But while justly respecting great geniuses for their enlightenment, society ought not to degrade the hands by which it is served.²⁵

In the even more direct words of Immanuel Kant, "Nature has willed that man should by himself, produce everything that goes beyond the mechanical ordering of his animal existence, and that he should partake of no other happiness or perfection than that which he himself, independently of instinct, has created by his own reason."²⁶ Nature and reason, if not God, command humanity to pursue technology; the human being is redefined not as *homo sapiens* but as *homo faber*. Technology is the essential human activity. In more ways than Kant explicitly proclaims, "Enlightenment is man's release from his self-incurred tutelage."²⁷

Following a redirecting (Bacon) or reinterpreting (D'Alembert and Kant) of the will, Bacon and his followers explicitly reject the ethical-political argument against technological activities in the name of moderation. With no apparent irony, Bacon maintains that the inventions of printing, gunpowder, and the compass have done more to benefit humanity than all the philosophical debates and political reforms throughout history. It may, he admits, be pernicious for an individual or a nation to pursue power. Individuals or small groups may well abuse such power. "But if a man endeavor to establish and extend the power and dominion of the human

race itself over the universe,” writes Bacon, “his ambition (if ambition it can be called) is without doubt both a more wholesome and a more noble thing than the other two.” And, of course, “the empire of man over things depends wholly on the arts and sciences” (*Novum Organum* 1.129).

Bacon does not expound at length on the wholesomeness of technics. All he does is reject the traditional ideas of their corrupting influence on morals by arguing for a distinction between change in politics and in the arts.

In matters of state a change even for the better is distrusted [Bacon observes], because it unsettles what is established; these things resting on authority, consent, fame and opinion, not on demonstration. But arts and sciences should be like mines, where the noise of new works and further advances is heard on every side. (*Novum Organum* 1.90)

Unlike Aristotle and Aquinas, both of whom noticed the same distinction but found it grounds for caution in technology,²⁸ Bacon thinks the observation itself is enough to set technology on its own path of development.

Bacon’s Enlightenment followers, however, go considerably further, and argue for the positive or beneficial influence of the arts on morals. The *Encyclopedia*, for instance, having identified “luxury” as simply “the use human beings make of wealth and industry to assure themselves of a pleasant existence” with its origin in “that dissatisfaction with our condition ... which is and must be present in all men,” undertakes to reply directly to the ancient “diatribes by the moralists who have censured it with more gloominess than light.”²⁹ Critics of material welfare have maintained that it undermined morals, and apologists have responded that this is the case only when it is carried to excess. Both are wrong. Wealth is, as we would say today, neutral. A survey of history reveals that luxury “did not determine morals, but ... it took its character rather from them.”³⁰ Indeed, it is quite possible to have a moral luxury, one that promotes virtuous development.

But if a first line of defense is to argue for moderation, and a second for neutrality, a third is to maintain a positive influence. David Hume (1711–76), for instance, in his essay “Of Commerce,” argues that a state should encourage its citizens to be manufacturers more than farmers or soldiers. By pursuit of “the arts of *luxury*, they add to the happiness of the state.”³¹ Then, in “Of Refinement in the Arts,” he explains that the ages of

luxury are both “the happiest and the most virtuous” because of their propensity to encourage industry, knowledge, and humanity.”³² “In times when industry and the arts flourish,” writes Hume, “men are kept in perpetual occupation, and enjoy, as their reward, the occupation itself, as well as those pleasures which are the fruit of their labour.”³³

Furthermore, the spirit of activity in the arts will galvanize that in the sciences and vice versa; knowledge and industry increase together. In Hume’s own inimitable words: “We cannot reasonably expect that a piece of woolen cloth will be wrought to perfection in a nation which is ignorant of astronomy.”³⁴ And the more the arts and sciences advance, “the more sociable men become.” Technical engagements promote civil peace because they siphon off energy that might otherwise go into sectarian competition. Technological commerce and scientific aspirations tend to break down national and class barriers, thus ushering in tolerance and sociability. In the words of Hume’s contemporary, Montesquieu: “Commerce is a cure for the most destructive prejudices; for it is a general rule, that wherever we find tender manners, there commerce flourishes; and that wherever there is commerce, there we meet with tender manners.”³⁵

The ethical significance of technological activity is not limited, however, to its socializing influence. Technology is an intellectual as well as a moral virtue, because it is a means to the acquisition of true knowledge. That technological activity contributes to scientific advance rests on a theory of knowledge that again is first clearly articulated by Bacon, who begins his *Novum Organum* or “new instrument” with the argument that true knowledge is acquired only by a close intercourse with things themselves. “Neither the naked hand nor the understanding left to itself can effect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand” (*Novum Organum* 1.2). Knowledge is to be acquired by active experimentation, and ultimately evaluated on the basis of its ability to engender works. The means to true knowledge is what Bacon candidly refers to as the “torturing of nature”; left free and at large, nature, like the human being, is loath to reveal her secrets.³⁶ The result of this new way will be the union of knowledge and power (*Novum Organum* 2.3). Bacon is, quite simply, an epistemological pragmatist. What is true is what works. “Our only hope,” he says, “therefore lies in a true induction” (*Novum Organum* 1.14).

The very basis of the great French *Encyclopedia or Dictionary of Sciences, Arts, and Crafts* is precisely this

epistemological vision, a unity between theory and practice. Bacon is explicitly identified as its inspiration, and is praised for having conceived philosophy “as being only that part of our knowledge which should contribute to making us better or happier, thus ... confining it within the limits of useful things [and inviting] scholars to study and perfect the arts, which he regards as the most exalted and most essential part of human science.”³⁷ Indeed, in explicating the priorities of the *Encyclopædia*, the “Preliminary Discourse” goes on to say that “too much has been written on the sciences; not enough has been written well on the mechanical arts.”³⁸ The article on “Art” in the *Encyclopædia* further criticizes the prejudice against the mechanical arts, not only because it has “tended to fill cities with ... idle speculation,”³⁹ but even more because of its failure to produce genuine knowledge. “It is difficult if not impossible ... to have a thorough knowledge of the speculative aspects of an art without being versed in its practice,” although it is equally difficult “to go far in the practice of an art without speculation.”⁴⁰ It is this new unity of theory and practice – a unity based in practice more than in theory⁴¹ – that is at the basis of, for instance, Bernard de Fontenelle’s eulogies of the practice of experimental science as an intellectual virtue as well as a moral one, and the Enlightenment reconception of Socrates as having called philosophy down from the heavens to experiment with the world.⁴²

Bacon’s true induction likewise rests on a metaphysical rejection of natural teleology. The pursuit of a knowledge of final causes “rather corrupts than advances the sciences,” declares Bacon, “except such as have to do with human action” (*Novum Organum* 2.2). Belief in final causes or purposes inherent in nature is a result of superstition or false religion. It must be rejected in order to make possible “a very diligent dissection and anatomy of the world” (*Novum Organum* 1.124). Nature and artifice are not ontologically distinct. “All Nature is but Art, unknown to thee,” claims Alexander Pope.⁴³ “Nature does not exist,” declares Voltaire, “art is everything.” The Aristotelian distinction between arts of cultivation and of construction is jettisoned in favor of universal construction.

With regard to Pope, although it is not uncommon to find comparisons of the God/nature and artist/artwork relationships in Greek and Christian, ancient and modern authors, there are subtle differences. For Plato (*Sophist* 265b and *Timaeus* 27c) and St. Augustine (*De civitate Dei* 11.21), for example, there is first a fundamental distinction to be made between divine and human *poiesis*, which is itself to be distinguished from *techné* and, second, the fact

that even though made by a god the world is not to be looked upon as an artifact or something that functions in an artificial manner. Thomas Hobbes, Bacon’s secretary, however, proposes to view nature not just as produced by a divine art but as itself “the art whereby God hath made and governs the world.”⁴⁴ Indeed, so much is this the case that for Hobbes human art itself can be said to produce natural objects – or, to say the same thing in different words, the whole distinction between nature and artifice disappears.

This last point also links up with the first: metaphysics supports volition. If nature and artifice are not ontologically distinct, then the traditional distinction between technics of cultivation and technics of domination disappears. There are no technics that help nature to realize its own internal reality, and human beings are free to pursue power. If nature is just another form of mechanical artifice, it is likewise reasonable to think of the human being as a machine. “Man is a machine and ... in the whole universe there is but a single substance variously modified,” concludes LaMettrie.⁴⁵ “For what is the heart,” wrote Hobbes a century earlier, “but a spring; and the nerves, but so many strings; and the joints, but so many wheeles.”⁴⁶ But the activities appropriate to machines are technological ones; *homo faber* is yet another form of *l’homme machine*, and vice versa.

Like that of the ancients, then, the distinctly modern way of being-with technology may be articulated in terms of four interrelated arguments: (1) the will to technology is ordained for humanity by God or by nature; (2) technological activity is morally beneficial because, while stimulating human action, it ministers to physical needs and increases sociability; (3) knowledge acquired by a technical closure with the world is truer than abstract theory; and (4) nature is no more real than – indeed it operates by the same principles as – artifice. It is scarcely necessary to illustrate how aspects of this ideology remain part of intellectual discourse in Marxism, in pragmatism, and in popular attitudes regarding technological progress, technology assessment and public policy, education, and medicine.

Romantic Uneasiness

The premodern argument that technology is bad but necessary characterizes a way of being-with technology that effectively limited rapid technical expansion in the West for approximately two thousand years. The Renaissance and Enlightenment argument in support of the theory

that technology is inherently good discloses a way of being-with technology that has been the foundation for a Promethean unleashing of technical power unprecedented in history. The proximate causes of this radical transformation were, of course, legion: geographic, economic, political, military, scientific. But what brought all such factors together in England in the mid-eighteenth century to engender a new way of life, what enabled them to coalesce into a veritable new way of being-in-the-world, was a certain kind of optimism regarding the expansion of material development that is not to be found so fully articulated at any point in premodern culture.⁴⁷

In contrast with premodern skepticism about technology, however, the typically modern optimism has not retained its primacy in theory even though it has continued to dominate in practice. The reasons for this are complex. But faced with the real-life consequences of the Industrial Revolution, from societal and cultural disruptions to environmental pollution, post-Enlightenment theory has become more critical of technology. Romanticism, as the name for the typically modern response to the Enlightenment, thus implicitly contains a new way of being-with technology, one that can be identified with neither ancient skepticism nor modern optimism.

Romanticism is, of course, a multi-dimensioned phenomenon. In one sense, it can refer to a permanent tendency in human nature that manifests itself differently at different times. In another, it refers to a particular manifestation in nineteenth-century literature and thought. Virtually all attempts to analyze this particular historical manifestation interpret romanticism as a reaction to and criticism of modern science. Against Newtonian mechanics, the romantics propose an organic cosmology; in opposition to scientific rationality, romantics assert the legitimacy and importance of imagination and feeling. What is seldom appreciated is the extent to which romanticism can also be interpreted as a questioning – in fact, the first self-conscious questioning – of modern technology.⁴⁸ So interpreted, however, romanticism reflects an uneasiness about technology that is nevertheless fundamentally ambiguous; although as a whole the romantic critique may be distinct from ancient skepticism and modern optimism, in its parts it nevertheless exhibits differential affinities with both.

To begin with, consider the volitional aspect of technology. On the ancient view, technology was seen as a turning away from God or the gods. On the modern, it is ordained by God or, with the Enlightenment rejection of God, by Nature. With the romantics the will to

technology either remains grounded in nature or is cut free from all extrahuman determination. In the former instance, however, nature is reconceived as not just mechanistic movement but as an organic striving toward creative development and expression. From the perspective of “mechanical philosophy,” human technology is a prolongation of mechanical order; from that of *Naturphilosophie* it becomes a participation in the self-expression of life. When liberated from even such organic creativity, technology is grounded solely in the human will to power, but with recognition of its often negative consequences; the human condition takes on the visage of Gothic pathos.⁴⁹ The most that seems able to be argued is that the technological intention, that is the will to power, should not be pursued to the exclusion of other volitional options – or that it should be guided by aesthetic ideals.

William Wordsworth (1770–1850), for instance, the most philosophical of the English romantic poets, in the next-to-last book of his long narrative poem, *The Excursion* (1814), describes how he has “lived to mark / A new and unforeseen creation rise” (bk. 8, lines 89–90).

Casting reserve away, exult to see
An intellectual mastery exercised
O'er the blind elements, a purpose given,
A perseverance fed; almost a soul
Imparted – to brute matter. I rejoice,
Measuring the force of those gigantic powers
That, by the thinking mind, have been compelled
To serve the will of feeble-bodied Man.

(bk. 8, lines 200–207)

Here the rejoicing in and affirmation of technological conquest: and control is clearly in harmony with Enlightenment sentiments.

Yet in the midst of this exultation
I grieve, when on the dark side
Of this great change I look; and there behold
Such outrage done to nature.

(151–53)

And afterward he writes,

How insecure, how baseless in itself,
Is the Philosophy whose sway depends
On mere material instruments; – how weak
Those arts, and high inventions, if unpropped
By virtue.

(223–27)

Here Enlightenment optimism is clearly replaced by something approaching premodern skepticism.

Wordsworth clarifies his position in the last book of the poem. True, he has complained, in regard to the factory labor of children, that a child is

...subject to the arts
Of modern ingenuity, and made
The senseless member of a vast machine.
(bk. 9, lines 157–59)

Still, he is not insensitive to the fact that the rural life is also often an “unhappy lot” enslaved to “ignorance” “want” and “miserable hunger” (lines 163–65). Nevertheless, he says, his thoughts cannot help but be

...turned to evils that are new and chosen,
A bondage lurking under shape of good, –
Arts, in themselves beneficent and kind,
But all too fondly followed and too far.
(187–90)

In such lines Wordsworth no longer maintains with any equanimity the Enlightenment principle that the arts are “in themselves beneficent and kind.” With his suggestion that the self-creative thrust has in technology been followed “too fondly” and “too far,” and that bondage has been created under the disguise of good, a profound questioning is introduced. But unlike the ancients, who called for specific delimitations on technics, with the romantics there is no clear outcome other than a critical uneasiness – or a heightened aesthetic sensibility.

Later, in a sonnet on “Steamboats, Viaducts, and Railways” (1835), having observed contradictions between the practical and aesthetic qualities of such artifacts, Wordsworth concludes that

In spite of all that beauty may disown
In your harsh features, Nature doth embrace
Her lawful offspring in Man’s art; and Time,
Pleased with your triumphs o’er his brother Space,
Accepts from your bold hands the proffered crown
Of hope, and smiles on you with cheer sublime.

Once again technology, in Enlightenment fashion, is viewed as an extension of nature, and even described in Baconian terms as the triumph of time over space.⁵⁰ The “lawful offspring” is nevertheless ugly, full of “harsh features” that beauty disowns. Yet from the “bold hands” of technology temporal change is given the “crown of

hope ... with cheer sublime” that things will work out for the good. In Wordsworth’s own commentary on *The Excursion*, the problem “is an ill-regulated and excessive application of powers so admirable in themselves.”⁵¹ But it is precisely this ill-regulated and excessive technology that also gives birth to a new kind of admiration, that of the sublime.

With regard to the moral character of technology, ambiguity is even more apparent. Consider, for instance, the arguments of Jean-Jacques Rousseau (1712–78), a man who is, in important respects, the founder of the romantic movement, and whose critique takes shape even before the inauguration of the Industrial Revolution itself, strictly in reaction to ideas expressed by the *philosophes*. In 1750, in a prize-winning “Discourse on the Moral Effects of the Arts and Sciences,” critical of the kinds of ideas that would shortly be voiced by D’Alembert’s “Preliminary Discourse,” Rousseau boldly concludes that “as the conveniences of life increase, as the arts are brought to perfection, and luxury spreads, true courage flags, the virtues disappear.”⁵² “Money, though it buys everything else,” he argues, “cannot buy morals and citizens.”⁵³ “The politicians of the ancient world,” he says, “were always talking of morals and virtue; ours speak of nothing but commerce and money.”⁵⁴ In fact, from Rousseau’s point of view, not only have “our minds ... been corrupted in proportion as the arts and sciences have improved,”⁵⁵ but the arts and sciences themselves “owe their birth to our vices.”⁵⁶ Action, even destructive action, particularly on a grand (or sublime) scale, is preferable to nonaction.⁵⁷

What sounds, at first, like a straightforward return to the moral principles of the ancients, however, is made in the name of quite different ideals. Virtue, for Rousseau, is not the same thing it is for Plato or Aristotle – as is clearly indicated by his praise of Francis Bacon, “perhaps the greatest of philosophers.”⁵⁸ In agreement with Bacon, Rousseau criticizes “moral philosophy” as an outgrowth of “human pride,”⁵⁹ as well as the hiatus between knowledge and power, thought and action, that he finds to be a mark of civilization; instead, he praises those who are able to act decisively in the world, to alter it in their favor, even when these are men whom the Greeks would have considered barbarians. Virtue, for instance, lies with the Scythians who conquered Persia, not the Persians; with the Goths who conquered Rome, not the Romans; with the Franks who conquered the Gauls, or the Saxons who conquered England.⁶⁰ In civilized countries, he says, “There are a thousand prizes for fine discourses, and none for good action.”⁶¹

With Bacon, Rousseau argues the need for actions, not words, and approves the initial achievements of the Renaissance in freeing humanity from a barren medieval scholasticism.⁶² But unlike Bacon, Rousseau sees that even scientific rationality, through the alienation of affection, can often weaken the determination and commitment needed for decisive action. Thus, in a paradox that will become a hallmark of romanticism, Rousseau turns against technology – but in the name of ideals that are at the heart of technology. He criticizes a particular historical embodiment of technology, but only to advance a project that has become momentarily or partially impotent.

It was in England, however, where the Industrial Revolution found its earliest full-scale manifestation, that this paradoxical critique achieved an initial broad literary expression. Such expression took a realistic turn, rejecting classical patterns in favor of the specific depiction of real situations often in unconventional forms. A poem such as William Blake's "London" (1794) or a novel like Charles Dickens's *Hard Times* (1854), in their presentation of the dehumanizing consequences of factory labor, equally well illustrate the force of this approach. Wordsworth, again, may be quoted to extend the issue of the alienation of affections to the social level. In a letter from 1801 he writes:

It appears to me that the most calamitous effect which has followed the measures which have lately been pursued in this country, is a rapid decay of the domestic affections among the lower orders of society For many years past, the tendency of society, amongst all the nations of Europe, has been to produce it; but recently, by the spreading of manufactures through every part of the country . . . the bonds of domestic feeling . . . have been weakened, and in innumerable instances entirely destroyed If this is true, . . . no greater curse can befall a land.⁶³

Romantic realism is, however, allied with visionary symbolism and, through this, epistemological issues. Consider, for instance, another aspect of Blake's genius, his prophetic poems. John Milton over a century before had in *Paradise Lost* (1667) already identified Satan with the technical activities of mining, smelting, forging, and molding the metals of hell into the city of Pandemonium.⁶⁴ Following this lead, Blake, in *Milton* (1804), identifies Satan with the abused powers of technology – and Newtonian science. Satan, "Prince of the Starry Hosts and of the Wheels of Heaven," also has the job of turning "the [textile] Mills day & night."⁶⁵ But in the prefatory

lyric that opens this apocalyptic epic, Blake rejects the necessity of "these dark Satanic Mills" and cries out

I will not cease from Mental Fight,
Nor shall my Sword sleep in my hand
Till we have built Jerusalem
In England's green & pleasant Land.

This lyric, "And Did Those Feet in Ancient Time," is set to music and becomes the anthem of the British Socialism. A visionary, imaginative – not to say Utopian – socialism is the romantic answer to the romantic critique of the moral limitations of technology. Mary Shelley's *Frankenstein* (1818), in another instance, likewise presents a love-hate relationship with technology in which that which is hated is properly redeemed not by premodern delimitation but by the affective correlate of an expansive imagination – namely, love.

Industrialization, then, undermines affection – that is, feeling and emotion, at both the individual and social levels. And this practical fact readily becomes allied with a more theoretical criticism of the Enlightenment emphasis on reason as the sole or principle cognitive faculty. The Enlightenment argued for the primacy of reason as the only means to advance human freedom from material limitations. According to the romantic reply, not only does such an emphasis on reason not free humanity from material bonds (witness the evils of the Industrial Revolution), but in itself it is (in the words of William Blake) a "mind-forged manacle." The focus on reason is itself a limitation that must be overcome; and through the consequent liberation of imagination the historical condition of technical activity can in turn be altered. In the "classic" epistemological defense and definition of Samuel Taylor Coleridge:

The imagination . . . I consider either as primary, or secondary. The primary imagination I hold to be the living power and prime agent of all human perception, and as a repetition in the finite mind of the eternal act of creation in the infinite I AM. The secondary I consider as an echo of the former, co-existing with the conscious will, yet still as identical with the primary in the kind of its agency, and differing only in degree, and in the mode of its operation. It dissolves, diffuses, dissipates, in order to recreate; or where this process is rendered impossible, yet still, at all events, it struggles to idealize and to unify.⁶⁶

Indeed, it is to this power that Blake also appeals as the source of his social revolution, when he proclaims, "I know of no other Christianity and of no other Gospel

than the liberty both of body & mind to exercise the Divine Arts of Imagination, the real & eternal World of which this Vegetable Universe is but a faint shadow, & in which we shall live in our Eternal or Imaginative Bodies when these Vegetable Mortal Bodies are no more.”⁶⁷

Finally, with regard to artifacts, the romantic view is again both like and unlike that of the Enlightenment. It is Enlightenment-like in the belief that nature and artifice operate by the same principles. Contra the Enlightenment, however, the romantic view takes nature as the key to artifice rather than artifice as the key to nature. The machine is a diminished form of life, not life a complex machine. Furthermore, nature is no longer perceived primarily in terms of stable forms; the reality of nature is one of process and change. Wordsworth and other English romantics are taken with the “mutability” of nature. Lord Byron, for instance, at the conclusion of *Childe Harold's Pilgrimage* (1818), when he aspires “to mingle with the Universe, and feel / What I can ne'er express” (canto 4, stanza 177), describes nature as the

...glorious mirror, where the Almighty's form
Glasses itself in tempests; in all time,
Calm or convulsed – in breeze, or gale, or storm –
Icing the Pole, or in the torrid clime
Dark-heaving – boundless, endless, and sublime –
The image of Eternity

(canto 4, stanza 183)

Nature, thus reconceptualized, reflects its new character into the world of artifice.

For the Enlightenment, nature and artifice both exhibit at their highest levels of reality various aspects of mechanical order, the interlocking of parts in a mathematical interrelation of the well-drafted lines of a Euclidean geometry. The metaphysical character of such reality is manifest to the senses through a “classical” vision of the beautiful – although there develops an Enlightenment excitement with the great or grandiose and the consequent projecting of art beyond nature that contradicts the models of harmonious stability within nature characteristic of classical antiquity and thus intimates romantic sensibilities. For romanticism, by contrast, the metaphysical reality of both nature and artifice is best denoted not by stable or well-ordered form but by process or change, especially as apprehended by the new aesthetic category of the sublime or the overwhelming and what Byron refers to as “pleasing fear” (canto 4, stanza 184).

As an aesthetic category, the idea of the sublime can be traced back to Longinus (third century A.D.) who departed from classical canons of criticism by praising literature that could provoke “ecstasy.” But the concept received little real emphasis until Edmund Burke's *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful* (1757). For Burke, beauty is associated with social order and is represented with harmony and proportion in word and figure; the sublime, by contrast, is concerned with the individual striving and is indicated by magnitude and broken line. “Whatever is fitted in any sort to excite the ideas of pain, and danger, whatever is in any sort terrible, or is conversant about terrible objects, or operates in a manner analogous to terror, is a source of the *sublime*,” is Burke's famous definition.⁶⁸ Certainly modern technological objects and actions – from Hiroshima to Chernobyl – have tended to become a primary objective correlative of such a sentiment.

Like premodern skepticism and Enlightenment optimism the romantic way of being-with technology can thus be characterized by a pluralism of ideas that constitute a critical uneasiness: (1) the will to technology is a necessary self-creative act, which nevertheless tends to overstep its rightful bounds; (2) technology makes possible a new material freedom but alienates from the decisive strength to exercise it and creates wealth while undermining social affection; (3) scientific knowledge and reason are criticized in the name of imagination; and (4) artifacts are characterized more by process than by structure and invested with a new ambiguity associated with the category of the sublime. The attractive and repulsive interest revealed by the sublime expresses perhaps better than any other the uniqueness of the romantic way of being-with technology.

Summary and Epilogue

As the analysis of romantic being-with technology has especially tended to indicate, the ideas associated with the four aspects of technology as volition, as activity, as knowledge, and as object cannot be completely separated. Theology, ethics, epistemology, and metaphysics are ultimately aspects of a way of being in the world. Acknowledging this limitation, it is nevertheless possible to summarize the three ways of life in relation to technology by means of the matrix displayed in Table 1.

Table 1 Historico-philosophical epochs

<i>Conceptual elements</i>	<i>Ancient skepticism (suspicious of technology)</i>	<i>Enlightenment optimism (promotion of technology)</i>	<i>Romantic uneasiness (ambiguous about technology)</i>
Volition or intention (religious)	Will to technology involves tendency to turn away from God or the gods.	Will to technology is ordained by God or by Nature.	Will to technology is an aspect of creativity – which tends to crowd out other aspects.
Action (ethics and politics)	Personal: Technical affluence undermines individual virtue. Societal: Technical change weakens political stability.	Personal: Technical activities socialize individuals. Societal: Technology creates public wealth.	Personal: Technology engenders freedom but alienates from affective strength to exercise it. Societal: Technology weakens social bonds of affection.
Knowledge (epistemology)	Technical information is not true wisdom.	Technical engagement with the world yields true knowledge (pragmatism).	Imagination and vision are more crucial than technical knowledge.
Objects (metaphysics and aesthetics)	Artifacts are less real than natural objects and thus require external guidance.	Nature and artifice operate by the same mechanical principles.	Artifacts expand the processes of life and reveal the sublime.

At the outset, however, the argument of this essay was indicated to have some relation to Heidegger's early analysis of technology, although it has taken off in a trajectory not wholly consistent with Heidegger's own analysis or intentions. Yet there remains a final affinity worth noting. In Heidegger's existential analysis there is a paradox that the personal that is revealed through the technical is also undermined thereby. The use of tools is with others and in a world of artifacts owned by others, but the others easily become treated as all the same and thus become, as he calls it, a They – mass society.

In utilizing public means of transport and in making use of information services such as the newspapers every Other [person] is like the next. The Being-with-one-another dissolves one's own *Dasein* [or existence] completely into the kind of Being of "the Others," in such a way, indeed, that the Others, as distinguishable and explicit, vanish more and more.⁶⁹

With regard to the romantic way of being-with technology there is also a paradox. Not only is there a certain ambiguity built into this attitude, but the attitude itself has not been adopted in any wholehearted way by modern culture. Romanticism is, if you will, uneasy with itself. Indeed, this may be in part why romanticism has so far been unable to demonstrate the kind of practical efficacy exhibited by both premodern skepticism and Enlightenment optimism. The paradox of the romantic way of being-with technology is that, despite an intellectual cogency and expressive power, it has yet to take hold as a truly viable way of life. Given almost two centuries of active articulation, this impotence may well point toward inherent weaknesses. Perhaps the truth is that romanticism has been adopted, but that it is precisely its internal ambiguities, its bipolar attempt to steer a middle course between premodern skepticism and Enlightenment optimism, that vitiates its power.

Notes

- 1 Martin Heidegger, *Being and Time*, trans. John Macquarrie and Edward Robinson (New York: Harper and Row, 1962), p. 154.
- 2 One *locus classicus* of such celebration is Sophocles, *Antigone* 332.
- 3 For an interpretation of the specifically religious dimensions of this negative mythology, see Carl Mitcham, "The Love of Technology Is the Root of All Evil," *Epiphany Journal* 8, no. 1 (Fall 1987): 17–28.
- 4 For Plato, see especially the fifth book of the *Laws* (743d), where agriculture is described as keeping production within proper limits and as helping to focus attention on the care of the soul and the body. Cf. also *Laws*, bk. 8 (842d–e) and bk. 10 (889d).
- 5 For Aristotle, see especially the *Politics* 1.8–11, and the distinction between two ways of acquiring goods, agriculture and business, the former of which is said to be "by nature" (1258a38), the latter "not by nature" (1258b41). In

- the *Politics* 6.2, agrarian based democracy is described as both “oldest” and “best” (1318b7–8).
- 6 Following Aristotle, St. Thomas Aquinas’s commentary on the *Politics* terms farming “natural,” “necessary,” and “praise worthy” (*Sententia libri Politiconum* 1, lectio 8), and again in *De regimine principum* 2.3, Thomas identifies farming as “better” than commercial activities for providing for material welfare. For Thomas Aquinas, however, farming tends to be spoken of in relation to all manual labor, and in consequence of the doctrine of the Fall takes on a certain ambiguity not found in Aristotle. For instance, in the *Summa theologiae* 2.2, quaestio 187, articulus 3, “Whether Religious Are Bound to Manual Labour,” it is argued that all human beings must work with their hands for four reasons: to obtain food (as proof texts Thomas cites Gen. 3.19 and Ps. 128.2), to avoid idleness (Sirach 33.27), to restrain concupiscence by mortifying the body (2 Cor. 6.4–6), and to enable one to give alms (Eph. 4.28). Note that there is a subtle difference between the first two reasons (which cite the Hebrew Scriptures) and the second (which cite the Greek Scriptures). For a relevant interpretation of Thomas Aquinas’s thought, which nevertheless fails to recognize the tensions alluded to here, see George H. Speltz, *The Importance of Rural Life according to the Philosophy of St. Thomas Aquinas* (Washington, D.C.: Catholic University of American Press, 1945). Cf. also Philo, “De agricultura,” a commentary on Noah as farmer.
 - 7 “Those who labour in the earth are the chosen people of God, if ever he had a chosen people, whose breasts he has made his peculiar deposit for substantial and genuine virtue Corruption of morals in the mass of cultivators is a phaenomenon of which no age nor nation has furnished an example.” Thomas Jefferson, *Notes on the State of Virginia* (1782) (Chapel Hill: University of North Carolina Press, 1955), Query 19, “Manufactures.” See also a letter to John Jay, 23 August 1785: “Cultivators of the earth are the most valuable citizens. They are the most vigorous, the most independent, the most virtuous, and they are tied to their country, and wedded to its liberty and interest, by the most lasting bonds. As long, therefore, as they can find employment in this line, I would not convert them into mariners, artisans or anything else.”
 - 8 Xenophon, *Memorabilia* (Oxford: Clarendon Press, 1890) 1.1.7, 1.1.9, and Cf. 4.7.10.
 - 9 Cf. also *Memorabilia* 4.7.6–7.
 - 10 Cf. Empedocles, frag. 111.
 - 11 Cicero, *Tusculan Disputations* 5.4.10–11. See also *Academia* 1.4.15.
 - 12 For a development of this argument, see “Philosophy and the History of Technology,” *The History and Philosophy of Technology*, ed. George Bugliarello and Dean B. Doner (Urbana: University of Illinois Press, 1979), pp. 163–201.
 - 13 Compare Aristotle, *Physics* 2.1.193a 12–17; *Politics* 7.7.1337a2; and *Oeconomica* 1.1.1343a26–b2.
 - 14 Plutarch, “Life of Marcellus,” in *Plutarch’s Lives*, ed. A. H. Clough (Boston: Little, Brown, and Company, 1859), 2.252–55.
 - 15 On the inadequacy of human knowledge, see the Book of Job, Prov. 1.7, Isa: 44.25, and Col. 2.8. Power over the world, Satan says in the Gospel of Luke, has been given to him (Luke 4.6). The prince of this world, according to the Gospel of John, is to be cast out (John 12.31).
 - 16 In his study of Milton (in “The Lives of the Poets,” 1.99–100 [paragraphs 39–41]), Samuel Johnson criticizes a program of education which would concentrate on natural philosophy. “The truth is, that the knowledge of external nature, and the sciences which that knowledge requires or includes, are not the great or the frequent business of the human mind. Whether we provide for action or conversation . . . the first requisite is the religious and moral knowledge of right and wrong Physiological learning is of such rare emergence, that one may know another half his life, without being able to estimate his skill in hydrostatics or astronomy; but his moral and prudential character immediately appears [And] if I have Milton against me, I have Socrates on my side. It was his labour to turn philosophy from the study of nature to speculations upon life; but the innovators whom I oppose . . . seem to think, that we are placed here to watch the growth of plants, or the motions of stars. Socrates was rather of the opinion that what he had to learn was, how to do good, and avoid evil.” Cf. also “The Rambler” no. 24 (Saturday, 9 June 1750).
 - 17 Norbert Wiener, “A Scientist Rebels,” *Bulletin of the Atomic Scientists* 3, no. 1 (January 1947): 31.
 - 18 John Wesley. *Works* (Grand Rapids, Mich.: Zondervan, n.d. [photomechanical reprint of the edition published by the Wesleyan Conference, London, 1872]), 7: 289.
 - 19 Martin Heidegger, “The Thing,” in *Poetry, Language, Thought*, trans. Albert Hofstadter (New York: Harper and Row, 1971), p. 166. See also Heidegger’s essay on Rilke, “What Are Poets For” esp. pp. 112–17.
 - 20 Francis Bacon, “Preface,” *The Great Instauration*, in *Selected Writings of Francis Bacon*, ed. Hugh G. Dick (New York: Modern Library, 1955).
 - 21 Bacon, *Essays*, no. 24, “Of Innovations,” in *Selected Writings of Francis Bacon*, p. 65.
 - 22 Francis Bacon, *Novum Organum*, in *The Works of Francis Bacon* (Stuttgart-Bad Canstatt: Friedrich Fromann Verlag Gunther Holzboog, 1963), 1.68. Subsequent references to the *Novum Organum* will appear parenthetically within the text.
 - 23 According to the Talmud, “As God fills the entire universe, so does the soul fill the whole body” (Berakhot 10a). According to the teachings of Jesus, “Love your enemies and pray for those who persecute you, so that you may be sons of your Father who is heaven; for he makes his sun rise on the evil and on the good, and sends rain on the just and on the unjust” (Matt. 5.44–45).

- 24 For a study of this transformation in the history of ideas, see C. E. Trinkhous, *In Our Image and Likeness: Humanity and Disunity in Italian Humanist Thought*, 2 vols. (London: Constable, 1970).
- 25 Jean Le Rond D'Alembert, *Preliminary Discourse to the Encyclopedia Of Diderot*, trans. Richard N. Schwab and Walter E. Rex (Indianapolis, Ind.: Bobbs-Merrill, 1963), p. 42.
- 26 Immanuel Kant, "Idea for a Universal History from a Cosmopolitan Point of View" (1784), Third Thesis, in *On History*, trans. Lewis White Beck (Indianapolis, Ind.: Bobbs-Merrill, 1963), p. 13.
- 27 Immanuel Kant, "What Is Enlightenment?" (1784), in *On History*, p. 3.
- 28 See Aristotle, *Politics* 1268b25–1269a25; and St. Thomas Aquinas, *Summa theologiae* 1–2, quaestio 97, articulus 2.
- 29 Charles-François de Saint-Lambert, "Luxury," in *Encyclopedia: Selections*, trans. Nelly S. Hoyt and Thomas Cassirer (Indianapolis, Ind.: Bobbs-Merrill, 1965), p. 204 (translation slightly altered).
- 30 Saint-Lambert, "Luxury," p. 231.
- 31 David Hume, *Essays* (London: Oxford University Press, 1963), p. 262.
- 32 *Ibid.*, p. 276.
- 33 *Ibid.*, p. 277.
- 34 *Ibid.*, p. 277–78.
- 35 Charles Montesquieu, *The Spirit of the Laws*, trans. Thomas Nugent, ed. David Wallace Carrithers (Berkeley: University of California Press, 1977), vol. 1, bk. 20: 1.
- 36 See Francis Bacon, *The Great Instauration*, "The Plan of the Work," in *Selected Writings*.
- 37 D'Alembert, *Preliminary Discourse*, p. 75.
- 38 *Ibid.*, p. 122.
- 39 Denis Diderot, "Art," in *Encyclopedia*, p. 5.
- 40 *Ibid.*, p. 4.
- 41 For some discussion of this contrast, see Nicholas Lobkowitz, *Theory and Practice: History of a Concept from Aristotle to Marx* (Notre Dame, Ind.: University of Notre Dame Press, 1967).
- 42 On this interesting topic, see K. J. H. Berland, "Bringing Philosophy Down from the Heavens: Socrates and the New Science," *Journal of the History of Ideas* 47, no. 2 (April–June 1986): 299–308, a commentary on Amyas Busche's *Socrates: A Dramatic Poem* (1758). One point Berland does not consider is the extent to which this view of Socrates, which is also found in Aristophanes' *The Clouds* as well as other sources, might be legitimate; see, e.g., Leo Strauss, *Socrates and Aristophanes* (New York: Basic Books, 1966).
- 43 Alexander Pope, *An Essay on Man*, epistle 1, line 289.
- 44 Thomas Hobbes, *Leviathan, or the Matter, Forme, & Power of a Common Wealth Ecclesiasticall and Civill* (1651), edited by C. B. Macpherson (New York: Penguin Books, 1968), p. 81.
- 45 Julien Offray de La Mettrie, *Man a Machine (L'Homme Machine, 1748)* (La Salle, 111.: Open Court, 1912), p. 148.
- 46 Hobbes, *Leviathan*, "Introduction," p. 23.
- 47 This is vividly demonstrated by the vicissitudes of development now taking place in countries of the Third World. Geographic advantage, scientific knowledge, imported hardware, political or economic decisions, piecemeal optimism, and envious desire cannot by themselves or even in concert effect industrialization. Despite the ideological rhetoric of Maoist China and Khomeni's Iran, modern technology does not seem to be adopted independently of certain key elements of Western culture. The westernization of Japan confirms the argument from the other side of the divide.
- 48 For one collection of texts that does begin to point in this direction, see Humphrey Jennings, *Pandaemonium: The Coming of the Machine as Seen by Contemporary Observers, 1660–1886*, ed. Mary-Lou Jennings and Charles Madge (New York: Free Press, 1985). Note that even Leo Marx in a later essay continues to speak of science as the focus of concern, see "Reflections on the Neo-Romantic Critique of Science," *Daedalus* 107, no. 2 (Spring 1978): 61–74. However, in *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1964) he describes one aspect of the romantic critique of technology. Cf. also Wylie Sypher, *Literature and Technology: The Alien Vision* (New York: Random House, 1968).
- 49 Cf. Friedrich Nietzsche, *The Gay Science* (1882), section 12. For a mundane philosophy of gothic pathos, see Jean-Paul Sartre, *Being and Nothingness* (1943), trans. Hazel Barnes (New York: Washington Square Press, 1968), p. 784, the last sentence of the last chapter of which declares that "Man is a useless passion."
- 50 See Francis Bacon, "The Masculine Birth of Time," translation included in Benjamin Farrington, *The Philosophy of Francis Bacon* (Chicago: University of Chicago Press, 1966).
- 51 The note is to *The Excursion*, bk. 8, line 112, at the beginning of a passage describing the industrial transformation of the English landscape as one in which "where not a habitation stood before / Abodes of men" are now "irregularly massed / Like trees in forests" (lines 122–24) and as a "trumph that proclaims / How much the mild Directress of the plough / Owes to alliance with these new-born arts!" (lines 130–32). "In treating of this subject," Wordsworth writes in his note, "it was impossible not to recollect, with gratitude, the pleasing picture . . . Dyer has given of the influences of manufacturing industry upon the face of this Island. He wrote at a time when machinery was first beginning to be introduced, and his benevolent heart prompted him to auger from it nothing but good." Wordsworth, as much as Sophocles (*Antigone*, 331), is capable of appreciating the benefits of technology. But, he adds, now "Truth has compelled me to

- dwell upon the baneful effects arising out of an ill-regulated and excessive application of powers so admirable in themselves.”
- 52 Jean-Jacques Rousseau, “A Discourse on the Arts and Sciences,” in *The Social Contract and Discourses*, trans. G. D. H. Cole (New York: Dutton, 1950), p. 164.
- 53 *Ibid.*, p. 162.
- 54 *Ibid.*, p. 161.
- 55 *Ibid.*, p. 150.
- 56 *Ibid.*, p. 158–59.
- 57 Cf. in this same regard, Niccolo Machiavelli’s use of *virtù* as power in *The Prince* (1512).
- 58 Rousseau, “A Discourse on the Arts and Sciences,” p. 173. The encyclopedics likewise praise Bacon above all other philosophers.
- 59 *Ibid.*, p. 158.
- 60 *Ibid.*, p. 152.
- 61 *Ibid.*, p. 168.
- 62 *Ibid.*, p. 146.
- 63 William Wordsworth, letter to Charles James Fox, 14 January 1801. In this commentary on his presentation of “domestic affections” in the poems “The Brothers” and “Michael,” Wordsworth further remarks that “The evil [of the destruction of domestic affections] would be the less to be regretted, if these institutions [of industrialization] were regarded only as palliatives to a disease [in a manner not unlike that associated with ancient skepticism]; but the vanity and pride of their promoters are so subtly interwoven with them, that they are deemed great discoveries and blessings to humanity [as per Enlightenment optimism].”
- 64 See John Milton, *Paradise Lost*, bk. 1, line 670. Milton also associates Satan’s legions with engines and engineering at bk. 1, line 750 and bk. 6, line 553.
- 65 William Blake, *Milton* (1804), ed. Kay Pankhurst Esson and Roger R. Esson (Boulder, Colo.: Shambhala, 1978), bk. 1, sec. 4, lines 9–10.
- 66 Samuel Taylor Coleridge, *Biographia Literaria*, ed. George Watson (New York: Button, 1956), chap. 13, p. 167.
- 67 William Blake, *Jerusalem*, pf. 4, “To the Christians,” introduction (London: George Allen & Unwin, 1964).
- 68 Edmund Burke, *A Philosophical Enquiry into the Origin of our Ideas of the Sublime and Beautiful* (1757) (London: R. & J. Dodsley, 1759), pt. 1, sec. 7, first sentence.
- 69 Heidegger, *Being and Time*, p. 164.

A Phenomenology of Technics

Don Ihde

The task of a phenomenology of human–technology relations is to discover the various structural features of those ambiguous relations. In taking up this task, I shall begin with a focus upon experientially recognizable features that are centered upon the ways we are bodily engaged with technologies. The beginning will be within the various ways in which I-as-body interact with my environment by means of technologies.

A Technics Embodied

If much of early modern science gained its new vision of the world through optical technologies, the process of embodiment itself is both much older and more pervasive. To embody one’s praxis *through* technologies is ultimately an *existential* relation with the world. It is something humans have always – since they left the naked perceptions of the Garden – done.

I have previously and in a more suggestive fashion already noted some features of the visual embodiment of optical technologies. Vision is technologically transformed through such optics. But while the fact *that* optics transform vision may be clear, the variants and invariants of such a transformation are not yet precise. That becomes the task for a more rigorous and structural phenomenology of embodiment. I shall begin by drawing

from some of the previous features mentioned in the preliminary phenomenology of visual technics.

Within the framework of phenomenological relativity, visual technics first may be located within the intentionality of seeing.

I see–through the optical artifact–the world

This seeing is, in however small a degree, at least minimally distinct from a direct or naked seeing.

I see–the world

I call this first set of existential technological relations with the world *embodiment relations*, because in this use context I take the technologies *into* my experiencing in a particular way by way of perceiving *through* such technologies and through the reflexive transformation of my perceptual and body sense.

In Galileo’s use of the telescope, he embodies his seeing through the telescope thusly:

Galileo–telescope–Moon

Equivalently, the wearer of eyeglasses embodies eyeglass technology:

I–glasses–world

Don Ihde, originally “Program 1: A Phenomenology of Technics,” abridged from *Technology and the Lifeworld* (Bloomington: Indiana University Press, 1990), pp. 72–108. Reprinted by permission of Indiana University Press.

The technology is actually *between* the seer and the seen, in a *position of mediation*. But the referent of the seeing, that towards which sight is directed, is “on the other side” of the optics. One sees *through the* optics. This, however, is not enough to specify this relation as an embodiment one. This is because one first has to determine *where* and *how*, along what will be described as a continuum of relations, the technology is experienced.

There is an initial sense in which this positioning is doubly ambiguous. First, the technology must be *technically* capable of being seen through; it must be transparent. I shall use the term *technical* to refer to the physical characteristics of the technology. Such characteristics may be designed or they may be discovered. Here the disciplines that deal with such characteristics are informative, although indirectly so for the philosophical analysis per se. If the glass is not transparent enough, seeing-through is not possible. If it is transparent enough, approximating whatever “pure” transparency could be empirically attainable, then it becomes possible to embody the technology. This is a material condition for embodiment.

Embodying as an activity, too, has an initial ambiguity. It must be learned or, in phenomenological terms, constituted. If the technology is good, this is usually easy. The very first time I put on my glasses, I see the now-corrected world. The adjustments I have to make are not usually focal irritations but fringe ones (such as the adjustment to backglare and the slight changes in spatial motility). But once learned, the embodiment relation can be more precisely described as one in which the technology becomes maximally “transparent.” It is, as it were, taken into my own perceptual-bodily self experience thus:

(I–glasses)–world

My glasses become part of the way I ordinarily experience my surroundings; they “withdraw” and are barely noticed, if at all. I have then actively embodied the technics of vision. Technics is the symbiosis of artifact and user within a human action.

Embodiment relations, however, are not at all restricted to visual relations. They may occur for any sensory or microperceptual dimension. A hearing aid does this for hearing, and the blind man’s cane for tactile motility. Note that in these corrective technologies *the same structural features of embodiment* obtain as with the visual example. Once learned, cane and hearing aid “withdraw” (if the

technology is good – and here we have an experiential clue for the perfecting of technologies). I hear the world through the hearing aid and feel (and hear) it through the cane. The juncture (I–artifact)–world is through the technology and brought close by it.

Such relations *through* technologies are not limited to either simple or complex technologies. Glasses, insofar as they are engineered systems, are much simpler than hearing aids. More complex than either of these mono-sensory devices are those that entail whole-body motility. One such common technology is automobile driving. Although driving an automobile encompasses more than embodiment relations, its pleurability is frequently that associated with embodiment relations.

One experiences the road and surroundings *through* driving the car, and motion is the focal activity. In a finely engineered sports car, for example, one has a more precise feeling of the road and of the traction upon it than in the older, softer-riding, large cars of the fifties. One embodies the car, too, in such activities as parallel parking: when well embodied, one feels rather than sees the distance between car and curb – one’s bodily sense is “extended” to the parameters of the driver-car “body.” And although these embodiment relations entail larger, more complex artifacts and entail a somewhat longer, more complex learning process, the bodily tacit knowledge that is acquired is perceptual-bodily.

Here is a first clue to the polymorphous sense of bodily extension. The experience of one’s “body image” is not fixed but malleably extendable and/or reducible in terms of the material or technological mediations that may be embodied. I shall restrict the term embodiment, however, to those types of mediation that can be so experienced. The same dynamic polymorphousness can also be located in non-mediational or direct experience. Persons trained in the martial arts, such as karate, learn to feel the vectors and trajectories of the opponent’s moves within the space of the combat. The near space around one’s material body is charged.

Embodiment relations are a particular kind of use-context. They are technologically relative in a double sense. First, the technology must “fit” the use. Indeed, within the realm of embodiment relations one can develop a quite specific set of qualities for design relating to attaining the requisite technological “withdrawal.” For example, in handling highly radioactive materials at a distance, the mechanical arms and hands which are designed to pick up and pour glass tubes inside the shielded enclosure have to “feed back” a delicate sense of touch to the operator.

The closer to invisibility, transparency, and the extension of one's own bodily sense this technology allows, the better. Note that the design perfection is not one related to the machine alone but to the combination of machine and human. The machine is perfected along a bodily vector, molded to the perceptions and actions of humans.

And when such developments are most successful, there may arise a certain romanticizing of technology. In much anti-technological literature there are nostalgic calls for returns to simple tool technologies. In part, this may be because long-developed tools are excellent examples of bodily expressivity. They are both direct in actional terms and immediately experienced; but what is missed is that such embodiment relations may take any number of directions. Both the sports car driver within the constraints of the racing route and the bulldozer driver destroying a rainforest may have the satisfactions of powerful embodiment relations.

There is also a deeper desire which can arise from the experience of embodiment relations. It is the doubled desire that, on one side, is a wish for *total transparency*, total embodiment, for the technology to truly "become me." Were this possible, it would be equivalent to there being no technology, for total transparency would *be* my body and senses; I desire the face-to-face that I would experience without the technology. But that is only one side of the desire. The other side is the desire to have the power, the transformation that the technology makes available. Only by using the technology is my bodily power enhanced and magnified by speed, through distance, or by any of the other ways in which technologies change my capacities. These capacities are always *different* from my naked capacities. The desire is, at best, contradictory. I want the transformation that the technology allows, but I want it in such a way that I am basically unaware of its presence. I want it in such a way that it becomes me. Such a desire both secretly *rejects* what technologies are and overlooks the transformational effects which are necessarily tied to human-technology relations. This illusory desire belongs equally to pro- and anti-technology interpretations of technology.

The desire is the source of both utopian and dystopian dreams. The actual, or material, technology always carries with it only a partial or quasi-transparency, which is the price for the extension of magnification that technologies give. In extending bodily capacities, the technology also transforms them. In that sense, all technologies in use are non-neutral. They change the basic situation,

however subtly, however minimally; but this is the other side of the desire. The desire is simultaneously a desire for a change in situation – to inhabit the earth, or even to go beyond the earth – while sometimes inconsistently and secretly wishing that this movement could be without the mediation of the technology.

The direction of desire opened by embodied technologies also has its positive and negative thrusts. Instrumentation in the knowledge activities, notably science, is the gradual extension of perception into new realms. The desire is to see, but seeing is seeing through instrumentation. Negatively, the desire for pure transparency is the wish to escape the limitations of the material technology. It is a platonism returned in a new form, the desire to escape the newly extended body of technological engagement. In the wish there remains the contradiction: the user both wants and does not want the technology. The user wants what the technology gives but does not want the limits, the transformations that a technologically extended body implies. There is a fundamental ambivalence toward the very human creation of our own earthly tools.

The ambivalence that can arise concerning technics is a reflection of one kind upon the *essential ambiguity* that belongs to technologies in use. But this ambiguity, I shall argue, has its own distinctive shape. Embodiment relations display an essential magnification/reduction structure which has been suggested in the instrumentation examples. Embodiment relations simultaneously magnify or amplify and reduce or place aside what is experienced through them.

The sight of the mountains of the moon, through all the transformational power of the telescope, removes the moon from its setting in the expanse of the heavens. But if our technologies were only to replicate our immediate and bodily experience, they would be of little use and ultimately of little interest. A few absurd examples might show this:

In a humorous story, a professor bursts into his club with the announcement that he has just invented a reading machine. The machine scans the pages, reads them, and perfectly reproduces them. (The story apparently was written before the invention of photocopying. Such machines might be said to be "perfect reading machines" in actuality.) The problem, as the innocent could see, was that this machine leaves us with precisely the problem we had prior to its invention. To have reproduced through mechanical "reading" all the books in the world leaves us merely in the library.

A variant upon the emperor's invisible clothing might work as well. Imagine the invention of perfectly transparent clothing through which we might technologically experience the world. We could see through it, breathe through it, smell and hear through it, touch through it. Indeed, it effects no changes of any kind, since it is *perfectly* invisible. Who would bother to pick up such clothing (even if the presumptive wearer could find it)? Only by losing some invisibility – say, with translucent coloring – would the garment begin to be usable and interesting. For here, at least, fashion would have been invented – but at the price of losing total transparency – by becoming that through which we relate to an environment.

Such stories belong to the extrapolated imagination of fiction, which stands in contrast to even the most minimal actual embodiment relations, which in their material dimensions simultaneously extend and reduce, reveal and conceal.

In actual human-technology relations of the embodiment sort, the transformational structures may also be exemplified by variations: In optical technologies, I have already pointed out how spatial significations change in observations through lenses. The entire gestalt changes. When the apparent size of the moon changes, along with it the apparent position of the observer changes. Relativistically, the moon is brought “close”; and equivalently, this optical near-distance applies to both the moon's appearance and my bodily sense of position. More subtly, every dimension of spatial signification also changes. For example, with higher and higher magnification, the well-known phenomenon of depth, instrumentally mediated as a “focal plane,” also changes. Depth diminishes in optical near-distance.

A related phenomenon in the use of an optical instrument is that it transforms the spatial significations of vision in an instrumentally focal way. But my seeing without instrumentation is a full bodily seeing – I see not just with my eyes but with my whole body in a unified sensory experience of things. In part, this is why there is a noticeable irreality to the apparent position of the observer, which only diminishes with the habits acquired through practice with the instrument. But the optical instrument cannot so easily transform the entire sensory gestalt. The focal sense that is magnified through the instrument is mono-dimensional.

Here may be the occasion (although I am not claiming a cause) for a certain interpretation of the senses. Historians of perception have noted that, in medieval

times, not only was vision not the supreme sense but sound and smell may have had greatly enhanced roles so far as the interpretation of the senses went. Yet in the Renaissance and even more exaggeratedly in the Enlightenment, there occurred the reduction to sight as the favored sense, and within sight, a certain reduction *of* sight. This favoritism, however, also carried implications for the other senses.

One of these implications was that each of the senses was interpreted to be clear and distinct from the others, with only certain features recognizable through a given sense. Such an interpretation impeded early studies in echo location.

In 1799 Lazzaro Spallanzani was experimenting with bats. He noticed not only that they could locate food targets in the dark but also that they could do so blindfolded. Spallanzani wondered if bats could guide themselves by their ears rather than by their eyes. Further experimentation, in which the bats' ears were filled with wax, showed that indeed they could not guide themselves without their ears. Spallanzani surmised that either bats locate objects through hearing or they had some sense of which humans knew nothing. Given the doctrine of separate senses and the identification of shapes and objects through vision alone, George Montagu and Georges Cuvier virtually laughed Spallanzani out of the profession.

This is not to suggest that such an interpretation of sensory distinction was due simply to familiarity with optical technologies, but the common experience of enhanced vision through such technologies was at least the standard practice of the time. Auditory technologies were to come later. When auditory technologies did become common, it was possible to detect the same amplification/reduction structure of the human-technology experience.

The telephone in use falls into an auditory embodiment relation. If the technology is good, I hear *you* through the telephone and the apparatus “withdraws” into the enabling background:

(I–telephone)–you

But as a monosensory instrument, your phenomenal presence is that of a voice. The ordinary multi-dimensional presence of a face-to-face encounter does not occur, and I must at best imagine those dimensions through your vocal gestures. Also, as with the telescope, the spatial significations are changed. There is here an

auditory version of visual near-distance. It makes little difference whether you are geographically near or far, none at all whether you are north or south, and none with respect to anything but your bodily relation to the instrument. Your voice retains its partly unreal near-distance, reduced from the full dimensionality of direct perceptual situations. This telephonic distance is different both from immediate face-to-face encounters and from visual or geographical distance as normally taken. Its distance is a mediated distance with its own identifiable significations.

While my primary set of variations is to locate and demonstrate the invariance of a magnification/reduction structure to any embodiment relation, there are also secondary and important effects noted in the histories of technology. In the very first use of the telephone, the users were fascinated and intrigued by its auditory transparency. Watson heard and recognized Bell's *voice*, even though the instrument had a high ratio of noise to message. In short, the fascination attaches to magnification, amplification, enhancement. But, contrarily, there can be a kind of forgetfulness that equally attaches to the reduction. What is *revealed* is what excites; what is concealed may be forgotten. Here lies one secret for technological trajectories with respect to development. There are *latelic* telics that occur through inventions.

Such telics are clear enough in the history of optics. Magnification provided the fascination. Although there were stretches of time with little technical progress, this fascination emerged from time to time to have led to compound lenses by Galileo's day. If some magnification shows the new, opens to what was poorly or not at all previously detected, what can greater magnification do? In our own time, the explosion of such variants upon magnification is dramatic. Electron enhancement, computer image enhancement, CAT and NMR internal scanning, "big-eye" telescopes – the list of contemporary magnificational and visual instruments is very long.

I am here restricting myself to what may be called a *horizontal* trajectory, that is, optical technologies that bring various micro- or macro-phenomena to vision through embodiment relations. By restricting examples to such phenomena, one structural aspect of embodiment relations may be pointed to concerning the relation to microperception and its Adamic context. While *what* can be seen has changed dramatically – Galileo's New World has now been enhanced by astronomical phenomena never suspected and by micro-phenomena

still being discovered – there remains a strong phenomenological constant in *how* things are seen. All lenses and optical technologies of the sort being described bring what is to be seen into a normal bodily space and distance. Both the macroscopic and the microscopic appear within the same near-distance. The "image size" of galaxy or amoeba is the *same*. Such is the existential condition for visibility, the counterpart to the technical condition, that the instrument makes things visually present.

The mediated presence, however, must fit, be made close to my actual bodily position and sight. Thus there is a reference within the instrumental context to my face-to-face capacities. These remain primitive and central within the new mediational context. Phenomenological theory claims that for every change in what is seen (the object correlate), there is a noticeable change in how (the experiential correlate) the thing is seen.

In embodiment relations, such changes retain both an equivalence and a difference from non-mediated situations. What remains constant is the bodily focus, the reflexive reference back to my bodily capacities. What is seen must be seen from or within my visual field, from the apparent distance in which discrimination can occur regarding depth, etc., just as in face-to-face relations. But the range of what can be brought into this proximity is transformed by means of the instrument.

Let us imagine for a moment what was never in fact a problem for the history of instrumentation: If the "image size" of both a galaxy and an amoeba is the "same" for the observer using the instrument, how can we tell that one is macrocosmic and the other microcosmic? The "distance" between us and these two magnitudes, Pascal noted, was the same in that humans were interpreted to be between the infinitely large and the infinitely small.

What occurs through the mediation is not a problem *because our construction of the observation presupposes ordinary praxical spatiality*. We handle the Paramecium, placing it on the slide and then under the microscope. We aim the telescope at the indicated place in the sky and, before looking through it, note that the distance is at least that of the heavenly dome. But in our imagination experiment, what if our human were *totally immersed* in a technologically mediated world? What if, from birth, all vision occurred only through lens systems? Here the problem would become more difficult. But in our distance from Adam, it is precisely the presumed difference that makes it possible for us to see both nakedly *and* mediatedly – and thus to be able to locate the difference – that places us even more distantly from any Garden.

It is because we retain this ordinary spatiality that we have a reflexive point of reference from which to make our judgments.

The noetic or bodily reflexivity implied in all vision also may be noticed in a magnified way in the learning period of embodiment. Galileo's telescope had a small field, which, combined with early hand-held positioning, made it very difficult to locate any particular phenomenon. What must have been noted, however, even if not commented upon, was the exaggerated sense of bodily motion experienced through trying to fix upon a heavenly body – and more, one quickly learns something about the earth's very motion in the attempt to use such primitive telescopes. Despite the apparent fixity of the stars, the hand-held telescope shows the earth-sky motion dramatically. This magnification effect is within the experience of one's own bodily viewing.

This bodily and actional point of reference retains a certain privilege. All experience refers to it in a taken-for-granted and recoverable way. The bodily condition of the possibility for seeing is now twice indicated by the very situation in which mediated experience occurs. Embodiment relations continue to locate that privilege of my being here. The partial symbiosis that occurs in well-designed embodied technologies retains that motility which can be called expressive. Embodiment relations constitute one existential form of the full range of the human-technology field.

B Hermeneutic Technics

Heidegger's hammer in use displays an embodiment relation. Bodily action through it occurs within the environment. But broken, missing, or malfunctioning, it ceases to be the means of praxis and becomes an obtruding *object* defeating the work project. Unfortunately, that negative derivation of objectness by Heidegger carries with it a block against understanding a second existential human-technology relation, the type of relation I shall term *hermeneutic*.

The term hermeneutic has a long history. In its broadest and simplest sense it means "interpretation," but in a more specialized sense it refers to *textual* interpretation and thus entails *reading*. I shall retain both these senses and take hermeneutic to mean a special interpretive action within the technological context. That kind of activity calls for special modes of action and perception, modes analogous to the reading process.

Reading is, of course, a reading of ____; and in its ordinary context, what fills the intentional blank is a text, something *written*. But all writing entails technologies. Writing has a product. Historically, and more ancient than the revolution brought about by such crucial technologies as the clock or the compass, the invention and development of writing was surely even more revolutionary than clock or compass with respect to human experience. Writing transformed the very perception and understanding we have of language. Writing is a technologically embedded form of language.

There is a currently fashionable debate about the relationship between speech and writing, particularly within current Continental philosophy. The one side argues that speech is primary, both historically and ontologically, and the other – the French School – inverts this relation and argues for the primacy of writing. I need not enter this debate here in order to note the *technological difference* that obtains between oral speech and the materially connected process of writing, at least in its ancient forms.

Writing is inscription and calls for both a process of writing itself, employing a wide range of technologies (from stylus for cuneiform to word processors for the contemporary academic), and other material entities upon which the writing is recorded (from clay tablet to computer printout). Writing is technologically mediated language. From it, several features of hermeneutic technics may be highlighted. I shall take what may at first appear as a detour into a distinctive set of human-technology relations by way of a phenomenology of reading and writing.

Reading is a specialized perceptual activity and praxis. It implicates my body, but in certain distinctive ways. In an ordinary act of reading, particularly of the extended sort, what is read is placed before or somewhat under one's eyes. We read in the immediate context from some miniaturized bird's-eye perspective. What is read occupies an expanse within the focal center of vision, and I am ordinarily in a somewhat rested position. If the object-correlate, the "text" in the broadest sense, is a chart, as in the navigational examples, what is represented retains a representational isomorphism with the natural features of the landscape. The chart represents the land- (or sea)scape and insofar as the features are isomorphic, there is a kind of representational "transparency." The chart in a peculiar way "refers" beyond itself to what it represents.

Now, with respect to the embodiment relations previously traced, such an isomorphic representation is both

similar and dissimilar to what would be seen on a larger scale from some observation position (at bird’s-eye level). It is similar in that the shapes on the chart are reduced representations of distinctive features that can be directly or technologically mediated in face-to-face or embodied perceptions. The reader can compare these similarities. But chart reading is also different in that, during the act of reading, the perceptual focus is the chart itself, a substitute for the landscape.

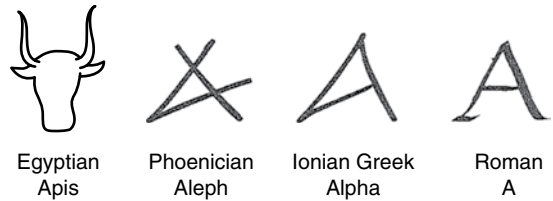
I have deliberately used the chart-reading example for several purposes. First, the “textual” isomorphism of a representation allows this first example of hermeneutic technics to remain close to yet differentiated from the perceptual isomorphism that occurs in the optical examples. The difference is at least perceptual in that one sees *through* the optical technology, but now one sees the chart as the visual terminus, the “textual” artifact itself.

Something much more dramatic occurs, however, when the representational isomorphism disappears in a printed text. There is no isomorphism between the printed word and what it “represents,” although there is some kind of *referential* “transparency” that belongs to this new technologically embodied form of language. It is apparent from the chart example that the chart itself becomes the *object of perception* while simultaneously referring beyond itself to what is not immediately seen. In the case of the printed text, however, the referential transparency is distinctively different from technologically embodied perceptions. *Textual transparency is hermeneutic transparency, not perceptual transparency.*

Historically, textual transparency was neither immediate nor attained at a stroke. The “technology” of phonetic writing, which now is increasingly a world-wide standard, became what it is through a series of variants and a process of experimentation. One early form of writing was pictographic. The writing was still somewhat like the chart example; the pictograph retained a certain representational isomorphism with what was represented. Later, more complex ideographic writing (such as Chinese) was, in effect, a more abstract form of pictography.

Calligraphers have shown that even early phonetic writing followed a gradual process of formalizing and abstracting from a pictographic base (see figure). Letters often depicted a certain animal, the first syllable of whose name provided the sound for the letter in a simultaneous sound and letter. Built into such early phonetic writing was thus something like the way the alphabet is still taught to children: “C is for Cow.” Most educated persons are familiar with the mixed form of writing,

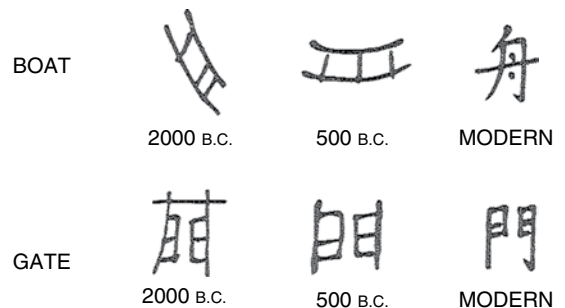
hieroglyphics. Although the writing is pictographic, not all pictographs stood for the entity depicted; some represented sounds (phonemes).



An interesting cross-cultural example of this movement from a very pictographic to a formalized and transformed ideographic writing occurs with Chinese writing. The same movement from relatively concrete representations in pictographs occurs through abbreviated abstractions – but in a different direction, non-phonetic and ideographic. Thus, for phonetic writing there is a double abstraction (from pictograph to letter and then reconstituting a small finite alphabet into represented spoken words), whereas the doubled abstraction of ideographic writing does not reconstitute to words as such, but to concepts.

In the most ancient Chinese writing in the period of the “Tortoise Shell Language” (prior to 2000 B.C.) and even in some cases through the later “Metal Language” period (2000–500 B.C.), if one is familiar with the objects as they occur within Chinese culture, one can easily detect the pictographic representation involved. For example, one can see in the figure below that the ideograph for boat actually abstractly represents the sampan-type boats of the riverways (still in use). Similarly, in the ideograph for gate one can still recognize the uniquely Oriental-type gate in the drawing. The modern variants – related but more abstracted – have clearly lost that instant representational isomorphism.

Implied in these transformations are changes of both technique and related technologies. Sergei Eisenstein,



the film maker and one sensitive to such image technologies, has pointed to just such a transformation which arose out of the invention of the brush and India ink:

But then, by the end of the third century, the brush is invented. In the first century after the “joyous event” (A.D.) – paper. And, lastly, in the year 220 – India ink.

A complete upheaval. A revolution in draughtmanship. And, after having undergone in the course of history no fewer than fourteen different styles of handwriting, the hieroglyph crystallized in its present form. The means of production (brush and India ink) determined the form.

The fourteen reforms had their way. As a result:



In the fierily cavorting hieroglyph *ma* (a horse) it is already impossible to recognize the features of the dear little horse sagging pathetically in its hindquarters, in the writing style of Ts'ang Chiech, so well-known from ancient Chinese bronzes.¹

If this is an accurate portrayal of the evolution of writing, it follows something like a Husserlian origin-of-geometry trajectory. The trajectory was from the more concrete to the greater degrees of abstraction, until virtually all “likeness” to origins disappeared. In this respect, writing only slowly approximated speech.

Once attained, like any other acquisition of the life-world, writing could be read and understood in terms of its unique linguistic transparency. Writing becomes an embodied hermeneutic technics. Now the descriptions may take a different shape. What is referred to is referred by the text and is referred to *through* the text. What now presents itself is the “world” of the text.

This is not to deny that all language has its unique kind of transparency. Reference beyond itself, the capacity to let something become present through language, belongs to speech as well. But here the phenomenon being centered upon is the new embodiment of language in writing. Even more thematically, the concern is for the ways in which writing as a “technology” transforms experiential structures.

Linguistic transparency is what makes present the *world* of the text. Thus, when I read Plato, Plato’s “world”

is made present. But this presence is a *hermeneutic* presence. Not only does it occur *through* reading, but it takes its shape in the interpretative context of my language abilities. His world is linguistically mediated, and while the words may elicit all sorts of imaginative and perceptual phenomena, it is through language that such phenomena occur. And while such phenomena may be strikingly rich, they do not appear *as* word-like.

We take this phenomenon of reading for granted. It is a sedimented acquisition of the literate lifeworld and thus goes unnoticed until critical reflection isolates its salient features. It is the same with the wide variety of hermeneutic technics we employ.

The movement from embodiment relations to hermeneutic ones can be very gradual, as in the history of writing, with little-noticed differentiations along the human-technology continuum. A series of wide-ranging variants upon readable technologies will establish the point. First, a fairly explicit example of a readable technology: Imagine sitting inside on a cold day. You look out the window and notice that the snow is blowing, but you are toasty warm in front of the fire. You can clearly “see” the cold in Merleau-Ponty’s pregnant sense of perception – but you do not actually *feel* it. Of course, you could, were you to go outside. You would then have a full face-to-face verification of what you had seen.

But you might also see the thermometer nailed to the grape arbor post and *read* that it is 28°F. You would now “know” how cold it was, but you still would not feel it. To retain the full sense of an embodiment relation, there must also be retained some isomorphism with the felt sense of the cold – in this case, tactile – that one would get through face-to-face experience. One could invent such a technology; for example, some conductive material could be placed through the wall so that the negative “heat,” which is cold, could be felt by hand. But this is not what the thermometer does.

Instead, you read the thermometer, and in the immediacy of your reading you *hermeneutically* know that it is cold. There is an instantaneity to such reading, as it is an already constituted intuition (in phenomenological terms). But you should not fail to note that *perceptually* what you have seen is the dial and the numbers, the thermometer “text.” And that text has hermeneutically delivered its “world” reference, the cold.²

Such constituted immediacy is not always available. For instance, although I have often enough lived in countries where Centigrade replaces Fahrenheit, I still must translate from my intuitive familiar language to the

less familiar one in a deliberate and self-conscious hermeneutic act. Immediacy, however, is not the test for whether the relation is hermeneutic. A hermeneutic relation mimics sensory perception insofar as it is also a kind of seeing as ____; but it is a referential seeing, which has as its immediate perceptual focus seeing the thermometer.

Now let us make the case more complex. In the example cited, the experiencer had both embodiment (seeing the cold) and hermeneutic access to the phenomenon (reading the thermometer). Suppose the house were hermetically sealed, with no windows, and the only access to the weather were through the thermometer (and any other instruments we might include). The hermeneutic character of the relation becomes more obvious. I now clearly have to know how to read the instrumentation and from this reading knowledge get hold of the “world” being referred to.

This example has taken actual shape in nuclear power plants. In the Three Mile Island incident, the nuclear power system was observed only through instrumentation. Part of the delay that caused a near meltdown was *misreadings* of the instruments. There was no face-to-face, independent access to the pile or to much of the machinery involved, nor could there be.

An intentionality analysis of this situation retains the mediational position of the technology:

I–technology–world
(engineer–instruments–pile)

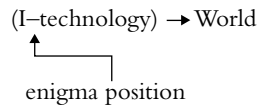
The operator has instruments between him or her and the nuclear pile. But – and here, an essential difference emerges between embodiment and hermeneutic relations – what is immediately perceived is the instrument panel itself. It becomes the object of my microperception, although in the special sense of a hermeneutic transparency, I *read* the pile through it. This situation calls for a different formalization:

I–(technology–world)

The parenthesis now indicates that the immediate *perceptual* focus of my experience is the control panel. I read through it, but this reading is now dependent upon the semi-opaque connection between the instruments and the referent object (the pile). This *connection* may now become enigmatic.

In embodiment relations, what allows the partial symbiosis of myself and the technology is the capacity of

the technology to become perceptually transparent. In the optical examples, the glassmaker’s and lens-grinder’s arts must have accomplished this end if the embodied use is to become possible. Enigmas which may occur regarding embodiment–use transparency thus may occur within the parenthesis of the embodiment relation:

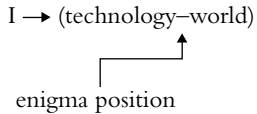


(This is not to deny that once the transparency is established, thus making microperception clear, the observer may still fail, particularly at the macroperceptual level. For the moment, however, I shall postpone this type of interpretive problem.) It would be an oversimplification of the history of lens-making were not problems of this sort recognized. Galileo’s instrument not only was hard to look through but was good only for certain “middle range” sightings in astronomical terms (it did deliver the planets and even some of their satellites). As telescopes became more powerful, levels, problems with chromatic effects, diffraction effects, etc., occurred. As Ian Hacking has noted,

Magnification is worthless if it magnifies two distinct dots into one big blur. One needs to resolve the dots into two distinct images. ... It is a matter of diffraction. The most familiar example of diffraction is the fact that shadows of objects with sharp boundaries are fuzzy. This is a consequence of the wave character of light.³

Many such examples may be found in the history of optics, technical problems that had to be solved before there could be any extended reach within embodiment relations. Indeed, many of the barriers in the development of experimental science can be located in just such limitations in instrumental capacity.

Here, however, the task is to locate a parallel difficulty in the emerging new human–technology relation, hermeneutic relations. The location of the technical problem in hermeneutic relations lies in the *connector* between the instrument and the referent. Perceptually, the user’s visual (or other) terminus is *upon* the instrumentation itself. To read an instrument is an analogue to reading a text. But if the text does not correctly refer, its reference object or its world cannot be present. Here is a new location for an enigma:



While breakdown may occur at any part of the relation, in order to bring out the graded distinction emerging between embodiment and hermeneutic relations, a short pathology of connectors might be noted.

If there is nothing that impedes my direct perceptual situation with respect to the instrumentation (in the Three Mile Island example, the lights remain on, etc.), interpretive problems in reading a strangely behaving “text” at least occur in the open; but the technical enigma may also occur within the text-referent relation. How could the operator tell if the instrument was malfunctioning or that to which the instrument refers? Some form of *opacity* can occur within the technology-referent pole of the relation. If there is some independent way of verifying which aspect is malfunctioning (a return to unmediated face-to-face relations), such a breakdown can be easily detected. Both such occurrences are reasons for instrumental redundancy. But in examples where such independent verification is not possible or untimely, the opacity would remain.

Let us take a simple mechanical connection as a borderline case. In shifting gears on my boat, there is a lever in the cockpit that, when pushed forward, engages the forward gear; upward, neutral; and backwards, reverse. Through it, I can ordinarily feel the gear change in the transmission (embodiment) and recognize the simple hermeneutic signification (forward for forward) as immediately intuitive. Once, however, on coming in to the dock at the end of the season, I disengaged the forward gear – and the propeller continued to drive the boat forward. I quickly reversed – and again the boat continued. The hermeneutic significance had failed; and while I also felt a difference in the way the gear lever felt, I did not discover until later that the clasp that retained the lever itself had corroded, thus preventing any actual shifting at all. But even at this level there can be opacity within the technology-object relation.

The purpose of this somewhat premature pathology of human-technology relations is not to cast a negative light upon hermeneutic relations in contrast to embodiment ones but rather to indicate that there are different locations where perceptual and human-technology relations interact. Normally, when the technologies work, the technology-world relation would retain its unique her-

meneutic transparency. But if the I-(technology-world) relation is far enough along the continuum to identify the relation as a hermeneutic one, the intersection of perceptual-bodily relations with the technology changes.

Readable technologies call for the extension of my hermeneutic and “linguistic” capacities *through* the instruments, while the reading itself retains its bodily perceptual location as a relation *with* or *towards* the technology. What is emerging here is the first suggestion of an emergence of the technology as “object” but without its negative Heideggerian connotation. Indeed, the type of special capacity as a “text” is a condition for hermeneutic transparency.

The transformation made possible by the hermeneutic relation is a transformation that occurs precisely through *differences* between the text and what is referred to. What is needed is a particular set of textually clear perceptions that “reduce” to that which is immediately readable. To return to the Three Mile Island example, one problem uncovered was that the instrument panel design was itself faulty. It did not incorporate its dials and gauges in an easily readable way. For example, in airplane instrument panel design, much thought has been given to pattern recognition, which occurs as a perceptual gestalt. Thus, in a four-engined aircraft, the four dials indicating r.p.m. will be coordinated so that a single glance will indicate which, if any, engine is out of synchronization. Such technical design accounts for perceptual structures.

There is a second caution concerning the focus upon connectors and pathology. In all the examples I have used to this point, the hermeneutic technics have involved material connections. (The thermometer employs a physical property of a bimetallic spring or mercury in a column; the instrument panel at TMI employs mechanical, electrical, or other material connections; the shift lever, a simple mechanical connection.) If reading does not employ any such material connections, it might seem that its referentiality is essentially different, yet not even all technological connections are strictly material. Photography retains representational isomorphism with the object, yet does not “materially” connect with its object, it is a minimal beginning of action at a distance.

I have been using contemporary or post-scientific examples, but non-material hermeneutic relations do not obtain only for contemporary humans. As existential relations, they are as “old” as post-Garden humanity. Anthropology and the history of religions have long

been familiar with a wide variety of shamanistic praxes which fall into the pattern of hermeneutic technics. In what may at first seem a somewhat outrageous set of examples, note the various “reading” techniques employed in shamanism. The reading of animal entrails, of thrown bones, of bodily marks – all are hermeneutic techniques. The patterns of the entrails, bones, or whatever are taken to *refer* to some state of affairs, instrumentally or textually.

Not only are we here close to a familiar association between magic and the origins of technology suggested by many writers, but we are, in fact, closer to a wider hermeneutic praxis in an intercultural setting. For that reason, the very strangeness of the practice must be critically examined. If the throwing of bones is taken as a “primitive” form of medical diagnosis – which does play a role in shamanism – we might conclude that it is indeed a poor form of hermeneutic relations. What we might miss, however, is that the entire gestalt of what is being diagnosed may differ radically from the other culture and ours.

It may well be that as a focused form of diagnosis upon some particular bodily ailment (appendicitis, for example), the diagnosis will fail. But since one important element in shamanism is a wider diagnosis, used particularly as the occasion of locating certain communal or social problems, it may work better. The sometimes socially contextless emphasis of Western medicine upon a presumably “mechanical” body may overlook precisely the context which the shaman so clearly recognizes. The entire gestalt is different and differently focused, but in both cases there are examples of hermeneutic relations.

In our case, the very success of Western medicine in certain diseases is due to the introduction of technologies into the hermeneutic relation (fever/thermometer; blood pressure/manometer, etc.) The point is that hermeneutic relations are as commonplace in traditional and ancient social groups as in ours, even if they are differently arranged and practiced.

By continuing the intentionality analysis I have been following, one can now see that hermeneutic relations vary the continuum of human–technology–world relations. Hermeneutic relations maintain the general mediation position of technologies within the context of human praxis towards a world, but they also change the variables within the human–technology–world relation. A comparative formalism may be suggestive:

General intentionality relations
Human–technology–world

Variant A: embodiment relations
(I–technology) → world

Variant B: hermeneutic relations
I → (technology world)

While each component of the relation changes within the correlation, the overall shapes of the variants are distinguishable. Nor are these matters of simply how technologies are experienced.

Another set of examples from the set of optical instruments may illustrate yet another way in which instrumental intentionalities can follow new trajectories. Strictly embodiment relations can be said to work best when there is both a transparency and an isomorphism between perceptual and bodily action within the relation. I have suggested that a trajectory for development in such cases may often be a horizontal one. Such a trajectory not only follows greater and greater degrees of magnification but also entails all the difficulties of a technical nature that go into allowing what is to be seen as though by direct vision. But not all optical technologies follow this strategy. The introduction of hermeneutic possibilities opens the trajectory into what I shall call *vertical* directions, possibilities that rely upon quite deliberate hermeneutic transformations.

It might be said that the telescope and microscope, by extending vision while transforming it, remained *analogue* technologies. The enhancement and magnification made possible by such technologies remain visual and transparent to ordinary vision. The moon remains recognizably the moon, and the microbe – even if its existence was not previously suspected – remains under the microscope a beastie recognized as belonging to the animate continuum. Here, just as the capacity to magnify becomes the foreground phenomenon to the background phenomenon of the reduction necessarily accompanying the magnification, so the similitude of what is seen with ordinary vision remains central to embodiment relations.

Not all optical technologies mediate such perceptions. In gradually moving towards the visual “alphabet” of a hermeneutic relation, deliberate variations may occur which enhance previously undiscernible *differences*:

- (1) Imagine using spectacles to correct vision, as previously noted. What is wanted is to *return* vision as closely as possible to ordinary perception, not to distort or modify it in any extreme micro- or macro- perceptual direction. But now, for snowscapes

or sun on the water or desert, we modify the lenses by coloring or polarizing them to cut glare. Such a variation transforms *what* is seen in some degree. Whether we say the polarized lens removes glare or “darkens” the landscape, what is seen is now clearly different from what may be seen through untinted glasses. This difference is a clue which may open a new *telic direction* for development.

- (2) Now say that somewhere, sometime, someone notes that certain kinds of tinting reveal unexpected results. Such is a much more complex technique now used in infrared satellite photos. (For the moment, I shall ignore the fact that part of this process is a combined embodiment and hermeneutic relation.) If the photo is of the peninsula of Baja California, it will remain recognizable in shape. Geography, whatever depth and height representations, etc., remain but vary in a direction different from any ordinary vision. The infrared photo enhances the difference between vegetation and non-vegetation beyond the limits of any isomorphic color photography. This difference corresponds, in the analogue example, to something like a pictograph. It simultaneously leaves certain analogical structures there and begins to modify the representation into a different, non-perceived “representation.”
- (3) Very sophisticated versions of still representative but non-ordinary forms of visual recognition occur in the new heat-sensitive and light-enhanced technologies employed by the military and police. Night scopes which enhance a person’s heat radiation still look like a person but with entirely different regions of what stands out and what recedes. In high-altitude observations, “heat shadows” on the ground can indicate an airplane that has recently had its engines running compared to others which have not. Here visual technologies bring into visibility what was not visible, but in a distinctly now perceivable way.
- (4) If now one takes a much larger step to spectrographic astronomy, one can see the acceleration of this development. The spectrographic picture of a star no longer “resembles” the star at all. There is no point of light, no disk size, no spatial isomorphism at all – merely a band of differently colored rainbow stripes. The naive reader would not know that this was a picture of a star at all – the reader would have to know the language, the alphabet, that has coded the star. The astronomer-hermeneut does know the language and “reads” the visual “ABCs” in such a way that he knows the chemical

composition of the star, its internal makeup, rather than its shape or external configuration. We are here in the presence of a more fully hermeneutic relation, the star mediated not only instrumentally but in a transformation such that we must now thematically *read* the result. And only the informed reader can do the reading.

There remains, of course, the *reference* to the star. The spectrograph is *of* Rigel or *of* Polaris, but the individuality of the star is now made present hermeneutically. Here we have a beginning of a special transformation of perception, a transformation which deliberately enhances differences rather than similarities in order to get at what was previously unperceived.

- (5) Yet even the spectrograph is but a more radical transformation of perception. It, too, can be transformed by a yet more radical *hermeneutic* analogue to the *digital* transformation which lies embedded in the preferred quantitative praxis of science. The “alphabet” of science is, of course, mathematics, a mathematics that separates itself by yet another hermeneutic step from perception embodied.

There are many ways in which this transformation can and does occur, most of them interestingly involving a particular act of *translation* that often goes unnoticed. To keep the example as simple as possible, let us assume *mechanical* or *electronic* “translation.” Suppose our spectrograph is read by a machine that yields not a rainbow spectrum but a set of numbers. Here we would arrive at the final hermeneutic accomplishment, the transformation of even the analogue to a digit. But in the process of hermeneuticization, the “transparency” to the object referred to becomes itself enigmatic. Here more explicit and thematic interpretation must occur.

Hermeneutic relations, particularly those utilizing technologies that permit vertical transformations, move away from perceptual isomorphism. It is the *difference* between what is shown and how something is shown which is informative. In a hermeneutic relation, the world is first transformed into a text, which in turn is read. There is potentially as much flexibility within hermeneutic relations as there are in the various uses of language. Emmanuel Mounier early recognized just this analogical relationship with language:

The machine as implement is not a simple material extension of our members. It is of another order, an annex to our

language, an auxiliary language to mathematics, a means of penetrating, dissecting and revealing the secret of things, their implicit intentions, their unemployed capacities.⁴

Through hermeneutic relations we can, as it were, *read* ourselves into any possible situation without being there. In science, in contrast to literature, what is important is that the reading retain *some* kind of reference or hermeneutic transparency to what is there. Perhaps that is one reason for the constant desire to reverse what is read back towards what may be perceived. In this reversal, contemporary technologically embodied science has frequently derived what might be called *translation technologies*. I mention two in passing:

- (a) Digital processes have become *de rigueur* within the perceptual domain. The development of pictures from space probes is such a *double translation* process. The photograph of the surface of Venus is a technological analogue to human vision. It at least is a field display of the surface, incorporating the various possible figures and contrasts that would be seen instantaneously in a visual gestalt – but this holistic result cannot be transmitted in this way by the current technologies. Thus it is “translated” into a digital code, which can be transmitted. The “seeing” of the instrument is broken down into a series of digits that are radiographically transmitted to a receiver; then they are reassembled into a spatter pattern and enhanced to reproduce the photograph taken millions of miles away. It would be virtually impossible for anyone to read the digits and tell what was to be seen; only when the linear text of the digits has been retranslated back into the span of an instantaneous visual gestalt can it be seen that the rocks on Venus are or are not like those on the moon. Here the analogues of perception and language are both utilized to extend vision beyond the earth.
- (b) The same process is used audially in digital recordings. Once again, the double translation process takes place and sound is reduced to digital form, reproduced through the record, and translated back into an auditory gestalt.

Digital and analogue processes blur together in certain configurations. Photos transmitted as points of black on a white ground and reassembled within certain size limits are perceptually gestalted; we see Humphrey Bogart, not simply a mosaic of dots. (Pointillism did the

same in painting, although in color. So-called concrete poetry employs the same crossover by placing the words of the poem in a visual pattern so the poem may be both read and seen as a visual pattern.)

Such translation and retranslation processes are clearly transformations from perceptually gestalted phenomena into analogues of writing (serial translation and retranslation processes are clearly transformations from perceptual gestalt phenomena into analogues of writing serial transmissions along a “line,” as it were), which are then retranslatable into perceptual gestalts.

I have suggested that the movement from embodiment relations to hermeneutic ones occurs along a human-technology continuum. Just as there are complicated, borderline cases along the continuum from fully haired to bald men, there are the same less-than-dramatic differences here. I have highlighted some of this difference by accenting the bodily-perceptual distinctions that occur between embodiment and hermeneutic relations. This has allowed the difference in perceptual and hermeneutic transparencies to stand out.

There remain two possible confusions that must be clarified before moving to the next step in this phenomenology of technics. First, there is a related sense in which perception and interpretation are intertwined. Perception is primitively already interpretational, in both micro- and macrodimensions. To perceive is already “like” reading. Yet reading is also a specialized act that receives both further definition and elaboration within literate contexts. I have been claiming that one of the distinctive differences between embodiment and hermeneutic relations involves perceptual position, but in the broader sense, interpretation pervades both embodiment and hermeneutic action.

A second and closely related possible confusion entails the double sense in which a technology may be used. It may be used simultaneously both as something *through* which one experiences and as something *to* which one relates. While this is so, the doubled relation takes shapes in embodiment different from those of hermeneutic relations. Return to the simple embodiment relation illustrated in wearing eyeglasses. *Focally*, my perceptual experience finds its directional aim *through* the lenses, terminating my gaze upon the object of vision; but as a *fringe* phenomenon, I am simultaneously aware of (or can become so) the way my glasses rest upon the bridge of my nose and the tops of my ears. In this fringe sense, I am aware of the glasses, but the focal phenomenon is the perceptual transparency that the glasses allow.

In cases of hermeneutic transparency, this doubled role is subtly changed. Now I may carefully read the dials within the core of my visual field and attend to them. But my reading is simultaneously a reading through them, although now the terminus of reference is not necessarily a perceptual object, nor is it, strictly speaking, perceptually present. While the type of transparency is distinct, it remains that the purpose of the reading is to gain hermeneutic transparency.

Both relations, however, at optimum, occur within the familiar acquisitional praxes of the lifeworld. Acute perceptual seeing must be learned and, once acquired, occurs as familiarly as the act of seeing itself. For the accomplished and critical reader, the hermeneutic transparency of some set of instruments is as clear and as immediate as a visual examination of some specimen. The peculiarity of hermeneutic transparency does not lie in either any deliberate or effortful accomplishment of interpretation (although in learning any new text or language, that effort does become apparent). That is why the praxis that grows up within the hermeneutic context retains the same sense of spontaneity that occurs in simple acts of bodily motility. Nevertheless, a more distinctive presence of the technology appears in the example. My awareness of the instrument panel is both stronger and centered more focally than the fringe awareness of my eyeglasses frames, and this more distinct awareness is essential to the optimal use of the instrumentation.

In both embodiment and hermeneutic relations, however, the technology remains short of full objectiveness or *otherwise*. It remains the means through which something else is made present. The negative characterization that may occur in breakdown pathologies may return. When the technology in embodiment position breaks down or when the instrumentation in hermeneutic position fails, what remains is an obtruding, and thus negatively derived, object.

Both embodiment and hermeneutic relations, while now distinguished, remain basic existential relations between the human user and the world. There is the danger that my now-constant and selective use of scientific instrumentation could distort the full impact of the existential dimension. Prior to moving further along the human-technology-world continuum, I shall briefly examine a very different set of instrumental examples. The instrumentation in this case will be *musical instrumentation*.

In the most general sense, it should be easy to see that the use of musical instrumentation, in performance, falls into the same configurations as do scientific instruments:

I—musical instrument—world
I—scientific instrument—world

But the praxical context is significantly changed. If scientific or knowledge-developing praxis is constrained by the need to have a referential terminus within the world, the musical praxis is not so constrained. Indeed, if there is a terminus, it is a reference not so much to some thing or region of the environment as to the production of a musical event within that environment. The “musical, object” is whatever sound phenomenon occurs through the performance upon the instrument. Musical sounds are produced, *created*. Whereas in the development of scientific instrumentation the avoidance of phenomena that would be artifacts of the instrument rather than of its referent are to be avoided or reduced as much as possible, the very discovery and enhancement of such instrumental artifacts may be a positive phenomenon in making music. There are interesting and significant differences in these two praxical contexts, but for the moment, I shall restrict myself to a set of observations about the similarities in the intentionality structures of both scientific and musical instrumentation.

It should be obvious that a very large use of musical instrumentation falls clearly into the embodiment relation pattern. The player picks up the instrument (having learned to embody it) and expressively produces the desired music:

Player—instrument—sound

In embodiment cases, the sound-making instrument will be partially symbiotically embodied:

(Player—instrument)—sound

Second, the previously noted amplification/reduction structure also occurs here. If our player is a trombonist, the “buzz” his lip vibrations produce can be heard without any instrument but, once amplified and transformed *through* the trombone, occur as the musical sound distinctive to the human-instrument pairing. Equally immediately, at least within the complex of contemporary instrumentation, one may detect that nothing like a restriction to human sound as such belongs to the contemporary musical context. Isomorphism to human sound, while historically playing a significant cultural role, now occupies only one dimension of musical sound.

This history, however, is interesting. There have been tendencies in Western musical history to restrict to or at least to develop precisely along horizontally variant ways. The restriction of musical sound to actual human voices (certain Mennonite sects do not allow any musical instrumentation, and all hymn singing is done a cappella) is a form of this tendency. Instrumentation that mimics or actually amplifies vocal sounds and their ranges is another example: woodwinds, horns, organs (even to the organ stop titles which are usually voice analogues) – all are ancient instruments that often deliberately followed a kind of vocal isomorphism. Medieval music was often doubly constrained. Not only must the music remain within the range of human similitude, but even the normatively controlled harmonics and chant lines were religio-culturally constrained. Later, one could detect a much more vocal model to much Italian (Renaissance through Baroque) music in contrast to a more instrumental oriented model in German music.

The implicit valuational model of the human voice was also reflected in the music history of the West by the ranking of instruments by *expressivity*, with those instruments thought most expressive – the violin, for example – rated more highly than those farther from the vocal model.

The difference between embodiment and hermeneutic relations appears within this context as well. While embodiment relations in the most general existential sense need not be strictly constrained by isomorphism, hermeneutic variants occur very quickly along the musical spectrum. The piano retains little vocal isomorphism; yet when played, it falls into the embodiment relation, is expressive of the individual style and attainment of the performer, etc. Farther along the continuum, computer-produced music clearly occurs much more fully within the range of hermeneutic relations, in some cases with the emergence of random-sound generation very close to the sense of *otherness*, which will characterize the next set of relations where the technology emerges as *other*.

Instrumental music, as technics, may go in either embodiment or hermeneutic directions. It may develop its instrumentation in both vertical and horizontal trajectories. In either direction there are recognizable clear, technological transformations. If the Western “bionic” model of much early music was voice, in Andean music it was bird song (both in melody and in sound quality produced by breathy wood flutes). Contrarily, percussion instrumentation (drum music and communication) was,

from the outset, a movement in a vertical and thus more hermeneutic direction. This exploration of possibility trees in horizontal and vertical directions belongs to the realm of musical praxis as much as to scientific, but is without any referentiality to a natural world.

The result of technological development in musical technics is also suggestively different from its result in scientific praxis. The “world” produced musically through all the technical adumbrations is *not* that suggested either by the new philosophy of science or by a Heideggerian philosophy of technology. The closest analogy to the notion of standing reserve (resource well) that the musical “world” might take is that the realm of all possible sound may be taken and/or transformed musically. But the acoustical resources of musical technics are utilized through the creative sense of *play* which pervades musical praxis. The “musical object” is a created object, but its creation is not constrained by the same imperatives of scientific praxis. Yet the materialization of musical sound *through* instrumentation remains a fully human technological form of action.

What can be glimpsed in this detour into musical instrumentation is that while the human-technology structures are parallel with those found within scientific instrumentation, the “world” created does not at all imply the same reduction to what has been claimed as the unique Western view of the domination of nature. Here, then, is an opening to a different possible trajectory of development.

C Alterity Relations

Beyond hermeneutic relations there lie *alterity relations*. The first suggestions of such relations, which I shall characterize as relations *to* or *with* a technology, have already been suggested in different ways from within the embodiment and hermeneutic contexts. Within embodiment relations, were the technology to intrude upon rather than facilitate one’s perceptual and bodily extension into the world, the technology’s objectness would necessarily have appeared negatively. Within hermeneutic relations, however, there emerged a certain positivity to the objectness of instrumental technologies. The bodily-perceptual focus *upon* the instrumental text is a condition of its own peculiar hermeneutic transparency. But what of a positive or presential sense of relations with technologies? In what phenomenological senses can a technology be *other*?

The analysis here may seem strange to anyone limited to the habits of objectivist accounts, for in such accounts technologies as objects usually come first rather than last. The problem for a phenomenological account is that objectivist ones are non-relativistic and thus miss or submerge what is distinctive about human-technology relations.

A naive objectivist account would likely begin with some attempt to circumscribe or define technologies by object characteristics. Then, what I have called the technical properties of technologies would become focal. Some combination of physical and material properties would be taken to be definitional. (This is an inherent tendency of the standard nomological positions such as those of Bunge and Hacking). The definition will often serve a secondary purpose by being stipulative: only those technologies that are obviously dependent upon or strongly related to contemporary scientific and industrial productive practices will count.

This is not to deny that objectivist accounts have their own distinctive strengths. For example, many such accounts recognize that technological or “artificial” products are different from the simply found object or the natural object. But the submergence of the human-technology relation remains hidden, since either object may enter into praxis and both will have their material, and thus limited, range of technical usability within the relation. Nor is this to deny that the objectivist accounts of types of technologies, types of organization, or types of designed purposes should be considered. But the focus in this first program remains the phenomenological derivation of the set of human-technology relations.

There is a tactic behind my placing alterity relations last in the order of focal human-technology relations. The tactic is designed, on the one side, to circumvent the tendency succumbed to by Heidegger and his more orthodox followers to see the otherness of technology only in negative terms or through negative derivations. The hammer example, which remains paradigmatic for this approach, is one that derives objectness from breakdown. The broken or missing or malfunctioning technology could be *discarded*. From being an obtrusion it could become *junk*. Its objectness would be clear – but only partly so. Junk is not a focal object of use relations (except in certain limited situations). It is more ordinarily a background phenomenon, that which has been put out of use.

Nor, on the other side, do I wish to fall into a naively objectivist account that would simply concentrate upon

the material properties of the technology as an object of knowledge. Such an account would submerge the relativity of the intentionality analysis, which I wish to preserve here. What is needed is an analysis of the positive or presentential senses in which humans relate to technologies as relations *to* or with technologies, to technology-as-other. It is this sense which is included in the term “alterity.”

Philosophically, the term “alterity” is borrowed from Emmanuel Levinas. Although Levinas stands within the traditions of phenomenology and hermeneutics, his distinctive work, *Totality and Infinity*, was “anti-Heideggerian.” In that work, the term “alterity” came to mean the radical difference posed to any human by another human, an *other* (and by the ultimately other, God). Extrapolating radically from within the tradition’s emphasis upon the non-reducibility of the human to either objectness (in epistemology) or as a means (in ethics), Levinas poses the otherness of humans as a kind of *infinite* difference that is concretely expressed in an ethical, face-to-face encounter.

I shall retain but modify this radical Levinasian sense of human otherness in returning to an analysis of human-technology relations. How and to what extent do technologies become other or, at least, *quasi-other*? At the heart of this question lie a whole series of well-recognized but problematic interpretations of technologies. On the one side lies the familiar problem of anthropomorphism, the personalization of artifacts. This range of anthropomorphism can reach from serious artifact-human analogues to trivial and harmless affections for artifacts.

An instance of the former lies embedded in much AI research. To characterize computer “intelligence” as human-like is to fall into a peculiarly contemporary species of anthropomorphism, however sophisticated. An instance of the latter is to find oneself “fond” of some particular technofact as, for instance, a long-cared-for automobile which one wishes to keep going and which may be characterized by quite deliberate anthropomorphic terms. Similarly, in ancient or non-Western cultures, the role of sacredness attributed to artifacts exemplifies another form of this phenomenon.

The religious object (idol) does not simply “represent” some absent power but is endowed with the sacred. Its aura of sacredness is spatially and temporally present within the range of its efficacy. The tribal devotee will defend, sacrifice to, and care for the sacred artifact. Each of these illustrations contains the seeds of an alterity relation.

A less direct approach to what is distinctive in human-technology alterity relations may perhaps better open the way to a phenomenologically relativistic analysis. My first example comes from a comparison to a technology and to an animal “used” in some practical (although possibly sporting) context: the spirited horse and the spirited sports car.

To ride a spirited horse is to encounter a lively-animal *other*. In its pre- or nonhuman context, the horse has a life of its own within the environment that allowed this form of life. Once domesticated, the horse can be “used” as an “instrument” of human praxis – but only to a degree and in a way different from counterpart technologies; in this case, the “spirited” sports car.

There are, of course, analogues which may at first stand out. Both horse and car give the rider/driver a magnified sense of power. The speed and the experience of speed attained in riding/driving are dramatic extensions of my own capacities. Some prominent features of embodiment relations can be found analogously in riding/driving. I experience the trail/road through horse/car and guide/steer the mediating entity under way. But there are equally prominent differences. No matter how well trained, no horse displays the same “obedience” as the car. Take malfunction: in the car, a malfunction “resists” my command – I push the accelerator, and because of a clogged gas line, there is not the response I expected. But the animate resistance of a spirited horse is more than such a mechanical lack of response – the response is more than malfunction, it is disobedience. (Most experienced riders, in fact, prefer spirited horses over the more passive ones, which might more nearly approximate a mechanical obedience.) This life of the other in a horse may be carried much further – it may live without me in the proper environment; it does not need the *deistic* intervention of turning the starter to be “animated.” The car will not shy at the rabbit springing up in the path any more than most horses will obey the “command” of the driver to hit the stone wall when he is too drunk to notice. The horse, while approximating some features of a mediated embodiment situation, never fully enters such a relation in the way a technology does. Nor does the car ever attain the sense of animation to be found in horseback riding. Yet the analogy is so deeply embedded in our contemporary consciousness (and perhaps the lack of sufficient experience with horses helps) that we might be tempted to emphasize the similarities rather than the differences.

Anthropomorphism regarding the technology on the one side and the contrast with horseback riding on the other point to a first approximation to the unique type of otherness that relations to technologies hold. Technological otherness is a *quasi-otherness*, stronger than mere objectness but weaker than the otherness found within the animal kingdom or the human one; but the phenomenological derivation must center upon the positive experiential aspects outlining this relation.

In yet another familiar phenomenon, we experience technologies as *toys* from childhood. A widely cross-cultural example is the spinning top. Prior to being put into use, the top may appear as a top-heavy object with a certain symmetry of design (even early tops approximate the more purely functional designs of streamlining, etc.), but once “deistically” animated through either stick motion or a string spring, the now spinning top appears to take on a life of its own. On its tip (or “foot”) the top appears to defy its top-heaviness and gravity itself. It traces unpredictable patterns along its pathway. It is an object of *fascination*.

Note that once the top has been set to spinning, what was imparted through an embodiment relation now exceeds it. What makes it fascinating is this property of quasi-animation, the life of its own. Also, of course, once “automatic” in its motion, the top’s movements may be entered into a whole series of possible contexts. I might enter a game of warring tops in which mine (suitably marked) represents me. If I-as-top am successful in knocking down the other tops, then this game of hermeneutics has the top winning for me. Similarly, if I take its quasi-autonomous motion to be a hermeneutic predictor, I may enter a divination context in which the path traced or the eventual point of stoppage indicates some fortune. Or, entering the region of scientific instrumentation, I may transform the top into a gyroscope, using its constancy of direction within its now-controlled confines as a better-than-magnetic compass. But in each of these cases, the top may become the focal center of attention as a quasi-other to which I may relate. Nor need the object of fascination carry either an embodiment or hermeneutic referential transparency.

To the ancient and contemporary top, compare briefly the fascination that occurs around video games. In the actual use of video games, of course, the embodiment and hermeneutic relational dimensions are present. The joystick that embodies hand and eye coordination skills extends the player into the displayed field. The field itself displays some hermeneutic context (usually either some

“invader” mini-world or some sports analogue), but this context does not refer beyond itself into a worldly reference.

In addition to these dimensions, however, there is the sense of *interacting with* something other than me, the technological *competitor*. In competition there is a kind of dialogue or exchange. It is the quasi-animation, the quasi-otherness of the technology that fascinates and challenges. I must beat the machine or it will beat me.

In each of the cases mentioned, features of technological alterity have shown themselves. The quasi-otherness, the quasi-autonomy which appears in the toy or the game is a variant upon the technologies that have fascinated Western thinkers for centuries, the *automaton*.

The most sophisticated Greek (and similarly, Chinese) technologies did not appear in practical or scientific contexts so often as in game or theatrical ones. (War contexts, of course, have always employed advanced technologies.) Within these contexts, automatons were devised. From rediscovered treatises by Hero of Alexandria on pneumatics and hydraulics (which had in the second century B.C. already been used for humorous applications), the Renaissance builders began to construct various automata. The applications of Hero had been things like automatically opening temple doors and artificial birds that sang through steam whistles. In the Renaissance reconstructions, automata became more complex, particularly in fountain systems:

The water garden of the Villa d'Este, built in 1550 at Tivoli, outside Rome, for the son of Lucrezia Borgia [was the best known]. The slope of the hill was used to supply fountains and dozens of grottos where water-powered figures moved and played and spouted ... The Chateau Merveilleux of Helbrun ... is full of performing figures of men and women where fountains turn on and off unexpectedly or, operating in the intricate and quite amazing theatre of puppets, run by water power.⁵

The rage for automata was later to develop in a number of directions from music machines, of which the Deutsches Museum in Munich has a grand collection, to Vaucanson's automated duck which quacked, ate, drank, and excreted.⁶ Much later, automation techniques were used in more practical contexts, although versions of partially automated looms for textiles did begin to appear in the eighteenth century (Vaucanson, the maker of the automated duck, invented the holed cylinder that preceded the punch-card system of the Jacquard loom).

Nor should the clock be exempted from this glance at automata fascination. The movements of the heavens, of the march of life and death, and of the animated figures on the clocks of Europe were other objects of fascination that seemed to move “autonomously.” The superficial aspects of automation, the semblance of the animate and the similitude of the human and animal, remained the focus for even more serious concerns with automatons. That which is more “like” us seemed to center the fascination and make the alterity more quasi-animate.

Fascination may hide what is reductive in technological selectivities. But it may also hide, doubly, a second dimension of an instrumental intentionality, its possible dissimilarity direction, which may often prove in the longer run the more interesting trajectory of development. Yet semblance usually appears to be the first focus.

It was this *semblance* which became a worry for Modern (seventeenth and eighteenth century) Philosophy. Descartes's famous doubts also utilize the popular penchant for automata. In seeking to prove that it is the mind alone and not the eyes that know things, he argues:

I should forthwith be disposed to conclude that the wax is known by the act of sight and not by the intuition of the mind alone were it not for the analogous instance of human beings passing on in the street below, as observed from a window. In this case, I do not fail to say that I see the men themselves, just as I say that I see the wax; and yet, what do I see from the window beyond hats and cloaks that might cover artificial machines, whose motions might be determined by springs?⁷

This can-I-be-fooled-by-a-cleverly-conceived-robot argument was to have an exceedingly long history, even into the precincts of contemporary analytic philosophies.

Were Descartes to become a contemporary of current developments in the attempt to mimic animal and human motions by automata, he might well rethink his illustration. Not only spring-run automata but also the most sophisticated computer-run automata look mechanical. These most sophisticated computer-run automata have difficulty maneuvering in anything like a lifelike motion. As Dreyfus has pointed out and as would be confirmed by many current researchers, bodily motion is perhaps harder to imitate than certain “mental” activities such as calculating.

To follow only the inclination towards similitude, however, is to reduce what may be learned from our relations with technologies. The current state of the art in AI

research, for example, while having been partially freed from its earlier fundamentalistic state, remains primarily within the aim of creating similarities with human intelligence or modeling what are believed to be analogues to our intelligence. Yet it might well be that the *differences* that emerge from computer experimentation may be more informative or, at least, as informative as the similitudes.

There are what I shall call technological *intentionalities* that emerge from many technologies. Let us engage in a pseudo-Cartesian, imaginative construction of a humanoid robot, within the limits of easily combinable and available technologies, to take account of the similarity/difference structures which may be displayed. I shall begin with the technology's "perceptions" of sensory equipment: What if the robot were to hear? The inventor, perhaps limited by a humanist's budget, could install an omnidirectional microphone for ears. We could check upon what our robot would "hear" by adding a cassette player for a recorded "memory" of its "hearing." What is heard would turn out to be very differently structured, to have a very different form of intentionality than what any human listener would hear.

Assume that our robot is attending a university lecture in a large hall and is seated, as a shy student might be, near the rear. Given the limits of the mentioned technology, what would be heard would fail to have either the foreground/background pattern of human listening or the selective elimination of noise that even ordinary listening displays. The robot's auditory memory, played back, would reveal something much more like a sense-data auditory world than the one we are familiar with. The lecturer's voice, though recorded and within low limits perhaps detectable, would often be buried under the noise and background sounds that are selectively masked by human listening. For other purposes, precisely this differently structured technological intentionality could well be useful and informative. Such a different auditory selectivity could perhaps give clues to better architectural dampening of sounds precisely because what is repressed in human listening here stands out. In short, there is "truth" to be found in both the similarity and the difference that technological intentionalities reveal.

A similar effect could be noted with respect to the robot's vision. Were its eyes to be made of television equipment and the record or memory of what it has seen displayed on a screen, we would once again note the flatness of its visual field. Depth phenomena would be greatly reduced or would disappear. Although we have

become accustomed to this flat field in watching television, it is easy to become reaware of the lack of depth between the baseball pitcher and the batter upon the screen. The technological shape of intentionality differs significantly from its human counterpart.

The fascination with human or animate similitude within the realm of alterity relations is but another instance of the types of fascination pervading our relations with technologies. The astonishment of Galileo at what he saw through the telescope was, in effect, the location of similitude within embodiment use. The magnification was the magnification of human visual capacity and remained within the range of what was familiarly visible. The horizontal trajectory of magnification that can more and more enhance vision is a trajectory along an already familiar praxis.

With the examples of fascination with automata, the fascination also remains within the realm of the familiar, now in a kind of mirror phenomenon for humans and the technology. Of all the animals in the earth's realm, it seems that the human ones are those who can prolong this fascination the most intensely. Paul Levinson, in an examination of the history of media technologies, has argued that there are three stages through which technologies pass. The first is that of technology as toy or novelty. The history of film technology is instructive:

The first film makers were not artists but tinkers ... "Their goal in making a movie was not to create beauty but to display a scientific curiosity." A survey of the early "talkies" like *The Jazz Singer*, first efforts in animation such as Disney's "Laugh-O-Gram" cartoons, and indeed the supposed debut of the motion picture in *Fred Ott's Sneeze* supports [this thesis] itself.⁸

The same observation could be made about much invention. But once taken more seriously, novelty can be transformed into a second stage, according to Levinson: that of technology as mirror of reality. This too happened in the history of film. Following the early curiosities at the onset of the film industry, the introduction of the Lumieres' presentation of "actualities" were, in part, fascinating precisely through the magnification/reduction selectivities that film technologies produce through unique film intentionalities. Examples could be as mundane as "workers leaving a factory, a baby's meal, and the famous train entering the station." What made such cinemas *vérités* dramatic were "in this case, a real train

chugging into a real station, at an angle such that the audience could almost believe the train was chugging at *them*.”⁹

This mirror of life, like the automaton, is not isomorphic with non-technological experience but is technologically transformed with the various effects that exaggerate or enhance some effects while simultaneously reducing others. Levinson is quite explicit in his analysis concerning the ways newly introduced technologies also enhance this development:

The growth of film from gimmick to replicator was apparently in large part dependent upon a new technological component The “toy” film played to individuals who peeked into individual kinetoscopes; but the “reality” film reached out to mass audiences, who viewed the reality-surrogate in group theatres. The connection between mass audiences and reality simulation, moreover, was no accident. Unlike the perception of novelties, which is inherently subjective and individualized, reality perception is a fundamentally objective, group process.¹⁰

Although the progression of the analysis here moves from embodiment and hermeneutic relations to alterity ones, the interjection of film or cinema examples is of suggestive interest. Such technologies are transitional between hermeneutic and alterity phenomena. When I first introduced the notion of hermeneutic relations, I employed what could be called a “static” technology: writing. The long and now ancient technologies of writing result in fixed texts (books, manuscripts, etc., all of which, barring decay or destruction, remain stable in themselves). With film, the “text” remains fixed only in the sense that one can repeat, as with a written text, the seeing and hearing of the cinema text. But the mode of presentation is dramatically different. The “characters” are now animate and theatrical, unlike the fixed alphabetical characters of the written text. The dynamic “world” of the cinema-text, while retaining many of the functional features of writing, also now captures the semblance of real-time, action, etc. It remains to be “read” (viewed and heard), but the object-correlate necessarily appears more “life-like” than its analogue – written text. This factor, naively experienced by the current generations of television addicts, is doubtless one aspect in the problems that emerge between television watching habits and the state of reading skills. James Burke has pointed out that “the majority of the people in the advanced industrialized nations spend more time watching television than doing anything else beside

work.”¹¹ The same balance of time use also has shown up in surveys regarding students. The hours spent watching television among college and university students, nationally, are equal to or exceed those spent in doing homework or out-of-class preparation.

Film, cinema, or television can, in its hermeneutic dimension, refer in its unique way to a “world.” The strong negative response to the Vietnam War was clearly due in part to the virtually unavoidable “presence” of the war in virtually everyone’s living room. But films, like readable technologies, are also *presentations*, the focal terminus of a perceptual situation. In that emergent sense, they are more dramatic forms of perceptual immediacy in which the presented display has its own characteristics conveying quasi-alterity. Yet the engagement with the film normally remains short of an engagement with an *other*. Even in the anger that comes through in outrage about civilian atrocities or the pathos experienced in seeing starvation epidemics in Africa, the emotions are not directed to the screen but, indirectly, through it, in more appropriate forms of political or charitable action. To this extent there is retained a hermeneutic reference elsewhere than at the technological instrument. Its quasi-alterity, which is also present, is not fully focal in the case of such media technologies.

A high-technology example of breakdown, however, provides yet another hint at the emergence of alterity phenomena. Word processors have become familiar technologies, often strongly liked by their users (including many philosophers who fondly defend their choices, profess knowledge about the relative abilities of their machines and programs, etc.). Yet in breakdown, this quasi-love relationship reveals its quasi-hate underside as well. Whatever form of “crash” may occur, particularly if some fairly large section of text is involved, it occasions frustration and even rage. Then, too, the programs have their idiosyncracies, which allow or do not allow certain movements; and another form of human-technology competition may emerge. (Mastery in the highest sense most likely comes from learning to program and thus overwhelm the machine’s previous brainpower. “Hacking” becomes the game-like competition in which an entire system is the alterity correlate.) Alterity relations may be noted to emerge in a wide range of computer technologies that, while failing quite strongly to mimic bodily incarnations, nevertheless display a quasi-otherness within the limits of linguistics and, more particularly, of logical behaviors. Ultimately, of course,

whatever contest emerges, its sources lie opaquely with other humans as well but also with the transformed technofact, which itself now plays a more obvious role within the overall relational net.

I have suggested that the computer is one of the stronger examples of a technology which may be positioned within alterity relations. But its otherness remains a quasi-otherness, and its genuine usefulness still belongs to the borders of its hermeneutic capacities. Yet in spite of this, the tendency to fantasize its quasi-otherness into an authentic otherness is pervasive. Romanticizations such as the portrayal of the emotive, speaking “Hal” of the movie *2001: A Space Odyssey*, early fears that the “brain power” of computers would soon replace human thinking, fears that political or military decisions will not only be informed by but also made by computers – all are symptoms revolving around the positing of otherness to the technology.

These romanticizations are the alterity counterparts to the previously noted dreams that wish for total embodiment. Were the technofact to be genuinely an other, it would both be and not be a *technology*. But even as quasi-other, the technology falls short of such totalization. It retains its unique role in the human–technology continuum of relations as the medium of transformation, but as a recognizable medium.

The wish–fulfillment desire occasioned by embodiment relations – the desire for a fully transparent technology that would *be* me while at the same time giving me the powers that the use of the technology makes available – here has its counterpart fantasy, and this new fantasy has the same internal contradiction: It both reduces or, here, extrapolates the technology into that which is not a technology (in the first case, the magical transformation is *into me*; in this case, *into the other*), and at the same time, it desires what is not identical with me or the other. The fantasy is for the transformational effects. Both fantasies, in effect, deny technologies playing the roles they do in the human–technology continuum of relations; yet it is only on the condition that there be some detectable differentiation within the relativity that the unique ways in which technologies transform human experience can emerge.

In spite of the temptation to accept the fantasy, what the quasi-otherness of alterity relations does show is that humans may relate positively or presentially *to* technologies. In that respect and to that degree, technologies emerge as focal entities that may receive the multiple attentions humans give the different forms of the other.

For this reason, a third formalization may be employed to distinguish this set of relations:

$$1 \rightarrow \text{technology}-(\text{world})$$

I have placed the parentheses thusly to indicate that in alterity relations there may be, but need not be, a relation through the technology to the world (although it might well be expected that the *usefulness* of any technology will necessarily entail just such a referentiality). The world, in this case, may remain context and background, and the technology may emerge as the foreground and focal quasi-other with which I momentarily engage.

This disengagement of the technology from its ordinary-use context is also what allows the technology to fall into the various disengaged engagements which constitute such activities as play, art, or sport.

A first phenomenological itinerary through direct and focal human–technology relations may now be considered complete. I have argued that the three sets of distinguishable relations occupy a continuum. At the one extreme lie those relations that approximate technologies to a quasi-me (embodiment relations). Those technologies that I can so take into my experience that through their semi-transparency they allow the world to be made immediate thus enter into the existential relation which constitutes my self. At the other extreme of the continuum lie alterity relations in which the technology becomes quasi-other, or technology “as” other *to* which I relate. Between lies the relation with technologies that both mediate and yet also fulfill my perceptual and bodily relation with technologies, hermeneutic relations. The variants may be formalized thus:

Human–technology–World Relations

Variant 1, Embodiment Relations

(Human–technology) \rightarrow World

Variant 2, Hermeneutic Relations

Human \rightarrow (technology–World)

Variant 3, Alterity Relations

Human \rightarrow technology–(–World)

Although I have characterized the three types of human–technology relations as belonging to a continuum, there is also a sense in which the elements within each type of relation are differently distributed. There is a *ratio* between the objectness of the technology and

its transparency in use. At the extreme height of embodiment, a background presence of the technology may still be detected. Similarly but with a different ratio, once the technology has emerged as a quasi-other, its alterity remains within the domain of human invention through which the world is reached. Within all the types of relations, technology remains artifactual, but it is also its very artifactual formation which allows the transformations affecting the earth and ourselves.

All the relations examined heretofore have also been focal ones. That is, each of the forms of action

that occur through these relations have been marked by an implicated self-awareness. The engagements through, with, and to technologies stand within the very core of praxis. Such an emphasis, while necessary, does not exhaust the role of technologies nor the experiences of them. If focal activities are central and foreground, there are also fringe and background phenomena that are no more neutral than those of the foreground.

[...]

Notes

- 1 Sergei Eisenstein, *Film Form: Essays in Film Theory*, ed. and trans. Jay Leyda (New York: Harcourt, Brace and World, 1949), p. 29.
- 2 This illustration is my version of a similar one developed by Patrick Heelan in his more totally hermeneuticized notion of perception in *Space Perception and the Philosophy of Science* (Berkeley: University of California Press, 1983), p. 193.
- 3 Ian Hacking, *Representing and Intervening* (Cambridge: Cambridge University Press, 1983), p. 195. Hacking develops a very excellent and suggestive history of the use of microscopes. His focus, however, is upon the technical properties that were resolved before microscopes could be useful in the sciences. He and Heelan, however, along with Robert Ackermann, have been among the pioneers dealing with perception and instrumentation in instruments. Cf. also *un Technics and Praxis* (Dordrecht: Reidel Publishers, 1979).
- 4 Emmanuel Mournier, *Be Not Afraid*, trans. Cynthia Rowland (London: Rockcliff, 1951), p. 195.
- 5 James Burke, *Connections* (Boston: Little, Brown, 1978), p. 106.
- 6 *Ibid.*, p. 107.
- 7 René Descartes, *A Discourse on Method*, trans. John Veitch (London: J. M. Dent, 1953), p. 92.
- 8 Paul Levinson, "Toy, Mirror and Art: The Metamorphosis of Technological Culture," in *Philosophy, Technology and Human Affairs*, ed. Larry Hickman (College Station: Ibis Press, 1985), p. 163.
- 9 *Ibid.*, p. 165.
- 10 *Ibid.*, p. 167.
- 11 Burke, *Connections*, p. 5.

Postphenomenology of Technology

Peter-Paul Verbeek

Introduction

How, then, to overcome the limitations of classical philosophy of technology? These limitations, as we have seen, are all too clear in the philosophies of Jaspers and Heidegger. Technology is primarily conceived as a form of alienation: it alienates human beings from themselves in preventing them from achieving authentic existence, and it alienates human beings from the world in denying them a meaningful place to exist. This negative judgment can, in part at least, be related to the historical situation in which Jaspers and Heidegger formulated their thought. In the first half of the twentieth century, society was undergoing rapid changes thanks to the influence of industrialization. The repetitive, monotonous character of assembly-line work appeared to herald a new kind of mass society and homogenized existence; cold, anonymous industrial complexes seemed to indicate the onset of a reduced relation to the world. But the classical diagnosis appeared to be premature, and failed to foresee the ways in which technological society and culture would develop. Today, over half a century later, we see that humanity has not been entirely swallowed up inside the production apparatus, and is able to approach reality not exclusively as a storehouse of raw materials.

Close inspection revealed that Jaspers and Heidegger failed to support their analysis of technology adequately.

They reduced technology to its conditions of possibility and then proceeded as if what they said about these conditions applied to technology itself. Heidegger's hermeneutical approach attempted to understand technology as an alienating way of disclosing reality, reducing concrete technological artifacts to the fruits of such disclosing. Jaspers's existential philosophy of technology attempted to understand technology in terms of bureaucracy, mass production, and the "limits of technology," and then likewise reduced it to what this made possible or to what imposed limits on it. Both philosophies appear to be governed by what one might call a "transcendental fix." In the style of transcendental philosophy, they tried to apprehend technology one-sidedly from its conditions of possibility. They thought "backward," reducing concrete technologies to nontechnological things such as "technological thinking" or "the system of mass production," with technology itself, in the end, falling out of the picture.

One of the most important counters to the standard classical picture of technology has come from empirical research into the development and use of technologies, which has revealed that this classical picture fails to match technological reality. The advance of technology does not follow a single dynamic but is rather the contingent outcome of a set of complex and interactive processes. But however much the empirical approach, contrary to Jaspers and Heidegger, gives concrete technologies the

Peter-Paul Verbeek, "Postphenomenology of Technology," from *What Things Do: Philosophical Reflections on Technology, Agency and Design*, trans. Robert P. Crease (University Park, PA: Pennsylvania State University Press, 2005), pp. 99–119.

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attention they deserve, it does not by itself present an adequate alternative to the classical philosophy of technology. For in empirical technology studies the hermeneutic and existential questions posed by the classical philosophers of technology fall out of the picture: What is the role that technology plays in human existence and in the relation between human beings and reality?

A full-fledged philosophy of technology would have to do justice to the concrete empirical reality of technology without giving up on the philosophical issues posed by the classical approach. In this chapter I shall show how to do so by shifting the philosophical attention from the conditions of technology to technology itself – to the technological devices and objects that are virtually ubiquitous in our daily lives – thereby seeking to understand them via the role that they play in our society and culture.¹ But how is it possible to think about technology from the perspective of artifacts? [...]

In order to sketch out the principles of such a philosophy, I shall begin by taking up a new interpretation of the phenomenological tradition from which Jaspers and Heidegger developed their positions. Following Don Ihde, I shall characterize this interpretation as “postphenomenology,” but I shall give it a broader definition than he himself does. I shall sketch out the contours of a postphenomenological perspective on technology that is able to do justice to concrete technologies without abandoning the hermeneutical and existential questions that inspire it.

Empirical Research into Technology

The classical philosophical image of technology has received severe criticism from empirical research into technology. The chief weaknesses that this empirical research exposed were the overgeneralizations and false determinism in the image of technology offered by the classical philosophy of technology. Technology was supposed to develop autonomously, with society adapting in its wake – an image to which Jaspers and Heidegger could indeed subscribe. According to Jaspers, technology has become an end in itself, demonically holding society in its grip; according to Heidegger technology is a sending of being and our only hope is to await expectantly a new configuration of being to take shape.

Empirical research into the evolution of specific technologies and the reciprocal interactions that they have with

society have undermined these deterministic approaches. This research took place initially under the social constructivist flag. Technology was conceived as the result of human activity instead of as something autonomous, paralleling an earlier development in science studies. Its evolution was viewed as an outcome of choices made by human beings in the specific circumstances in which they find themselves. The development of technologies was regarded as socially constructed, rather than following any innate pattern: each technology comes into being via a contingent process of social interaction.

This approach to technology became known via the acronym SCOT: the Social Construction of Technology. One of its important proponents was Wiebe Bijker, one of whose well-known studies concerned the coming about of the design of the modern bicycle as we now know it. Bijker examined other, past bicycle designs and how the interaction between these and the social context gave birth to the contemporary design. He thereby demonstrated that this cannot be viewed as the “one best solution,” but rather as the outcome of a complex power struggle between a multiplicity of “relevant social groups” who wanted to use bicycles for specific ends, found particular models too dangerous, and so forth.²

But limitations were soon found in the SCOT approach as it became clear that the technologies themselves also played an active role in “social” interaction processes. The example of the microwave oven mentioned in the introduction is a beautiful illustration: the factors that determine whether human beings take their meals together include not just human beings but also the microwave itself. Reducing technology to social interactions therefore fails to do justice to the active role played by technologies themselves. Phrased in terms of my criticism of Jaspers and Heidegger [elsewhere], it can also be stated that the empirical approach came to the conclusion that it could not do justice to technology by reducing it to its conditions.

The successor to social constructivism named itself simply “constructivism.” The most, influential framework for a constructivist approach to technology is supplied by the “actor-network” theory proposed by French philosopher and anthropologist Bruno Latour. Latour describes reality in terms of actors who link and interact with each other via networks. He calls his descriptions “symmetric,” inasmuch as they do not make any a priori distinction between human and non-human actors. Things and artifacts, too, can become actors and thus deserve to be studied on a par with

humans. Technologies do not merely arise from an interaction, but also play an active role in it. The speed with which we drive our cars, to use one of Latour's examples, is not only a function of our own choices and desires, but can also be affected by the existence of things like speed bumps on the road. The term "actor," in fact, misleads to the extent that it connotes human behavior; Latour therefore prefers to speak of "actants" rather than "actors."

Latour sees all phenomena that can possibly be encountered in the world – and especially technologies and scientific theories – as parts of networks of relations between actants. Some networks are vast, others small. The computer with which I write this book, for example, is part of an extensive network that includes software manufacturers, hardware manufacturers, the university where I work, which has given me access to the computer, the university's systems manager, and the automobile of my colleague with which the computer was delivered to my home. Without that network my computer would not be available for me as a functioning device in my study. This network is usually hidden: the only thing that matters when I work is that the computer is in front of me and functional. To use Latour's language, the computer is through and through a black box; it is viewed as an independent, self-standing object with both its internal engineering and the relations with other things that make it work hidden from view. But if we want to understand how the computer came to be in my study, or if we want to fix it when it breaks, then the network of which it is a part suddenly comes to light – or at any rate a part of that network.

Latour's actor-network theory arose from his research into the coming about of scientific knowledge. According to him, scientific knowledge cannot be understood as "the truth" about "reality itself," but is a product of the interaction between humans and nonhumans in a network involving definitions, problem-setting, experiments, and observations. That network consists of relations between researchers and the phenomena into which they are inquiring, and everything that plays a role in those relations. Generally the outcome of this interaction is black-boxed, just as is my computer in the above example: human beings take the theory as obviously "true" and forget about all the efforts that the scientists had to take in piecing it together. But when the black box of such a theory is opened, its obviousness becomes far less obvious – for this brings to light the enormous amount of activity that was required in order to make

the theory seem "true." A scientific theory must not be seen as a mirroring of reality, but as the product of a network of relations that link researchers with the phenomenon in question. Scientific knowledge is thus not discovered but constructed; it is an edifice that, up to a point, could have been otherwise.

This constructivist conception of reality can be used to investigate not only scientific knowledge but technology as well. Its advantage is that it does not simply reduce technologies to networks of social interactions, as did the social constructivist conception, but also analyzes the ways in which technologies themselves co-shape the interactions. In [short,] ... actor-network theory offers more than a "backward" approach to technology, but pays attention to what technology actually does in its context, without reducing its role solely to its origins.

Latour's empirical approach to technology, however, does not offer a true alternative to the classical philosophy of technology. The questions that classical philosophy of technology posed play hardly any role in Latour's work – neither the existential question of the role technology plays in human existence nor the hermeneutical question of how technology co-shapes the access human beings have to reality. In order to provide the necessary answers to such phenomenological questions, a new interpretation of the phenomenological perspective itself needs to be worked out.

Beyond Classical Phenomenology

Someone who uses a phenomenological approach to technology in the twenty-first century still has some explaining to do. Phenomenology was an important tradition in Continental philosophy in the first half of the twentieth century, but its influence has waned. Its fundamentals have been challenged as problematic due to a number of philosophical developments in the second half of the twentieth century, such as the linguistic turn and the subsequent appearance of postmodernism.³ Phenomenology was thrust on the defensive in its response to these challenges, thanks to the suspicion that it requires recourse to an "authentic" or "original" access to reality. Its suppositions seem to mesh poorly with the contemporary emphasis on locality and context-dependence, according to which human access to reality is never direct but always mediated. In light of postmodernism and the linguistic turn, phenomenology seems to

be obsolete, a romantic throwback. What could such a tradition still have to offer?

Yet phenomenology can be reinterpreted without the alienation thesis. It can be productively applied in a way that provides the framework for a “philosophy of artifacts.” The suspicion that classical phenomenology misunderstands the locality and context-dependence of human knowledge is understandable when the context in which it developed itself is taken into account. Phenomenology presented itself – wrongly, as I shall make clear – as a philosophical method that sought to describe “reality itself.” It had good reasons for so doing, which reveal how closely allied phenomenology is with postmodernism. For phenomenology opposes itself to the absolutization of the positivistic view of the world arising from modern natural science, which claims to describe reality as it actually is. Phenomenology sees this absolutization as going too far, inasmuch as it fails to disclose other aspects of reality that are not amenable to scientific analysis. In phenomenological terms, science reveals, not “reality itself,” but a reduced reality.

Dutch psychiatrist-phenomenologist J. H. Van den Berg, for instance, speaks of a lived reality as opposed to the dismantled world provided by sciences:

Have you ever drunk H₂O? Me neither. Nor do I want to. Real humans drink water. Have you ever gone swimming in H₂O+NaCl? What a shame! I've swum in the North Sea, the Atlantic Ocean, the Pacific, the Mississippi, the Po, and the Adriatic. That's an experience – a genuine experience . . . Phenomenology attempts, once again, to bring to center stage this original and meaningful world, which, of course is always there, and, to some extent, to deny as well that the natural sciences are right. The natural sciences work with the mere skeletons of things. Better: the natural sciences work with the conditions of things.⁴

Phenomenology's protest against the absolutization of the scientific perspective is still timely, but its claim to provide access to genuine reality and its full significance is not. It correctly pointed out that the scientific disclosure of reality is not a disclosure of “reality itself” but always that of a quite specific kind – but from this fact it failed to draw the conclusion that no final contact with “true reality” is possible at all, and that therefore even “lived reality” is always lived in a specific way. This is the crucial step that needs to be made in light of postmodernism and the linguistic turn. The tree that I climb is real for me in a different way than the one whose cells and sap I study, but so is the tree that I photograph, chop

down to use for firewood, or cut up to build a table. None of these disclosures can claim to reveal the “true” tree: they are each equally true.

Phenomenology's claim to regain access to an original, meaning-rich world, one lost by the natural sciences, makes its position difficult and open to challenge. It claimed to take its point of departure from an original position, one from which real human beings have become alienated, whereas among philosophers the insight grew that the human experience of reality is always mediated. The “original world, rich in meaning” of which Van den Berg speaks is thus just as mediated as the scientific world – by language, frameworks of interpretation, and social and behavioral contexts. Science, therefore, does not involve an exclusion of the meaning of the world, but a new and different kind of disclosure of it.⁵

Against method

Phenomenology, however, does not need to take shape as a philosophy of alienation. It originally took this direction in part in reaction to the positivistic world-view, but the ideas that lie at its foundation can be worked out in an entirely different manner. To see this, we need only direct our attention to these key ideas. Consider, for instance, the following passages from the famous preface to Maurice Merleau-Ponty's *Phenomenology of Perception*, which reveal not only the problematic aspects of classical phenomenology mentioned above but also the possibility of overcoming them.

[P]henomenology can be practiced and identified as a manner or style of thinking . . . It is a manner of describing, not of explaining or analyzing. Husserl's first directive to phenomenology, in its early stages, to be a “descriptive psychology,” or to return to the “things themselves,” is from the start a rejection of science . . . All my knowledge of the world, even my scientific knowledge, is gained from my own particular point of view, or from some experience of the world without which the symbols of science would be meaningless. The whole universe of science is built upon the world as directly experienced . . .

Science has not and never will have, by its nature, the same significance qua form of being as the world which we perceive, for the simple reason that it is a rationale or explanation of that world . . . Scientific points of view, according to which my existence is a moment of the world's, are always both naive and at the same time dishonest, because they take for granted, without explicitly mentioning it, the

other point of view, namely that of consciousness, through which from the outset a world forms itself round me and begins to exist for me. To return to the things themselves is to return to that world which precedes knowledge, of which knowledge always *speaks*, and in relation to which every scientific schematization is an abstract and derivative sign-language, as is geography in relation to the countryside in which we have learnt beforehand what a forest, a prairie or a river is ...

The real has to be described, not constructed or formed. Which means that I cannot put perception into the same category as the syntheses represented by judgments, acts or predications The world is not an object such that I have in my possession the law of its making; it is the natural setting of, and field for, all my thoughts and all my explicit perceptions When I return to myself from an excursion into the realm of dogmatic common sense or of science, I find, not a source of intrinsic truth, but a subject destined to be in the world. (Merleau-Ponty 1962, viii–xi)

At first glance these passages seem to address the same issues, while being affected by the same problems, as the more informal passage from Van den Berg. Merleau-Ponty introduces phenomenology as a method, as a way of describing the world that is an alternative, even *the* alternative, to the scientific method. From the phenomenological point of view, the scientific approach is a “rationale or explanation” of a more original world. Phenomenology returns to something more original – “To the things themselves!” (*Zu den Sachen selbst*), in Husserl’s famous slogan. This is precisely the conception of phenomenology as method that is brought into question by the problems cited above. Certainly we must have “learnt beforehand what a forest, a prairie or a river is” before we can undertake scientific analysis and clarification of these things, but to say that phenomenology is in a position to describe these “things themselves” goes too far. Of necessity, any description of reality cannot avoid being a rationale, explanation, or constitution. That is not to say that the world is only a construction, just that we can never know the world as it is in itself, but only as we disclose it. An uninterpreted world, a world in itself, cannot be experienced; an untouched world cannot be lived in. Human beings never encounter a world in itself, only and always a world for them.

At the same time, however, it would be a mistake to dismiss phenomenology by virtue of this claim to make possible an originary encounter with the world. For something strange is at work in the above passages by Merleau-Ponty. While he claims again and again that

phenomenology *describes* reality – and contrasts it with the sciences, which *analyze* it – he nowhere sets himself to producing such a description. What he actually does in the *Phenomenology of Perception* is to develop an analysis of the *relations* between human beings and their world, and he localizes this relation primarily in perception. Merleau-Ponty does not, then, describe the world, but rather the way in which human beings comport themselves to it. The “things themselves” that he addresses appear to be not the things of the world but rather the *relations between human beings and the world*. And in fact we find the same to be true of Husserl, the “founding father” of phenomenology, as well as of Heidegger, Husserl’s least faithful but most influential student. Husserl tried, at least in his early work, to understand how human consciousness relates itself to the world. For him the “things themselves” were not objects in the world, but rather phenomena in consciousness, which form the way in which the world appears to us. And Heidegger, in *Being and Time*, did not describe the world itself, but rather inquired into the structures of the ways in which humans are engaged with the world in their actions and experiences.

It is, therefore, more in keeping with actual phenomenological practice to treat phenomenology as a philosophical movement whose principal task is to analyze the relation between human beings and their world rather than as a method of describing reality.⁶ Thus I shall define “world” as “reality as disclosed by human beings”; the world-for-humans that arises when they act and experience it. Interpreted in this way, phenomenology sheds its claim to describe reality as it “authentically” is – and at the same time loses its vulnerability to contemporary philosophical criticism. Finally, this alternative interpretation of phenomenology opens up a new way to think about things.

Intentionality and human-world relations

How, then, does phenomenological analysis view the structure of the relations between human beings and their world? Although no single phenomenological method has been applied by all phenomenologists, a pattern can be discerned in the different approaches that phenomenologists take, a pattern that naturally does not do justice to the subtleties of the different philosophical positions, but that does indicate what they have in common.

The most important concept with which phenomenology works, and which should be preserved in a reformulation of phenomenology, is intentionality. In order to fully understand this concept, it is important to describe it in the context in which it arose. In the epistemology of the nineteenth century, two movements developed – realism and idealism – with different perspectives on the relation between knowing subject and known reality.⁷ Idealism awarded primacy to consciousness: all the knowledge that we have of reality was viewed as a product of consciousness. There can only be a reality when it is present in consciousness; reality appears as consciousness determines it. Realism, by contrast, assigns primacy to reality: all knowledge that we have of reality is a mirroring of the world itself. Consciousness then has genuine access to the world itself.

Phenomenology arose as an attempt to overcome the tension between idealism and realism. In this attempt, the concept of intentionality played the leading role. Husserl asked himself what is really given to human beings when they address themselves to the world. In answering this question, he found first of all that he had to suspend the “natural” attitude in which human beings assume that what is given to them corresponds to a world outside of them, or to an order fully articulated by reason. All presuppositions with respect to what is given must be put between brackets. This method of “putting things between brackets” Husserl called the *epochè*, or phenomenological reduction.

What remains left over of what is given to human beings, when the existence of a world outside of consciousness is put between brackets? First of all, it can no longer be characterized as a representation of a world, for the existence of a world can no longer be taken for granted. What remains left over are appearances, “phenomena” – whence the name phenomenology. But if this is the case, something else is given at the same time, namely, consciousness itself as the place where phenomena appear. But what more can profitably be said about this, at least without smuggling in new presuppositions? The following: that consciousness is directed to the phenomena that announce themselves in it. Human consciousness never exists in itself, but only as consciousness-of-something. It never exists as something isolated, but is always directed toward phenomena. This other-directedness is what Husserl calls intentionality. Intentionality is an essential characteristic of consciousness; a nonintentional consciousness is thus a contradiction in terms.

Phenomenology, however, did not remain a philosophy of consciousness. Husserl’s followers, and even the later Husserl himself, came to believe that phenomenology needed to be more fully extended and worked out than a philosophy of consciousness.⁸ Consciousness, consisting of knowledge about the world, came to be viewed as only one aspect of the relation between human beings and their world, and not necessarily the most relevant. Moreover, the world cannot be treated as an assemblage of objects for knowledge, but must be viewed as something in which human beings live: a lifeworld. Husserl’s philosophy of consciousness broadened out into an analysis of the relation between humans and their world in the largest sense. In place of consciousness, for instance, Heidegger and Merleau-Ponty spoke about “being-in-the-world.” Heidegger characterizes the intentional directedness to the world as having the structure of “care” (*Sorge*) – shaping one’s own existence in the careful dealings with everyday things – while Merleau-Ponty views perception as a form of “being destined to the world.” Husserl’s followers refuse to restrict themselves to thinking only about knowledge, for this is only one of the forms of contact between human beings and world.

Phenomenology thus overcomes the dichotomy between subject and object, humans and world, by replacing it with a mutual interrelation. Human beings are unthinkable apart from a relation to the world, which they continually experience and in which they realize their own existence. This interrelation is not a fact that could have been otherwise. That was the point Merleau-Ponty was making in the above passage when he states that human beings “cannot put perception into the same category as the syntheses represented by judgments, acts or predications” and speaks of “a subject destined to the world.” The focus on alienation so characteristic of classical phenomenology is absent from such phrases, and phenomenology is regarded as the analysis of the relation between human beings and their world. In order for a subject to render a judgment about reality, according to Merleau-Ponty, it must already be alongside and engaged with reality – which involves much more than judging, since it is the field in which judgments can take place. Human beings are continually engaged with their world, and this engagement precedes any judgment they may have of it. Put another way, it is impossible to speak about the world in the absence of human involvement with it. Reality-in-itself is unknowable, for as soon as we experience or encounter it, it becomes reality-for-us: a world.

There exists neither human beings in themselves nor world-in-itself.

Phenomenology developed in this way not only by weakening its ties to the philosophy of consciousness, but also by establishing connections with existential philosophy. ... [E]xistential philosophy, initiated by Kierkegaard, also consisted of an attempt to elucidate the relation between human beings and their world. It directed its attention not so much to the experiential aspects of this relation, but rather to the way in which humans realized their existence. One of its central insights was that human beings do not simply “exist” but have a relation to their own existence. Humans know that they exist and that they themselves need to shape their own existence. They can only do so in a world. The human way of existing is as “being there”; this existence always takes place somewhere. Existential philosophy, too, conceives human beings, therefore, via being-in-the-world, though in its efforts to elucidate being-in-the-world it emphasizes not the human experience of the world but rather the realization of human existence in it – human praxis or action.

The alliance between phenomenology and existential philosophy proved so fruitful that two perspectives on the relation between humans and world have crystallized out of it, one that approaches this relation from the perspective or “pole” of the world, and the other that takes as its point of departure the human “pole.” The first analyzes the human–world relation in terms of the way in which the world can present itself to human beings and become meaningful; the second looks at the way in which humans are able to realize themselves in the world. The first perspective can be called hermeneutic–phenomenological, inasmuch as it concerns interpretation and meaning – put most broadly, world-disclosure – and hermeneutics is the classical philosophical discipline that concerns itself with the disclosure of meaning. The second perspective, which concerns the way in which human existence takes shape, can be called existential–phenomenological.

Each of these two perspectives generates different philosophical questions about technology. In the hermeneutic perspective, the key question is the role technology plays in the way in which the world presents itself to human beings; in the existential perspective technology is described principally in terms of the role it plays in the way in which human existence takes shape. In my analysis [elsewhere] of classical philosophy of technology [...] I used the difference between these two phenomeno-

logical tasks as an implicit starting point, for Jaspers and Heidegger each occupy a different pole in the classical phenomenological approach to technology, with Jaspers representing the existential and Heidegger the hermeneutic pole.

Toward a Postphenomenology of Things

The above reinterpretation of phenomenology as the analysis of human–world relations makes it possible to overcome the dichotomy between idealism and realism in a more radical way than did classical phenomenology. While the latter bridged the gap between subject and object by stressing that, in fact, these two are always already intertwined thanks to the intentional engagement of human beings and world, a new interpretation of phenomenology can take this a step further by emphasizing that subject and object *constitute* each other. Not only are they intertwined, but they coshape one another. Human beings can only experience reality by relating to it, which does not involve any reality-in-itself but rather reality-for-them. As consciousness (perception, experience) can only exist as consciousness of something, reality is always reality for someone; in their engagement with reality, human beings always disclose it in a specific way. At the same time, humans themselves are constituted in this relation. The environment with which they are involved always codetermines in which ways they can be present to the world and each other. In the encounter between humans and world, each manifests itself in a particular way. In the mutual relation of humans and world there arises, therefore, a specific “objectivity” of world and a specific “subjectivity” of human beings.

Neither of these two poles can be absolutized. Human beings can not arbitrarily disclose any world, for there is always “something” that is disclosed – even if this “something” is inaccessible, just as was the case with Heidegger’s dimension of “concealment.” [...] Were that not so, one could not speak of a relation between human beings and world, for the world would be a mere product of human beings. But neither are human beings arbitrarily constituted in this relation, for if “no one” manifests herself or himself in this relation it would be impossible to speak of a relation either – even if that “someone” cannot be present

“in himself” or “in herself” but only in relation to a world. The fact that humans are what they are on the basis of their relation to the world does not imply that they are entirely determined by it.

This more radical phenomenological perspective, in which subject and object are not merely intertwined with each other but constitute each other, does justice to the contextualism of contemporary philosophy as it is expressed in the linguistic turn, in postmodernism, and also, for instance, in Latour’s actor-network theory. I shall call this reinterpretation of phenomenology “postphenomenology.” Ihde uses this term for his praxis-perception model of phenomenology, which revolves around the analysis of the perceptual aspects of the relation between human beings and their world.⁹ In the introduction to *Postphenomenology*, he says that his philosophical orientation includes a strong sense of “proliferating pluralism” and of the loss of centers and foundations (Ihde 1993b, 1), but he does not then go about showing what a reformulated phenomenology might look like under those conditions. This is the aim of the more radical interpretation of phenomenology that I am proposing, in which subject and object, or human beings and world, constitute each other. This interpretation can be called “postphenomenological” in that it overcomes both the essentialism and the fascination with alienation that characterized classical phenomenology.

Postphenomenology can be viewed as an offshoot of phenomenology that is motivated by the postmodern aversion to context-independent truths and the desire to overcome the radical separation of subject and object, but that does not result in relativism. From the postphenomenological perspective, reality cannot be entirely reduced to interpretations, language games, or contexts. To do so would amount to affirming the dichotomy between subject and object, with the weight merely being shoved to the side of the subject. Reality arises in relations, as do the human beings who encounter it. Only in this sense is postphenomenology a relativistic philosophy – it finds its foundation in relations.

Technological intentionality

Postphenomenology offers a suitable framework for formulating a philosophy of technological artifacts that can resist the “Orphic temptation” to which the classical phenomenological philosophy of technology fell victim. Its perspective on artifacts, however, also needs to avoid the contrary of transcendentalism, namely, realism. For

now that it is evident how problematic was the ambition of classical phenomenology to describe “the world itself,” and now that it is clear that subjectivity and objectivity are constituted in the relation between human beings and their world, a turn “to the things themselves” runs the risk of landing the philosophy of technology back where it started. The ambition to think from the “things themselves” suggests the existence of an unmediated access to them.

But this suggestion is false. The facts that technological artifacts can be conceived as constructions, always exist in a context, and are interpreted by human beings in terms of their specific frameworks of reference do not erase the fact that systematic reflection can be undertaken of the role that these contextual and interpreted constructions play concretely in the experience and behavior of human beings. That “the things themselves” are accessible only in mediated ways does not interfere with our ability to say something about the roles that they play, thanks to their mediated identities, in their environment. And it is precisely the postphenomenological perspective that offers a new way of so doing.

In order to articulate the contours of a postphenomenology of things one can begin with the early work of Heidegger. ... [T]his work conducts an analysis of technology that stands in sharp contrast to his later philosophy of technology. In *Being and Time* Heidegger saw the relations between human beings and equipment as occupying center stage – or rather, he saw the role of tools and equipment as occupying center stage in the relation between human beings and their world (Heidegger 1996, section 16). Heidegger showed that tools and equipment give shape to the encounter between humans and their world. Things make daily practices possible while withdrawing from the explicit field of attention. Only when human beings occupy themselves not with their tools proper, but rather with what they set themselves to do with the help of these tools, are these tools present *as tools*. The tools are then, in Heidegger’s words, “ready-to-hand.”

This concept of readiness-to-hand directs our attention to the way in which objects are present in the relation between human beings and their world, and brings such things into precisely the domain that phenomenology investigates. The crucial question now concerns the various ways in which things, on the basis of their readiness-to-hand, play a role in the human-world relation. For such things shape this relation from their withdrawn or ingrown position, as has been shown by

the examples already given. A train coshapes the way in which a landscape is present to human beings, a telephone coshapes the way human beings relate to each other. Things, therefore, are not neutral “intermediaries” between humans and world, but *mediators*; they actively mediate this relation.

Ihde has, from a phenomenological perspective, characterized this mediating role of artifacts in terms of what he calls *technological intentionality* (Ihde 1990, 141). By this he means that technologies – like consciousness for Husserl – have a certain directionality, an inclination or trajectory that shapes the ways in which they are used.¹⁰ As an example, Ihde mentions the difference in writing style that arises when one writes with a fountain pen, typewriter, or word processor. One writes slowly with a fountain pen, with the result that it allows one to think over the sentence several times while composing it. The compositional speed is much faster with a typewriter, which tends to promote a style much closer to that of spoken language. And a word processor, in contrast to pen and typewriter, vastly expands the ability to compose a text; for instance, sentences can be moved around and footnotes inserted at will. These writing technologies are therefore not neutral means, but rather play an active role in the relation between author and text. They have an intentionality, a trajectory that promotes a specific kind of use (140–43). They do not have a determining influence, for one can indeed write a slowly composed and carefully thought out text on a word processor, and write conversationally with a pen. But the technologies in question *promote* or *evoke* a distinct way of writing. Technologies, as it were, contain an “implicit user’s manual” (Procee 1997, 159). A constructivist perspective on technology refers to this phenomenon as the “script” of technologies.

In the case of the fountain pen, this intentionality or innate trajectory became explicitly visible at the time of the introduction of the ballpoint pen. As the historian of technology Henri Baudet has pointed out, loud protests were made against the ballpoint pen when it first appeared. It was charged with having a negative influence on children’s hand position and writing, and therefore on the quality of their work, the “neatness and care of their straight lines.” Ballpoint pens were therefore viewed as “undermining instructional and pedagogical traditions.” The classical way of writing with a fountain pen “represented a general social discipline,” and this discipline was suddenly shattered by a faddish disposable product (Baudet 1986, 9–13).

Another example of the intentionality or trajectory of things is provided by an episode that happened in 1996 in the Romanian city of Cluj.¹¹ The mayor of this city proposed to shorten the shafts of the rakes used by the employees of the public gardens. These rakes, according to him, made possible an undesirable practice, allowing the employees to lean on them excessively. By shortening their shafts, the mayor thought, he could discourage laziness and encourage harder work. If the rake were merely a neutral means for the end of raking, this intervention would not have been necessary. Action had to be taken because the rake, *en passant*, made possible an entirely different practice, one that was not anticipated but that arose only in the practice of raking. The rake *mediates* the relation between the workers and the public gardens; it is not merely a means but plays an active role in the way this relation takes shape.

Ihde, to be sure, is not the only one to argue for the active role that things can play in their contexts. In the above brief sketch of Latour’s actor–network theory it was clear that for him things are active and can play full-fledged roles as “actors.” The first philosopher of technology to devote extensive attention to the active role of artifacts was Langdon Winner. In his essay “Do Artifacts Have Politics?” (Winner 1986a), Winner described what has become a famous illustration of this principle, concerning the low-hanging overpasses on Long Island in New York.¹² These overpasses, designed by regional planner Robert Moses, were deliberately built low to prevent busses from using the roads and allowing only automobiles to pass underneath. The roads along which these overpasses were built lead to Long Island’s beaches, meaning that these were now accessible only by car. At the time these bridges were built, this meant that racial minorities and the poor, who could not afford cars and generally relied on public transportation, were effectively prevented from reaching the beaches. Winner characterizes the role played here by the overpasses as “the politics of artifacts.”¹³

The postphenomenological perspective described above allows a more radical extension of Ihde’s concept of “technological intentionality.” The “intentionality of artifacts” consists of the fact that they mediate the intentional relation between humans and world in which each is constituted. When human beings use an object, there arises a “technologically mediated intentionality,” a relation between human beings and world mediated by a technological artifact.

Two different meanings of “intentionality” are therefore intertwined here, a first referring (in Ihde’s sense of

“technological intentionality”) to the “intentions” of the technology itself, the second (in the more general phenomenological sense of “technologically mediated intentionality”) to the relations between human beings and world that are mediated by the technology.¹⁴ Both meanings are relevant for a phenomenological understanding of the role of technologies in human-world relations. When technologies mediate the intentional relation between humans and world, this always means from a phenomenological perspective that they codetermine how subjectivity and objectivity are constituted. Their “intentionalities,” in Ihde’s sense, consist of the fact that they coshape the contact between human beings and their world; they determine how human beings can be present in the world, and the world to them.

Multistability

There is, however, one pitfall that needs to be avoided in this analysis of the ability of artifacts to coshape the relation between human beings and world: this ability must not be conceived as an intrinsic property of the artifact itself. The effect of this misconception would be to smuggle back in again via the back door the old subject-object dichotomy – which it was precisely the triumph of phenomenology to have overcome. It would give rise to a kind of realism in which properties would be assigned to objects independently of the subjects for whom these objects exist. Winner’s example of Robert Moses’s overpasses makes clear, however, the shortcomings of such an approach. For the politics of these overpasses has considerably diminished with time. In a role reversal, the poor, too, now own automobiles, while many wealthy families take their vacations in campers big enough to be barred from traveling on the parkways in question (Achterhuis 1998, 386).

The thought that technological artifacts possess intrinsic properties and can themselves influence the relation between human beings and world supposes that technology can be spoken about independently of the humans that engage with it. But from the phenomenological perspective this is untenable. Artifacts can only be understood in terms of the relation that human beings have to them. Here one can make the same phenomenological move that others in that tradition make with respect to “consciousness” and “perception.” Just as “perception-in-itself” and “consciousness-in-itself” do not exist, neither does “technology-in-itself.” Just as perception can be understood intentionally only as

perception-of, and consciousness only as consciousness-of, so technology can only be understood as technology-in-order-to. The “in order to” indicates that technologies always and only function in concrete, practical contexts and cannot be technologies apart from such contexts. In Ihde’s words, “Were technologies merely objects totally divorced from human praxis, they would be so much ‘junk’ lying about. Once taken into praxis one can speak not of technologies ‘in themselves,’ but as the active relational pair, human-technology” (Ihde 1993b, 34).

The insight that technologies cannot be separated from their use contexts implies that they have no “essence”; they are what they are only in their use. A technology can receive an identity only within a concrete context of use, and this identity is determined not only by the technology in question but also by the way in which it becomes interpreted – as shown by Robert Moses’s overpasses. Another example illustrating the context dependence of technologies is to be found in the early development of the typewriter, driven as it was by the desire to design equipment for the blind and partially sighted. But it quickly took on another identity, as a writing technology that is useful for nearly everyone (Ihde 1993a, 116).

Ihde calls such context dependence “multistability,” and to clarify what he means he makes use of a perceptual example, the so-called Necker cube (Figure 1). When we look at this figure, we can see more than one thing. Sometimes we see a three-dimensional cube with

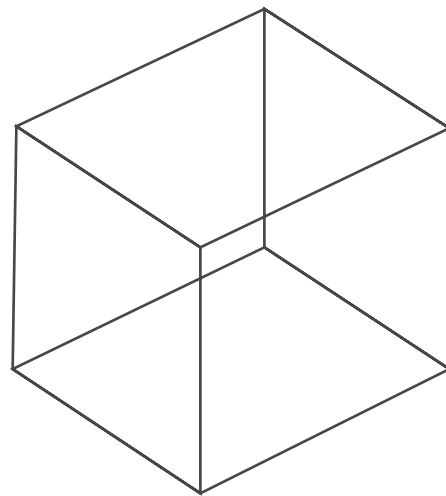


Figure 1 The Necker cube.

the bottom surface and two side surfaces turned toward us. If we try, we can switch between the two manifestations of the cube. We can also interpret the figure two-dimensionally and see it as an insect with six legs sitting in a six-sided cell of its web. Ihde uses this example to illustrate that different ways of seeing produce different figures. The figure allows multiple interpretations. What it “really” is remains undetermined. It is many things at once; it is “stable” in multiple ways. Something similar, according to Ihde, is at work in connection with technology. Just as the Necker cube has no “essence,” neither do technologies. They are only technologies in their concrete uses, and this means that one and the same artifact can have different identities in different use contexts.

Two dimensions

A postphenomenological “turn toward things” in the philosophy of technology, as indicated above, needs to consist of the analysis of the mediating role of technological artifacts in the relation between human beings and reality. Such an analysis can be carried out in the phenomenological territory just described – hermeneutical and existential. In both dimensions of

the intentional relation between human beings and world artifacts play a role. [...]

In hermeneutical terms, things can mediate the ways in which human beings have access to their world by the roles that such things play in human experience. Questions such as the following arise: In what way do telescopes and electron microscopes, automobiles and airplanes shape our access to the world? In what way are others present to us when we contact them via telephone or email? An analysis of the technological mediation of our experience produces a new interpretation of hermeneutics. In place of the traditional emphasis on language and text, in this “material hermeneutics” things take center stage. [...]

In existential terms, things mediate human existence. Here a different set of questions arises: How does the television set affect the way we divide up our day? What implications do automobiles and airplanes have for the way in which we organize our social relations? In seeking the answers to such questions, the existential-phenomenological perspective can acquire a more material interpretation. In this interpretation, concepts such as authenticity become less central, and more attention is paid to the way in which the material environment of human beings shapes the way in which they realize their existence.

Notes

- 1 In *Thinking Through Technology*, Carl Mitcham distinguishes among four different manifestations through which technology can be analyzed: as knowledge, as activity, as “will,” and as object. The word “technology” can indicate a form of *knowledge*, such as sensory-motor skills, rules of thumb, and technological theories. But it can also indicate the *activity* of design, manufacture, and use of new technologies; the (Heideggerian) technological *will to power*; or technological *artifacts*. My concern here is with technology in the latter sense: concrete technological objects or artifacts (Mitcham 1994, 137–60).
- 2 See Bijker (1995), chapter 2: “King of the Road: The Social Construction of the Safety Bicycle.”
- 3 Even Latour’s actor-network theory can be counted among these developments, though in a somewhat headstrong way; he calls his thinking not postmodern but amodern (Latour 1993, 1999).
- 4 This quotation is from a lecture Van den Berg gave in 1991 at the Vrije Universiteit Amsterdam, quoted in Heij (1995).
- 5 A second reason why phenomenology has fallen under suspicion is due to the so-called *Wesensschau* (essential

intuition) of Husserl’s methodology. Contrary to what is suggested by this term, the Husserlian *Wesensschau* does not seek to intuit “true” or “authentic” reality, but is rather an instrument with which to track down the building blocks of ideas by which consciousness functions. This method consists of imaginatively transforming a phenomenon in various ways so as to determine which aspects are essential to it and which not. We can imagine dogs with stripes and spots, with short ears and long ears, with pointed and flat noses – but never with wings or gills. In this way we can arrive at a general idea of “dog.” This general idea can never be found in the world itself, but is a pure idea; the *Wesensschau* is a perception of the ideas used by thinking itself. The method of *Wesensschau* is part of the so-called eidetic reduction, a stage in Husserl’s phenomenology in which a phenomenon in our consciousness is reduced to its “eidos,” its form or idea. This eidos is a construction that must be presupposed in order to understand how human knowledge of reality is possible. The eidetic reduction belongs to an idealistic interpretation of phenomenology, in which Husserl had few followers.

- 6 Thus I join Ihde's pragmatically colored interpretation of phenomenology. See, for instance, Ihde (1979, 4–6; 1990, 3–25; 1993b, 5; 1998, 14–19).
- 7 See Ihde (1976, 35–36).
- 8 See Ihde (1983, 122–35, 141–49).
- 9 See Ihde (1993b, 3, 7; 1990, 30).
- 10 For the sake of completeness, it should be noted that Ihde uses the term “technological intentionality” in another sense as well. By “technological” or “instrumental intentionality” he indicates the directedness of technologies toward specific aspects of reality. A cassette recorder, for instance, possesses a specific intentionality with respect to sound, which strongly differs from human intentionality, since it registers not only foreground but also background sound. Ihde also indicates this form of intentionality as a “technological telos.” See Ihde (1979, 77–78; 1983, 56; 1990, 102–3).
- 11 According to an article (“Shorter Shafts Combat Laziness”) in the Dutch newspaper *Algemeen Dagblad* of 23 March 1996.
- 12 See Winner (1986a) and Smits (2001).
- 13 Winner's example has recently been challenged. It turns out, for example, that the overpasses in question probably have never been an obstacle for buses, as can be shown with the help of timetables. See Woolgar and Cooper (1999).
- 14 In fact, three meanings of intentionality are intertwined here, if one includes the additional meaning referred to in note 10 above.

References

- Achterhuis, H. 1998. *De efenis van de utopie*. Amsterdam: Ambo.
- Achterhuis, H. ed. 2001. *American Philosophy of Technology: The Empirical Turn*. Trans. R. Crease. Bloomington: Indiana University Press.
- Baudet, H. 1986. *Een vertrouwde wereld: 100 Jaar innovatie in Nederland*. Amsterdam: Bert Bakker.
- Bijker, W. E. 1995. *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. Cambridge, MA: MIT Press.
- Heidegger, M. 1996. *Being and Time*. Trans. J. Macquarrie and E. Robinson. New York: Harper & Row.
- Heij, P. 1995. “J. H. van den Berg: Eerst en vooral fenomenoloog.” In *Metabetische perspectieven: Beschouwingen rond het werk van J. H. van den Berg*, ed. W. Vandereycken and J. de Visscher. Leuven and Amersfoort: Acco.
- Ihde, D. 1976. *Listening and Voice*. Athens: Ohio University Press.
- Ihde, D. 1979. *Technics and Praxis*. Dordrecht: Reidel.
- Ihde, D. 1983. *Existential Technics*. Albany: SUNY Press.
- Ihde, D. 1990. *Technology and the Lifeworld*. The Indiana Series in the Philosophy of Technology. Bloomington: Indiana University Press.
- Ihde, D. 1993a. *Philosophy of Technology: An Introduction*. New York: Paragon House.
- Ihde, D. 1993b. *Postphenomenology*. Evanston: Northwestern University Press.
- Ihde, D. 1998. *Expanding Hermeneutics*. Evanston: Northwestern University Press.
- Latour, B. 1993. *We Have Never Been Modern*. Trans. C. Porter. Cambridge, MA: Harvard University Press.
- Latour, B. 1999. “On Recalling ANT.” In *Actor-Network Theory and After*, ed. J. Law and J. Hassard. Oxford: Blackwell.
- Merleau-Ponty, M. 1962. *Phenomenology of Perception*. Trans. Colin Smith. London: Routledge & Kegan Paul.
- Mitcham, C. 1994. *Thinking Through Technology: The Path Between Engineering and Philosophy*. Chicago: University of Chicago Press.
- Procee, H. 1997. *De nieuwe ingenieu: Over techniekfilosofie en professioneel handelen*. Amsterdam: Boom.
- Smits, M. 2001. “Langdon Winner: Technology as a Shadow Constitution.” In *American Philosophy of Technology*, ed. H. Achterhuis.
- Winner, L. 1986. *The Whale and the Reactor*. Chicago: University of Chicago Press.
- Winner, L. 1986a. “Do Artifacts Have Politics?” In *The Whale and the Reactor*.
- Woolgar, S., and G. Cooper. 1999. “Do Artifacts Have Ambivalence?” *Social Studies of Science* 29 (3): 433–49.

Technoscience Studies after Heidegger? Not Yet

Robert C. Scharff

Heidegger's account of the global hegemony of technology has often been condemned as exaggerated and dystopian. Exposing technoscientific excess is one thing, so goes the argument, but engaging in a "totalizing" condemnation of technology and science themselves is quite another.¹ Moreover, those who argue this way often add that Heidegger's later discussion of technology is a kind of betrayal of the promising but flawed analysis of everyday practices he gives in *Being and Time* [SZ].

In my view, this line of criticism is simply mistaken. Heidegger's account of the rise and current dominance of technoscience is neither abstract nor dystopian; and his later questioning of technology is not only consistent with SZ but depends on it. In fact, his idea that we live in an ontologically enframed world is much less metaphysical and totalizing than the much more familiar and acceptable idea that we are living in the so-called "developed" world. Both ideas portray technoscientific life as the practical and theoretical culmination of the Western intellectual tradition. The difference is that Heidegger does not share the happy, unreflective complacency that usually accompanies the developed-world idea. Even before SZ, he is already trying to dismantle and rethink the popular understanding that nourishes such complacency, not just socio-politically but ontologically, so that instead of letting it define a way of disclosing what is real that seems necessary, we might see it as just the now-dominant, frequently occlusive,

and thus often "distressful" disclosure of sometimes all too "obvious" possibilities.

From Dilthey, Heidegger learned how to interpret his questions about what it is like to be born in the midst of this situation as an exercise in *Selbstbesinnung* – that is, as an effort at self-understanding he soon transforms into the ontological question: how it is to "be" philosophical in the present age?² At first, he conceives this situation quite generally and promissory note-like; it is "always already" a world of everyday affairs, but one that keeps getting metaphysically obscured whenever we try to "know" it. Eventually, Heidegger comes to articulate the character of this world more precisely as a technological one, and he distinguishes between trying to theorize this situation – which is what the Western tradition has typically done – and learning (as he says) to *think* it. He refuses to move directly to the usual questions of "what" there is and what we should "choose" to make of it. Instead he stops to ask: how "is" it to "be" in such a world? Must everything real and every way of living with it reiterate an ontology of knowable essences and instrumental choice? Like so many others in his time and ours, Heidegger does not understand technoscientific life to be an unrelievedly satisfying site of human progress.

It is at precisely this point that Heidegger's critics like to pounce. "See?" they say. Look at his romantic over-reaction! Just because we cannot celebrate our actual technoscientific present with the same incautious

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enthusiasm as the nineteenth century celebrated its then still mostly projected technoscientific future, this is no reason to throw a totalizing wet blanket over the whole age. The progressivist-scientific utopianism of the previous era is gone; and with it goes any need for dystopian rejoinders. The age of grand narratives is over.

In my view, however, the scientific optimism of the nineteenth century kind has not gone away. At least in North America and Western Europe, it is the widely, if silently, accepted default position – for the political economy’s administrators and technocrats, mainstream epistemologists, and most philosophers of science. It is the pedagogical outlook of the “developed” world – the world one already belongs to or wants to join. It is the stance of the mature and educated human mind. And those who express doubts about this development in more than piecemeal, reformist terms, are judged as simply having failed to move beyond the theological, ideological, or romantic beliefs of earlier times. Like Heidegger, they are seen as having refused to be even late moderns – while the rest of us, in our greater maturity, are already considering how to be postmodern.

Heidegger’s critics are right about one thing – his target. What “distresses” him is the way the current technoscientific world “sets up” and overshapes how we generally understand ourselves and the things we encounter as “being.” Yet if his complaints about this are extensive, that does not make them regressive or Luddite; and it certainly does not justify psychologizing him away as suffering from anti-scientific pathology, or terminal pessimism, or a faulty political conscience. On the contrary, when his descriptions of technoscientific life are taken as formal indications (the way he means them) instead of as essentialist pronouncements (the way his critics take them), these descriptions bring issues into focus that have grown even more pressing than they were when he wrote the Technology-essay.³

In fact, I am going to argue that the usual criticisms of Heidegger may ultimately tell us more about his critics than about Heidegger. All the complaints about his alleged romanticism and essentialism strongly suggest that his opponents overestimate the degree to which the nineteenth century’s scientific understanding of the age has been surpassed – and thus also overestimate their own success in thinking after it. Viewed from this angle, Heidegger’s analysis of technology may be not so much backward-looking or nostalgic, as “untimely” in Nietzsche’s sense. For he seems to be saying what those who are trying most

resolutely to be concrete about technoscientific life don’t want to hear, at precisely the moment they most need to hear it.

Heidegger’s Post-Heideggerian Critics

Critical reactions to Heidegger take several forms.⁴ I shall focus on two of them here. First, there are the American and European philosophers of technology – Don Ihde and Peter-Paul Verbeek among them – who have taken what Hans Achterhuis calls the “empirical turn” toward technology (or technoscience) studies.⁵ The most thorough and fair-minded elaboration of this position is probably Verbeek’s *What Things Do*.⁶ The technoscientific “empiricists,” he explains, are perhaps best understood as post-Husserlians, aspiring to be phenomenological about “[the technological] things themselves.” He agrees with their critique of Heidegger, but he admits that their actual criticisms are often too onesided in their neglect of his positive contribution to current technoscientific studies and too superficial and external to his own outlook to be really telling.⁷ Verbeek is right, I think, that Heidegger’s empiricist opponents tend to be just as abstract and totalizing in their portrayal of Heidegger as they accuse him of being about technology.

However, Verbeek seems less right in what he himself says about Heidegger instead. He does praise SZ for pointing the way to a phenomenology that “takes actual technologies seriously.” Yet he argues that Heidegger’s later work is fatally reductive because of what Verbeek calls its “transcendental” concern for technology’s essence. Transcendental philosophy, he reminds us, looks for THE conditions for THE possibility of something; and taking this approach to all technologies effectively closes off any possible transformation of modern technology understood as enframing and leaves us helplessly “awaiting the arrival of a new way of being” (95). This transcendentalism forces Heidegger to conceive technology, in Verbeek’s words, “backwards” instead of “forwards.” By looking to technology’s past in order to establish its allegedly essential conditions, Heidegger reduces all technology to its role in a “history of being,” rooted in the Ancient Greeks’ conception of τέχνη – and thereafter conceives everything about it as just a “consequence” of an earlier disclosure of being. The result is that Heidegger can never see technology instead as the possible “source” of future technoscientific transformations (91–94).

A second major reaction to Heidegger is represented by critical social theorists like Marcuse, Habermas, and Andrew Feenberg. Like the new empiricists, they often have positive things to say about SZ – only in their case, it is because they claim to find in this work the basis for a critique of ordinary life under capitalism that they cannot find in Marx. But they, too, regard SZ as betrayed by Heidegger's later work – and politically, they insist, not just philosophically. Habermas is of course the best known of these critics; and in addition to being politically influential, his polemics have also become a kind of *locus classicus* for any one wishing to defend the Enlightenment spirit against Heidegger's alleged attempt to “undermine ... Western rationalism.”⁸ According to Habermas, the early Heidegger was an existentialist; he was seduced in the 1930s by the implicit decisionism of SZ into using it to justify his shameful political activity, and he thereafter retreated into a mystical and apolitical quietism that allowed him to explain away his Nazi past.⁹

As a student of Marcuse, Feenberg was of course exposed to this view, but his own reading of Heidegger's texts has always been less self-serving and ideological. In fact, in recent writings Feenberg has largely come to accept Heidegger's account of our present technoscientific condition. For him, Heidegger is not so much wrong about today's world as he is badly placed to offer an alternative. Here, Feenberg comes close to Verbeek and the technoscientific empiricists. He, too, regards Heidegger's account of current technoscientific life as a “metaphysical” over-interpretation of it.¹⁰ He, too, construes Heidegger's claims about the “essence” of technology as claims about what is universally true and unchangeably necessary. Unlike the new empiricists, however, Feenberg's own program is not indebted primarily to SZ and to the post-Husserlian project of multiple phenomenologies. Instead, he looks to other parts of Heidegger's own work, but with a neo-Marxist eye. From Heidegger's interpretation of ancient τέχνη in the early lecture courses, Feenberg extracts a non-instrumentalist model of praxis. And in Heidegger's writings on poetry and art, he finds descriptions of a source of creative and less dehumanizing ideas about life and reality that might offer us a more democratizing vision of socio-political choice.

Now, I am entirely in favor of both Verbeek's phenomenological “turn toward things” and Feenberg's call for a humanized technology. Their mistake is thinking that Heidegger must oppose them. To start with, as others have pointed out, in Heidegger's vocabulary “essence,”

Wesen, is a verbal not a substantive noun. Hence, when Heidegger says that in the current eventuation of technoscience, there lies a pervasive “danger” more “essential” to it than its global reach and positive promise, he is characterizing how things most strongly tend to be, not how they cosmically have to be.¹¹ Thus he insists that “the essential unfolding of technology harbors within itself what we least expect, the possible rise of [a] saving power” (QT, 337). Indeed, if there were no potential “saving power” in our experience – that is, if we did not already have a strong sense that our relations with various technologies speak of other possible ways in which things are not just enframed and life is not just set up mostly as “one” instrumentally conceives it – we could not recognize these other possibilities as “other” at all. Things would simply “be” knowable and usable – and we would just “exist” with them – as knowers and users of stockpiled things.

We misread the Technology-essay, then, if we assume that what Heidegger says about *Gestell* and *Bestand* are the template for measuring every technology we currently encounter.¹² His point is not that all technologies are just instantiations of the universal idea of an enframed stockpile of useful things and nothing else. It is rather that, to the extent that we experience things as not being so, describing *how* they “really” are will be hard – in just the way SZ showed it is hard to give non-objectifying accounts of the stuff of everyday praxis. The central ontological fact of our age is that the “materially pervasive” presence of technology – so clearly a blessing in so many ways and so deserving of sensitive and detailed analysis in its own right – is also, and simultaneously, existentially intrusive. Hence, instead of reading him as discouraging the new phenomenological and critical accounts, we should understand how Heidegger's complaints arise at the very same time and from the very same place as these accounts. So, for example, we can love our information technologies and we can analyze their power and promise and fun just as concretely as we like – as long as we also consider how all this power and promise and fun happens in an ontological atmosphere that encourages us to *define* “knowledge” as information processing, to *define* “thought” as neural networking, and to *reduce* “intelligence” to having a big memory and an ability to manipulate symbols very fast.

Heidegger's critics are surely right – even if they do not see that Heidegger agrees with them – that we are all to some extent happy technoscientific pragmatists, and there is no going back. In a black mood, we might imagine

giving all of it up, but as he says, we cannot really “think” this. Nevertheless, there is also a whole disturbing array of experiences to be had at the margins of our happy technological practices, all of them tending to make technoscientific optimism as such feel profoundly unsatisfying. Today it is not just Heidegger who thinks that a depressing, retrograde, and dehumanizing threat seems at least somewhat more than equally constitutive of the kind of world for which the earlier modern tradition has nothing but praise. As even Feenberg now admits, when it comes to our current situation, Heidegger’s account is generally telling. Are we, for example, better now at asking about the Good Life, the Just Society, or the Nature of Beauty, or even about what it would take to “know” these things, than in earlier days? Is life more spiritually satisfying, our political economy more democratic? Can we be sure that post-Heideggerians will handle such questions better than onto-theological metaphysicians?

Critique of Heidegger’s Technoscientific Critics

To put this last point another way, as phenomenological or postphenomenological as Heidegger’s critics may be in their accounts of particular technologies, their critique of him often seems shaped by a very pre-phenomenological traditionalism. In the early 1920s, Heidegger saw just this sort of problem in Dilthey, Husserl, and Jaspers.¹³ For him, the real difficulty with, say, Dilthey’s philosophy of historical life, or Husserl’s phenomenology, or Jaspers’ philosophy of *Existenz* does not lie in what they try to do. Their descriptions of human experience, he says, are often “phenomenological enough.” The problem lies in their very traditional understanding of “who” – that is, what sort of philosopher – does the describing. A Dilthey who wants a “Critique of Historical Reason” still sees himself as a kind of anti-positivist positivist, epistemically looking down from above, reconstructing a second sort of method, for a second kind of objectivity, in a second set of sciences. The Husserl who wants a radically new beginning for philosophy still sees himself as founding a school, defending a traditional “scientific” ideal, looking for meaning in modes of “consciousness” as it intends different sorts of “objects,” and teaching a method that will make phenomenology the ultimate positivism. Even Jaspers, who says he only wants to describe with the greatest possible sensitivity “what life is,” still finds himself making “observations” about

lived experience in the old objectivist language of subject-and-object, method-and-substance, the knowable vs. the ineffable, etc.¹⁴

In my view, one often sees just this sort of split between insightful description and traditional self-understanding in Heidegger’s critics. On the one hand, the “empiricism” of the new American philosophers of technology is undoubtedly more phenomenological than traditional and more postphenomenological than traditionally phenomenological. Yet on the question of how our being-with various technologies is actually to be approached, they often explain themselves in very traditional terms – by saying, for example, that they are proceeding “materially” and “concretely,” rather than “theoretically” and “abstractly.” Verbeek and other so-called “new wave” figures now mostly reject the old idea that to be concrete means returning to an “original” sense of reality that lies beneath our scientific and technologically enhanced ones. But the real question is how to avoid this old idea in the right way. Verbeek argues that the notion of starting from a pure and uncorrupted life-world is a holdover from the embattled Husserlian era when phenomenology was preoccupied with undercutting the positivist-naturalist claim that a scientific view of the world is philosophically basic. Today, he says, we need only observe that

the tree that I climb is real for me in a different way than the one whose cells and sap I study, but so is the tree that I photograph, chop down to use for firewood, or cut up to build a table. None of these disclosures can claim to reveal the “true” tree: they are each equally true. (105)

Verbeek claims that even today’s scientists themselves accept this view. He says they realize that science does not involve “excluding” or replacing our older senses of the meaning of the world, but only offering “a new and different kind of disclosure of it” (105). Yet I seriously doubt that many scientists are this pluralistic about their “new disclosure” – and especially not when they are applying for grants, ranking the best journals, or taking sides in the Science Wars. In fact, and more importantly, when they dig in their ontological heels on the disclosure question ... they still tend to win. The Real is What Is the Case; there is nothing multistable about it. On this issue, science has no competitors, only detractors.

To such familiar and self-confident scientism, anti-scientistic pluralism is no reply, and technoscience studies pays a price for characterizing itself this way. In point of

fact, an egalitarian appeal to multiple perspectives is just as abstract and contextless as the reigning philosophical claim to objectivism. It is already a mistake not to recognize that no one lives in such a way that they can actually *be* someone who says – and means it – “I *understand* that ‘All the disclosures of things are *equally* true.’” Or “Let’s *compare* ordinary and enhanced experience.”¹⁵ But to make this mistake in an atmosphere in which philosophical objectivism is already winning simply guarantees that it will maintain its undeserved hegemony at phenomenology’s expense.

Critical social theorists, too, often seem to speak from a viewpoint that nobody lives – even when, as Feenberg clearly does, they explicitly deny that they are doing so and insist instead on attending to real and concrete socio-economic needs. Yet how, for example, does one achieve what Feenberg calls the “reflexive” outlook from which one feels justified in, first, embracing a de-essentialized version of Heidegger’s account of current technoscientific life and then, second, offering a “democratically” liberalized idea for its transformation? And how does one obtain his sort of assurance that this liberalized idea – or for that matter, any idea of technoscientific life – will ever succeed in addressing *all* our concerns and activities? Should all the issues associated with democratization – among them issues of race, gender, class, and species – be treated through a critical analysis of technoscience? How can we be sure that these other phenomena, if given their full due at the outset, would not displace precisely Feenberg’s own philosophical priorities? How does someone who has achieved his sort of reflexive standpoint respond to those who would appeal “concretely” to the very same experienced world as he does, but reject his technological displacement of, say, political economy, or class, or race as the basic issue?¹⁶

In short, stated without frills, both phenomenological and neo-Marxist critics of Heidegger, whatever they say they are doing, tend to display the following approach in their practice. Leave essentialism and bad theorizing behind, attend to the technoscientific matters at hand, and consider “normativity” whenever the occasion seems to call for us to turn to it.¹⁷ All of this should sound very familiar. It recapitulates in the new, allegedly post-scientific outlook a variant of precisely the same ahistorical viewpoint that Heidegger’s post-Heideggerian critics claim to have surpassed. In fact, whatever may be their intention, philosophers who “reject” the abstract and “decide” on the concrete are *behaving* like inverted Cartesian subjects. Like good Cartesians, they turn to

their phenomenological descriptions because they “resolve” to do so – just as they resolve to reverse Descartes original priorities. Instead of favoring his theories about nature, they ask us to return to all those everyday experiences that his *Meditations* distort and ignore (or at least view “differently”) ... so that we can describe and evaluate and privilege them instead.

It is this tendency toward the silent continuation of a kind of inverse traditionalism – an embrace of the old ontological dualism that now favors the side which has long been out of favour – that concerns me. Being committed to phenomenological description or democratically rationalized practice does nothing by itself to weaken the hegemony of the traditional privileging of *Wissenschaft*. Nor does it give us a world in which we have stopped playing the familiar ontological favorites. In fact, being thus committed is an expression of this hegemony. At this moment, in this world, it “is” not True, as Verbeek wants to say, that we can just decide to identify technologies in their multiple disclosures, instead of always judging them in terms of their essential utility and manipulating them according to what everyone knows and values. Our world does not contain any Understanders of Verbeek’s pluralizing Truth, because some of his multiple disclosures already arrive in our experience with significantly greater ontological clout than others. In our world, the problem is not that we cannot – sometimes, here and there, in some venues – have experiences that seem ill-served by the usual metaphysical understanding of things. It is rather that we have not figured out how to properly “think” this or to actually live out the unrealized possibilities of life that such non-framable experiences suggest to us.

Conclusion: A Modest Proposal

I conclude, then, with a philosophical statement of intent. I want to think in Heidegger’s wake without imagining that I think “after” him. On the grounds that it involves ontological backsliding, I refuse to “choose” between a humanizing, phenomenological interest in particular technologies, and a thoughtfully reflective self-concern for the fact that precisely this interest must work itself out in the technoscientific atmosphere of an ever more “developed” world that already sets up and “essentializes” everything. I happily acknowledge the rapid growth of technoscience studies.¹⁸ I want its proponents to make their concrete studies an integral part of twenty-first

century life. Yet if we ask what a phenomenologist, postphenomenologist, or critical theorist of technology actually does, their answers are still too often given in the metaphysical language of essentialism vs. empiricism, of abstract and concrete, of values and choices – even when their accounts of particular technologies achieve something better. The problem is that no study of material culture – not even the most resolutely post-phenomenological or democratically-minded – can actually become what it claims to be when it rests on a loud dismissal of the Heideggerian project as merely old-fashioned, metaphysical “world-interpretation.”¹⁹ Affirming one thing while dismissing another is just the sort of move one makes *within* a technoscientific “set up” world, under the delusion that one is doing so entirely by choice, and from Nowhere.

To explain all of this from one more angle, I close with a passage from *On the Internet*, the little book in which Hubert Dreyfus describes what he calls, “Nihilism on the Information Highway.” He begins with an analogy between Kierkegaard’s critique of “the Press” and his own critique of the World Wide Web. Kierkegaard, he says, would surely have regarded the Internet as a “hi-tech synthesis of the worst features of the newspaper and the coffeehouse.”²⁰ Dreyfus then continues:

What [Kierkegaard] envisaged as a consequence of the [Danish] press’s indiscriminate and uncommitted coverage is now fully realized on the World Wide Web. Thanks to hyperlinks, [all] meaningful differences have, indeed, been leveled. Relevance and significance have disappeared. And this is an important part of the attraction of the Web. Nothing is too trivial to be included. Nothing is so important that it demands a special place ... Kierkegaard [saw] the implicit nihilism in [this] idea ... On the Web, the attraction and the danger are that everyone can take [a detached and] godlike point of view. One can view a coffee pot in Cambridge, or the latest super-nova, study the Kyoto Protocol ... plough through millions of ads, all with equal ease and equal lack of any sense of what is important. The highly significant and the absolutely trivial are laid out together on the information highway. (78–79)

Dreyfus concludes that, in the world of the Press and the Web, we seem to have only two options left: conformity or nihilism. Either join in or, as Kierkegaard puts it, plunge into some activity, any activity, as long as you do so “with passionate commitment” (80).

Note carefully, however, that passages like this one can be read in two very different ways. If we take our cue

from Heidegger’s critics, it might be supposed that we should read it as a collection of essentialist claims about the Web with a capital “W.” And, obviously, we must therefore reject what Dreyfus says as mere romanticism, expressed in one-size-fits-all statements so abstract and general that they misrepresent just as many experiences as they cover. But it seems clear that Dreyfus intends this passage quite differently. I think he wants it to be heard with a Heideggerian ear, as describing how techno-science *for the most part* already tends to “occur,” to “give” reality to us – that is, to essentialize. And this gift, as Heidegger says, has a double structure: it discloses everything in a way that simultaneously makes it intelligible, fascinating, useful, fun *and also* often existentially intrusive, onto-logically oppressive, and unsatisfying.

Those of you who know Dreyfus will understand why I picked a Heideggerian-sounding passage from his work rather than someone else’s. For Dreyfus is famously no dystopian about technology, and no romantic about what’s wrong with it. But he is, like Heidegger, convinced that a “free relation” with technology is not already present in our world, that it cannot simply be chosen, and that it will therefore have to be “prepared” for.²¹ Indeed, the point of the chapter from which I am quoting is that if we see how the Press and the Web are “the ultimate enemy” of a fulfilling life that involves unconditional commitment and genuine risk (88), this also helps disclose to us by contrast precisely what such a life would have to “be.” The Press and the Web, while busy being themselves, are also the enemy of something. In other chapters, Dreyfus tells us what he thinks this something is – namely, all those aspects of human ek-sistence that are crucial to really flourishing lives, but that are now “metaphysically” subordinated in a dominant tradition that already tells us what is ontologically more fundamental. Thus, for example, *embodiment* already tends to lose out to disembodied cognition; technical and rule-governed skills are everywhere privileged over *expertise*; and propositional language and information processing are favored over what Kierkegaard is forced to call “*indirect communication*.”²²

Dreyfus’s aim is not just to complain about all this but to show how, precisely by making it explicit, we can find a voice for those elements of our lives that are now being obscured and subordinated. For example, says Dreyfus, if we use the Internet with my seemingly negative vision in mind, we may “remember that our culture has already fallen twice, first for the Platonic and then for the Christian temptation to try to get rid of our

vulnerable bodies” – including, pace Ihde, our hands. Such temptations are precisely what are now “developing” into nihilism and technoscience (143–44). Yet, in remembering this, we may also learn to think how life could be – if, that is, we begin to cultivate our embodied capacities as assiduously as our traditionally favored capacity for “enlightened” rationality and “principled” choice (121).

My complaint, then, is not that Heidegger’s critics are insufficiently distressed about the role of technologies in human life. My problem is that they often fail to think much about the *basic sense of being-in-the-midst-of-things that this life already sets up for us* – on the mistaken, and at bottom traditionalist, grounds that to do so would involve dwelling too much on the past, the dated, and the negative. One consequence of this lingering traditionalism is, as I have argued, the perception of a forced option between their approach to technologies and Heidegger’s. But there are others. To name just one, an eager turning-away from Heidegger’s technology-question in favor of allegedly better studies of it – when this turning-away is practiced in a world in which technoscience “is” already everywhere – encourages silence about whether there may be significant possibilities in

life that will never get their best interpretation in any technoscientific way. Are there, for example, technological problems that do not have technological fixes? Aspects of human health that a scientific idea of care can never articulate?²³ Features of human mentality that elude in principle any computer or information-processing model? In short, if there are such possibilities, considering them will require a “free” and “thoughtful” *relation with technoscience* rather than just more of it, or “new and improved” versions of it.

For me, the often polemical and self-willed characterizations that Heidegger’s critics give of their own philosophical outlook make their claims to be “post-” or “after” him seem unpersuasive. They are certainly right, that there are life experiences which either do not fit or may even challenge the currently enframed and undemocratically set-up sense of what is real and what matters. Indeed, herein lies technology’s possible “saving power.” But claiming that good descriptions of these experiences by themselves place the old problem of technoscience behind us is hermeneutically naïve. Making this claim is actually a very traditional and metaphysical thing to do – and is, I think, a glaring sign of technology’s currently essentializing “danger.”

Notes

- 1 For a laundry list of all the things that are typically claimed to be wrong with Heidegger, see Richard A. Cohen, “Technology: The Good, the Bad, and the Ugly,” in *Postphenomenology: A Critical Companion to Ihde*, ed. Evan Selinger (Albany: SUNY Press, 2006), 147–49.
- 2 Everyone else, Heidegger says, thinks of philosophy as moving in the direction of asserting “pure and incontrovertible truth.” For my part, I will be looking instead in the direction of “what goes on in philosophy before it becomes what [everybody thinks] it is.” *Ontology – The Hermeneutics of Facticity*, trans. John van Buren (Bloomington: Indiana University Press, 1999), 46. For philosophy, the enigma for any study of history (and by implication, any human phenomenon) “lies in what it means to be historical” (*The Concept of Time*, trans. William McNeill (Oxford: Blackwell, 1992), 20E).
- 3 “The Question Concerning Technology,” in *Martin Heidegger: Basic Writings*, 2nd ed., ed. David Farrell Krell (New York: HarperCollins, 2008), 311–41.
- 4 In addition to the empiricist/phenomenological and neo-Marxist/critical-theory inspired forms discussed here, the third major type is neo-pragmatist. For a sample of a contemporary pragmatist critique of Heidegger that follows similar lines to that of critical theory as discussed below, see, e.g., Larry A. Hickman, “Postphenomenology and Pragmatism: Closer Than You Might Think?” *Techné: Research in Philosophy and Technology* 12/2 (2008): 99–104; *Pragmatism as Post-Postmodernism* (New York: Fordham University Press, 2007); 92–96 (on “neo-Heideggerianism”); and *Philosophical Tools for Technological Culture: Putting Pragmatism to Work* (Bloomington: Indiana University Press, 2001), esp. 151–56, 172–84.
- 5 Hans Achterhuis, *American Philosophy of Technology: The Empirical Turn*, trans. Robert P. Crease (Bloomington: Indiana University Press, 2001), 6–8. Achterhuis also includes Andrew Feenberg in this empirical turn, but as I am about to explain, this ignores the distinctive, socio-political edginess in writings on technoscience by critical theorists like Feenberg. Moreover, in recent works, Feenberg in particular has moved much closer to agreeing with Heidegger’s critique of technology, so long as it is regarded only as a fairly accurate description of what is wrong with the current conception and use of technology and not also a diagnosis of its “essence.”
- 6 Peter-Paul Verbeek, *What Things Do: Philosophical Reflections on Technology, Agency and Design*, trans.

- Robert P. Crease (University Park: Pennsylvania State University Press, 2005).
- 7 Ibid., 47–95.
 - 8 See, e.g., Jürgen Habermas, *The Philosophical Discourse of Modernity: Twelve Lectures*, trans. Frederick Lawrence (Cambridge, MA: MIT Press, 1987), 131–60.
 - 9 See, e.g., my “Habermas on Heidegger’s *Being and Time*” *International Philosophical Quarterly* 31 (1991): 189–201.
 - 10 For Feenberg’s most positive account of Heidegger as furnishing a convincing critique of contemporary (undemocratic) technoscientific life – but in an unfortunately metaphysical form, see Andrew Feenberg, *Heidegger and Marcuse: The Catastrophe and Redemption of History* (New York: Routledge, 2005).
 - 11 See, e.g., Iain Thompson, *Heidegger on Ontotheology: Technology and the Politics of Education* (Cambridge: Cambridge University Press, 2005), 58–68. Also, “What’s Wrong with Being a Technological Essentialist? A Response to Feenberg,” *Inquiry* 43 (2000): 429–44.
 - 12 A well-known version of this mistake is the idea that Heidegger’s description of the essence of technology is a very unphenomenological attempt to provide a “one size fits all” account of each and every one of our technologies, including everything from hammers and bridges to musical instruments. See Don Ihde, “Heidegger on Technology: One Size Fits All,” in *Heidegger’s Technologies: Postphenomenological Perspectives* (New York: Fordham University Press, 2010), 114–27. Ihde admits that there have been “Heideggerian moments” in the development of, say, musical instruments using keys (e.g., flutes, clarinets, horns), but he argues that this happens only at the beginning of the introduction of new technologies when many protesting musicians still tend to focus more on what is being lost (e.g., there is a devaluation of actual fingering) than gained. He likens this sort of protest to Heidegger’s complaint about the typewriter (or to update the analogy, the electronic keyboard or touchscreen). But in both cases, the complaint tends to come either from amateurs (who do not understand the value of these “improvements” from the standpoint of those capable of expertise) or from those who are more experienced but who have not yet learned enough about how the improvement will work to appreciate it (especially when this involves some sort of revised facilitation of embodiment). All of this, however, misses Heidegger’s point, which is not about clinging to old-fashioned technologies when improvements come along. His question is: in what sort of ontological atmosphere are we understanding all of these changes? It is no rejoinder to explain that “any new technology in relation to human praxis, before it can become transparent and thus fully accommodated, must be ‘embodied’ if it is to be ‘known’ at all” (124–25).
 - 13 The following summarizes my argument in a review essay of Feenberg’s *Marcuse and Heidegger*, “Feenberg on Marcuse: ‘Redeeming’ Technological Culture,” *Techné* 9/3 (2006): 67–70 [<http://scholar.lib.vt.edu/ejournals/SPT/v9n3/scharff.html>].
 - 14 See, e.g., Heidegger’s “Comments on Karl Jaspers’ *Psychology of Worldviews*,” in *Pathmarks*, ed. William McNeill (Cambridge: Cambridge University Press, 1998), esp. 30–37, and above all its last line: “In order for [Jaspers’ findings] to be capable of effectively stimulating and challenging contemporary philosophy, [his method of] pure observation must evolve into the ‘infinite process’ of a radical questioning that *always includes itself in the inquiry*” (37, my emphasis, translation altered). On Husserl, Scheler, and Dilthey, see, e.g., Heidegger, *History of the Concept of Time*, trans. Theodore Kisiel (Bloomington: Indiana University Press, 1985), 17, 108–119; thesis summarized, 128–31.
 - 15 Consider seriously, e.g., what it *really* means for a white U.S. male, at the beginning of this century, in the midst of the “developed” part of the world, to assert that “Gender(s) are multistable.” Don Ihde, *Bodies in Technology* (Minneapolis: University of Minnesota Press, 2002), 33, my emphasis. Or for an analytic philosopher, serving on the screening committee for APA conference papers, to announce proudly that “every philosophical approach is equally welcome.”
 - 16 I discuss this issue in detail in “Feenberg on Marcuse.”
 - 17 For example, this is how Selinger defends Ihde against critics who say he has only “descriptive” things to say about contemporary technology. See his “Normative Judgment and Technoscience: Nudging Ihde, Again,” *Techné* 12/2 (2008): 120–25; and “Normative Phenomenology: Reflections on Ihde’s Significant Nudging,” in *Postphenomenology*, 89–107. However, my question is not whether Ihde sometimes displays, “theoretically and normatively,” that his heart is in the right place, but whether concrete “descriptions” *plus* some sort of better “theorizing” are the right means to empower free or democratic or (post)humanistic alternatives to the deterministic, elitist, and dehumanizing tendencies already, pre-theoretically, embedded in everything we say and do in the “developed” world.
 - 18 I acknowledge the sociological fact that many post-Husserlians think of themselves as belonging to “third” and “fourth wave” technoscience studies. See, e.g., Ihde’s “Forward” to *New Waves in Philosophy of Technology*, viii–xiii; and the “Concluding Phenomenological Postscript: Writing Technologies” in *Heidegger’s Technologies*, 128–39. My question is: “are” they right?
 - 19 Verbeek’s phrase (*What Things Do*, 142–43); and see, with much less sympathy, Soren Riis, “The Question Concerning Thinking,” in *New Waves in Philosophy of Technology*, 123–45.
 - 20 Hubert Dreyfus, *On the Internet*, 2nd ed. (New York: Routledge, 2008), 77. Dreyfus’ earlier and more detailed

- discussion of the suggestive comparison between “the Press” and the World Wide Web is “Anonymity versus Commitment: The Dangers of Education on the Internet,” *Ethics and Information Technology* 1 (1999): 15–20. [Chapter 53, this volume. Eds.]
- 21 Heidegger, “The Question Concerning Technology,” 311. See Dreyfus, “Heidegger on Gaining a Free Relation with Technology,” in Andrew Feenberg and Alastair Hannay, eds., *Technology and the Politics of Knowledge* (Bloomington: Indiana University Press, 1995), 97–107.
- 22 As Otto Pöggeler points out, Heidegger’s review of Jaspers’ *Psychology of Worldviews* ends by crediting Kierkegaard’s notion of “indirect communication” as the forerunner of the notion of formal indication Heidegger is developing at the time. *Martin Heidegger’s Path of Thinking*, trans. Daniel Magurshak and Sigmund Barber (Atlantic Highlands: Humanities Press, 1987), 267–68.
- 23 My favorite sources here are still Carl Elliott, *Better than Well: American Medicine Meets the American Dream* (New York: Norton, 2004); and *A Philosophical Disease: Bioethics, Culture, and Identity* (New York: Routledge, 1999).

Technology and Cyberspace

Introduction

Of all the technologies that shape contemporary life, computer technology is arguably the most powerful and pervasive. We commonly speak of “the computer revolution,” the rise of a global “computer culture,” and “the age of [computer-processed] information.” Not everyone, of course, is happy about this; but it is hard to find anyone ready to assure us that the computer’s influence matters little. At the same time, however, aside from those who are selling their own wares, it is difficult to find anyone who rejoices in the coming of cyberculture without at least some qualifications. Nowhere has this question been fought out in greater detail and by more philosophers, engineers, scientists, and proponents of technoscience studies than in connection with artificial intelligence (AI) research. What sort of “mind” can “know” something? Human only? And what if, instead, we are on the verge of creating artificial minds, or robots with minds, or even cyborgs verging on virtual (or “post-”) humanity (or vice versa)? And what does it mean that we are even thinking that we should try to do this? Some are happy and upbeat about the whole prospect, some are in varying degrees skeptical or critical, and some are only skeptical or critical about the current course and prospects of AI research, while others are more deeply suspicious of the philosophical understanding of humanity, mentality, science, and technology that underlies it.

In what might usefully be read as a paired set of articles, Daniel Dennett and Hubert L. Dreyfus represent

two radically different philosophical perspectives on the AI issue, each focused here on how it emerges in connection with robotics. The main question is: Can we build a “conscious robot”? Dennett, famously, takes the hard line: Yes, of course, because “we are a *sort* of robot ourselves.” Dreyfus, almost as famously (many AI researchers would say, notoriously), rejects this hard line: Until AI researchers and robotic engineers acquire a richer, more phenomenological understanding of embodied human life than hardliners now presuppose, results will continue to be crude, limited, and oversold.

Dennett begins his wonderfully clear and pointed discussion by asserting that if we never build a conscious robot, it will be because it costs too much or the engineering is too challenging, not because trying to build it would contradict some natural law. After replying to a few objections, he considers MIT’s well-known Cog project (closed down in 2003 after he wrote this essay). Several of the most important features of Dennett’s outlook are prominently on display throughout his discussion. First, Dennett holds a *functional* or computational position regarding mentality – namely, that thought-activity is related to the brain in the same way as computational activity is to the computer. Assuming this functional identity is what enables him to assert that “we” are a kind of robot ourselves. Second, Dennett’s view represents (with some disagreements in detail) what is usually called *strong AI* (dubbed by John Haugeland “Good Old-Fashioned AI” or GOFAI), which holds that since human intelligence consists of nothing but the application of rules to facts (i.e., is

“symbolic representation”), creating computers/robots that respond like intelligent humans boils down to writing programs for processing data that are sophisticated enough for the computers/robots to perform human tasks. Third, Dennett is a *scientific naturalist*, which means that he understands reality to be, and be only, what scientific investigation can find and theorize about (hence his famous critiques of religious doctrines and immaterial minds as supernaturalist fictions). Finally, given a naturalistic ontology, he is also committed to an externalist, or *third-person* “observational” standpoint (a very unphenomenological outlook that he provocatively calls “heterophenomenology”). Thus for Dennett, the “problem of consciousness” must be treated entirely in the same physical-scientific terms as any other phenomenon.

Regarding objections, Dennett’s general strategy is to find behind each of them the allegiance to a philosophical outlook that is not scientific naturalism. In response to the argument that consciousness cannot be understood materialistically, Dennett ridicules its dependence on the traditional sort of mind-body dualism that invariably winds up imagining that are some immaterial or non-natural substances like “selves” or mysterious “qualia” available only to private intuition or introspection. In fact, he says, every such phenomenon has eventually turned out to be either an obvious fiction or something perfectly intelligible, say, to molecular biology. To the related objection that consciousness requires an “organic” host, not a machine, Dennett replies that this raises at most a burdensome engineering problem – perhaps even too burdensome for us ever to actually build an entirely non-organic brain-like host – but this, then, is not a *philosophical* objection. To the objection that because consciousness is “born,” it cannot be mechanically produced, Dennett argues that this either amounts to a dogmatic sort of “origin chauvinism” or it mystifies the serious but purely practical problem of “making” a fully competent adult robot. We undoubtedly have to start, he says, with something more child-like. Finally, he dismisses as “scientifically boring” the appeal to insurmountable complexity. People also used to say this about producing mechanical heart valves, ear implants, and other prostheses. Of course, at the moment we may still have only simpler and cruder devices, but where is the justification for leaping to negative conclusions about what cannot be built in principle?

Dennett’s consideration of MIT’s humanoid robot (“Cog”) project starts with the barbed suggestion that

ongoing real-world projects might “teach us something interesting” while outsiders continue to fiddle with “philosophical conundrums.” This project, he says, was inspired by the promising idea (perhaps reinforced by objections from a younger generation of robotic engineers not as hostile to phenomenology?) that some replication of human “embodiment” through the addition of physical mobility, optical sensors, and a somewhat human-like form might improve robot learning opportunities both “perceptually” and through more successful “social” interaction. Dennett admits that one problem even for Cog is that learning some behaviors might prove too difficult without hard-wiring in some organizing rules as “innate endowments.” He mentions the difficulty of face recognition, but the most notorious of these problems is one he himself discovered by extrapolating from a formal-logical dilemma with the same name, namely, “the frame problem” (mentioned by Dreyfus below, in connection with the problem of giving robots “common sense”). Basically, the difficulty involves learning, not how to perform a task, but how to select what is relevant (and to deselect the millions of irrelevant considerations) for a task, or even how to identify something *as* a task. (“Hammering this nail into this piece of wood” is easy; playing this game of chess is harder; but attending a birthday party, or shopping for the week’s groceries...?) Obviously, if too much is built in – if, as one says in traditional terms, too much of the robot’s “knowledge” is *a priori* – the machine might well “behave” better, but one can no longer say it is “replicating” a human-like consciousness. What Dennett calls the “team of [programming] overseers” would become a kind of *deus ex machina* – or maybe better, the “consciousness” of the machine and its programs.

As Dreyfus’ discussion makes clear, a number of very sophisticated philosophical positions now lie between GOFAI and the phenomenological standpoint he takes in his essay. For this anthology, however, the main goal is not to survey or evaluate the relative merits of these positions but to connect their debates to technology studies. Hence, it is useful to begin with the story of Dreyfus’ initial unhappiness with GOFAI, in order to highlight features of his philosophical standpoint that are relevant to material in other parts of this collection. He tells us that, as a young MIT instructor, he became suspicious of claims made by his computer science students – that they were “solving” all the classical problems of philosophy about the nature of knowledge (already being referred to as “intelligence”). When he

looked into their claims, he discovered that far from replacing philosophy with real research, they were in fact, quite unreflectively and unfortunately, merely “turn[ing] central elements of modern] philosophical rationalism into a research program.” In a provocative RAND Corporation report, *Alchemy and Artificial Intelligence* (1965), Dreyfus explains in detail how deeply flawed this philosophical understanding of human knowing actually is and why adopting it doomed MIT’s AI program in advance. Referring especially to Heidegger’s *Being and Time*, he argues there that, except for fairly elementary tasks, we humans process information in ways that depend upon (a) a tolerance of ambiguity, (b) an ability to separate focal and fringe awareness, and (c) a capacity to discriminate between what is essential and inessential – all features of ordinary human knowing ignored by MIT’s preference for computer models of intelligence based on what little we know about brain functioning. Dreyfus does not mention the flap associated with his RAND report’s release, which soon enough led to his relocating to the University of California at Berkeley, but he does note that it became his famous *What Computers Can’t Do* (Harper 1972, 1979), which was ultimately updated to *What Computers Still Can’t Do* in 1992 (ironically, published by MIT Press). In his preface to the MIT edition, he explains why he could be so sure that the symbolic processing approach of GOFAI defined what Imre Lakatos called a degenerating research program – one, that is, which shows great promise initially and on a small scale but is destined for internal design reasons never to achieve the grand successes predicted for it by its founders. The reason for his prescience, in a nutshell, is that he was already a phenomenologist.

In the intervening decades, many AI researchers – including some at MIT – came to think that Dreyfus’ criticism of GOFAI is basically correct, and some of them also concluded that overcoming his objections would require incorporating something of his Heideggerian approach to intelligence into AI programming. GOFAI’s main mistake, Dreyfus showed, is philosophical; hence, adding theoretical or engineering epicycles to GOFAI cannot save it. To refer back to Dennett’s account of the Cog project, making robots with mechanical bodies that at least appear humanoid cannot increase their ability to learn behaviors that rely on the embodied nature of perceptual life, or draw on the common-sense character of our everyday understanding – for the simple reason that human embodiment and

common-sense understanding are nothing like, respectively, the physical state of a dolled-up artifact and a particular species of representing facts by rules. As described by Heidegger and Merleau-Ponty, being embodied, living spatio-temporally, and coping in a hundred ways with practical affairs constitutes a kind of everyday existence that is of an entirely different order from being a machine whose movements are directed by programmed coordinates on spatio-temporal maps and whose “thinking” is always some form of symbolic representation. Hence, GOFAI or any theory that assumes the activities of perception, thinking, and acting *must somehow* be “following rules” is doomed in advance, not for engineering, economic, or political reasons, but because one cannot “program” what has been ontologically misunderstood to begin with. Thus, in the present essay, Dreyfus criticizes Rodney Brooks’ 1990s empiricism for having essentially the same philosophical shortcomings as Marvin Minsky’s 1950s intellectualism, but in reverse. Where Minsky imagines symbolizing minds making sense out of a brute-factually given world, Brooks sees stimulated brains converting external input into reflexive responses. Both of them begin with the same traditional “us over here, world out there, organizing principles in the middle” metaphysics – which means they both miss the same point. *Before* traditional epistemologies of in-here and out-there can begin to analyze experience in third-person terms, split it up into a tripartite structure, and introduce theories to “explain” how the three parts “function” together, we are *already living* their intimate relatedness as “being-in-the-world,” and *being* globally responsive to anything and everything with no need for a separate set of organizing principles to get Us and the Other together. Indeed, as Dreyfus elsewhere, rationalist and empiricist reconstructivists betray their own recognition of this prior condition in never doubting that there is *something already unified to reconstruct* with their explanations – namely, the fact that “embodied beings like us take as input energy from the physical universe and respond in such a way as to *open them to a world* organized in terms of their needs, interests, and bodily capacities.”

Dreyfus goes on to discuss the work of Phil Agre and David Chapman, Michael Wheeler, and Walter Freeman, identifying the degree to which each of them seems to understand what Heidegger means by “openness to the world” and where their work still tends to fall back on an objectivist, or third-person, conception of what “must” be going on in human existence whether we “experience”

it or not. Dreyfus' main point is that being-in-the-world, as a more basic level of experience than cognizing and problem-solving, is not (yet) representational at all. Indeed, when we are busy coping with reasonable success, "we are drawn in by solicitations and respond directly to them, so that the distinction between us and our equipment vanishes." On one issue, however, Dreyfus thinks that none of the researchers he discusses have made progress. Their use of Heidegger is focused entirely on the (perfectly admirable) purpose of developing better models of brain functioning in order to enable future computers/robots to be more responsive to their surroundings. But of course in human lives, this responsiveness cashes out in our understanding what to do, in determining what is significant for us and, in the first instance, recognizing the ways in which any situation presents us with matters to respond to at all. Hence, the best and most Heideggerian model of brain function would at most prepare an improved computer/robot for *being responsive*, but then we would still have to figure out how it could be programmed to actually pick out domains of significance – that is, as Dreyfus puts it, in some sense "understand" our "particular way of being embedded and embodied such that what we experience is significant for us in the particular way that it is." The plain truth is, we are a long way from knowing how to put into computer programs "a model of a body very much like ours with our needs, desires, pleasures, pains, ways of moving, cultural background, etc." It is in this context that Dreyfus refers to the so-called "frame problem." As noted above, the version of this problem that has become relevant in AI work involves figuring out theoretically something that humans do automatically and as a matter of common sense – something it is implausible to even imagine being a matter of applying specific rules to discrete facts – namely, determining not only what items of information about our surroundings hold constant for a certain task, but selecting something *as a task* from the millions of stimuli we take in just by being in the midst of life. It is this capacity to "learn to act intelligently in our world" in a situation- or task-discriminating fashion that Dreyfus refers to at the end of his essay, when he says he already knows that the detailed models of human bodies and brains dreamed up in the "wild imaginations of a Ray Kurzweil or Bill Joy ... haven't a chance of being realized in the real world."

What philosophers of technology can take away from Dreyfus' discussion, then, is the argument that the promise of a research program is implicitly settled in

advance by the relative phenomenological richness of its initial understanding of human lifeworld experience. For someone like Minsky or Dennett, who "already know" how AI research must proceed, Dreyfus' argument must of course sound like little more than the expression of naïve preference for some sort of "unscientific" conception of consciousness instead of a "scientific" one, and they will read his subsequent willingness to concede that today's computers can do things he argued in the 1960s they could "never" do as simply his "moving the goal-posts" the way theologians used to do when they were fighting rearguard actions against scientific advances, especially in the study of humans. In fact, however, Dreyfus is not attacking the "science" but the "philosophy of science" of tradition-bound, still often symbolic representationalist AI. And here, the AI debates join with debates over building and using technologies more generally. For in the eyes of philosophers like Dreyfus (and Heidegger and many phenomenologists), starting a philosophical investigation of today's technologies by focusing on design issues and outcomes assessment – or, to take another example, by tacking on "ethical" questions or "political" concerns at the end of the analysis of ongoing technoscientific activity – comes too late and remains impotent in the face of whatever implicit (usually a late modern, empiricist-positivist version of traditional) philosophical understanding already informs the ongoing activity. This is why Heidegger and phenomenologists quite generally want their descriptions of everyday being-in-the-world to proceed without first seeking approval from the natural and human sciences. It is not that they mistakenly see themselves as producing another theory to compete with a "really scientific" approach to nature and humankind; rather, they are concerned that the philosophically primitive condition of the current understanding of nature and humankind will stunt the growth of the research programs it guides – as, for example, Dennett does when he takes it as "just obvious" that we "are" a kind of robot, because he is philosophically wedded to the idea that only what is physical and can be observed from a third-person viewpoint is "real." Of course, to what extent the numerous competing phenomenologies and postphenomenologies of being-in-the-world deserve the status claimed for them is an open question.

In her famous "Cyborg Manifesto," Donna Haraway suggests that the popular science fiction portrayals of cyborgs as part-human and part-machine reflect a general blurring in our age of the traditional boundary

lines not only between persons and hardware but also, thanks to biotechnology, even between species. The implication, of course, is that this change in our ideas of who we are goes hand in hand with changes in our understanding of how we relate to each other and to nature. The general process of blurring all the old species-defining lines, she argues, is a manifestation of the global dominance of an information economy, and it now issues in a condition that many call postmodern. Postmodernism and poststructuralism reject the standard notions of a unitary, “centered” human being or society, in this way reflecting an older European generation’s critiques of the unphenomenological character of traditional conceptions of our existence. Such conceptions – like the idea of an essential self or “subject” in Descartes, Kant, and the Romantics, as well the idea of a society functioning according to some central dynamic like “labor,” as in Marx – all belong to an earlier, modern era. (Especially in recent French thought regarding the “decentering” of the self, the psychoanalytic theories of Freud and Lacan are widely regarded as pioneering sources; and the idea of a decentered social totality is traced above all to the Marxist structuralist, Louis Althusser.) Haraway argues that essentialist feminism, according to which Woman has some unchanging (usually inferior/subordinate) nature, is just as dated and constrictive as are the older humanisms that posit an essence of Man. Drawing on the writings of multicultural feminists, she proposes a view of selves and societies in which the intersection and crossing of lines of class, gender, and race result in non-unitary systems of overlapping allegiances and partial “identities.” Just as boundaries between selves, ethnicities, sexes, and species are erased in science fiction’s cyborgs, so also are such boundaries being erased in the rapidly developing multi-ethnic, trans-sexual, bioengineered condition of our time. It is interesting to note that Haraway’s conception of the blurring of lines between human and inorganic as well as between nature and culture implicitly supersedes Merchant’s account of the idea of nature as Nurturing Mother being replaced by another idea of nature as a purposeless object of exploitation. For Haraway, both ideas are still presented in too holistic and essentialist a way to reflect our present circumstances. Her article closes with the much-discussed, anti-essentialist remark, “I would rather be a cyborg than a [traditionally understood] goddess.”

Like Haraway, Selinger and Engström ponder both the accuracy and the social and moral value of all the

currently fashionable talk about humans as cyborgs. Whereas Dreyfus (above) objects to the lingering influence of the symbolic representationalist or computational theory of mind (CTM) in robotics and cyborg engineering projects, they worry more about the way our ubiquitous use of technologies (in Selinger and Engström’s case, specifically digital devices) is increasingly being conceived in the same reductive terms. Thus, “wired and digitized” no longer just describes how we move around in the world; it threatens to form our fundamental conception of who and what we *are*. Selinger and Engström find examples of this reductive slide into “cyborg ontology” in philosophy, science studies, marketing, and popular journalism. In philosophy, for example, Andy Clark’s updated version of David Chalmers’ theory of “extended mind” defines human beings as “reasoning systems whose minds and selves are spread across biological brain and nonbiological circuitry” – in other words, as “cognitive opportunists” with computational minds that “merge” with “non-biological tools” to “solve problems.” Whatever issues Dreyfus thinks this ontologically pinched vision of humans might cause in research, Selinger and Engström worry that these issues will be seriously compounded as commercialized, popularized, and politicized versions of this vision come out of the laboratory and start to dominate our general sense of everyday life.

Clark’s definition of being human of course echoes Engels’ classical notion of humans as tool-users and tool-makers, but it is more crudely instrumentalist and apolitical, and these are the characteristics that make Clark’s theory possibly dangerous. Dreyfus is concerned to show that the era is drawing to a close when the philosophical enthusiasms of the Marvin Minskys, Steven Pinkers, and Daniel Dennetts of the profession can help make CTM the background understanding of choice for AI research programs. But Selinger and Engström think that CTM is actually on the rise as a cultural understanding of our everyday selves, of the artifacts we use, and of their relationship – and all the more so because there is commercial gold and political power in getting people to accept it. They cite, for example, both a “cyber-evangelist,” Kevin Warwick – who (like Nick Bostrom) hypes a post-human future in which we will technologically “upgrade the human form” – and a self-identified “consumer anthropologist,” Markus Giesler – who extrapolates from Clark’s theory to promote a “posthumanist epistemology of technology consumption.” Giesler especially is no scientific researcher in search of knowledge. He wants to

sell his epistemology to market researchers as a replacement for their more traditional Cartesian, representational epistemologies, so that they might better exploit the “meaning and experiences of technological consumption.” After all, a Cartesian epistemology – with its rigid subject–object dualism and old-fashioned philosophical anthropology of thinking selves – discourages marketers and consumers alike from appreciating, for example, that one’s relationship with an iPhone is a no longer a matter of me-using-an-artifact. It is a “merging” in which humans and machines form “cybernetic units,” and talking to Siri (Apple tells you in its blurbs that this *is* your “intelligent personal assistant”) is a “conversation.”

Perhaps most disturbing to Selinger and Engström, however, is that, from this “cyborg ontology,” certain obvious political conclusions fall out. Warwick and his colleagues are not only enthusiastic supporters of the bodily implantation of electronic communication devices, but also missionaries for a consumerist political economy in which corporate Big Brother is a friendly helper, monitoring our choices and marketing devices to us accordingly (what one critic has called the principle of Google’s Web Analytics, on steroids). Here the technological humanist present, where humans still think of themselves as tool-users and tool-makers, gives way to a cyber-utopian future, where we will *be* tool-made and tool-used. Selinger and Engström thus conclude by calling for a moratorium on cyborg talk. It is, they say, “political economy through the back door” – one whose political, social, and ethical implications never even come up for discussion, even though it quite clearly and strongly promotes a “worldview ... that attempts to tell us not just who or what we are, but ... who and what we should want to be.” Though the stakes are high and cyber-utopia surely an issue, they leave open the question of who might be persuaded to listen to their call, or why.

Finally, in “Anonymity versus Commitment” (revised later into a chapter in *On the Internet* (2001, 2009)), Dreyfus weaves a cautionary tale about the unintended effects of our ever-growing reliance on the Internet. Like Selinger and Engström, he is concerned about the way current technologies are shaping our conceptions of the

good life. In this essay, he expresses his concern by ingeniously rethinking our experience of the Internet in terms of Søren Kierkegaard’s critique of “The Press.” Kierkegaard, the nineteenth-century existentialist and religious thinker, describes the popular press of his time as driven by an urge to satisfy the insatiable demands of its readers for “information” to indiscriminately report every “interesting” new event – thus encouraging a dubious sort of uncommitted attitude of curiosity in which everything is momentarily interesting but nothing seems really worth knowing. In Kierkegaard’s language, “The Press” creates “The Public.” The trouble with being curious, of course, is that ultimately the only thing that can keep boredom at bay is yet another round of something “new.” Here Dreyfus sees similarities between Kierkegaard’s critique of the dissemination of “news” by The Press and his own misgivings about the endless availability of information on the Internet. But the bulk of his discussion is directed toward a provocative counter-suggestion. With a creative reinterpretation of Kierkegaard’s “three stages on life’s way,” he argues that the experience of having such an excess of information would most certainly encourage us to live *aesthetically*, like an undirected and idly curious Web-surfer. It might also lead us to discover the implicit flight from boredom that the life of an aesthete implies and thus drive us toward Kierkegaard’s *ethical* sense of life, where we would try to adhere to a “principled” conversion of all information into something that may or may not be worth selecting for the sake of knowledge from a “chosen” perspective. What is much less likely, however, is that our experiences on the Internet will encourage us to see the implicit nihilism in the ethical sense of life, where “choosing the principle of our choices” is of course itself nothing at bottom but a choice. And without recognizing this limitation in ethical choice, there is even less chance that processing all that Internet information will lead us to understand the difference between mere choice and the sort of genuine choice which Kierkegaard identifies with the *religious* stage (but which Dreyfus construes in a secular fashion) – that is, the kind of choice that turns an otherwise merely optional perspective into a genuine and risk-filled “commitment.”

Consciousness in Human and Robot Minds

Daniel C. Dennett

Good and Bad Grounds for Scepticism

The best reason for believing that robots might some day become conscious is that we human beings are conscious, and we are a *sort* of robot ourselves. That is, we are extraordinarily complex, self-controlling, self-sustaining physical mechanisms, designed over the eons by natural selection, and operating according to the same well-understood principles that govern all the other physical processes in living things: digestive and metabolic processes, self-repair and reproductive processes, for instance. It may be wildly overambitious to suppose that human artificers can repeat Nature's triumph, with variations in material, form, and design process, but this is not a deep objection. It is not as if a conscious machine contradicted any fundamental laws of nature, the way a perpetual motion machine does. Still, many sceptics believe – or in any event want to believe – that it will never be done. I wouldn't wager against them, but my reasons for scepticism are mundane, economic reasons, not theoretical reasons.

Conscious robots probably will always simply cost too much to make. Nobody will ever synthesize a gall bladder out of atoms of the requisite elements, but I think it is uncontroversial that a gall bladder is nevertheless 'just' a stupendous assembly of such atoms. Might a conscious

robot be 'just' a stupendous assembly of more elementary artefacts – silicon chips, wires, tiny motors, and cameras – or would any such assembly, of whatever size and sophistication, have to leave out some special ingredient that is requisite for consciousness?

Let us briefly survey a nested series of reasons someone might advance for the impossibility of a conscious robot:

1. Robots are purely material things, and consciousness requires immaterial mind-stuff. (Old-fashioned dualism.)

It continues to amaze me how attractive this position still is to many people. I would have thought a historical perspective alone would make this view seem ludicrous: over the centuries, every *other* phenomenon of initially 'supernatural' mysteriousness has succumbed to an uncontroversial explanation within the commodious folds of physical science. Thales, the pre-Socratic proto-scientist, thought the loadstone had a soul, but we now know better; magnetism is one of the best understood of physical phenomena, strange though its manifestations are. The 'miracles' of life itself, and of reproduction, are now analysed into the well-known intricacies of molecular biology. Why should consciousness be any exception? Why should the brain be the only complex physical object in the universe to have an interface with another realm of being? Besides, the notorious problems with the

Daniel Dennett, "Consciousness in Human and Robot Minds," from *Cognition, Computation, and Consciousness*, ed. Masao Ito, Yashushi Miyashita, and Edmund T. Rolls (Oxford: Oxford University Press, 1997), pp. 17–30. Reprinted by permission of Oxford University Press.

supposed transactions at that dualistic interface are as good as a *reductio ad absurdum* of the view. The phenomena of consciousness are an admittedly dazzling lot, but I suspect that dualism would never be seriously considered if there was not such a strong undercurrent of desire to protect the mind from science, by supposing it composed of a stuff that is in principle uninvestigatable by the methods of the physical sciences.

But if you are willing to concede the hopelessness of dualism, and accept some version of materialism, you might still hold that:

2. Robots are inorganic (by definition), and consciousness can exist only in an organic brain.

Why might this be? Instead of just hooting this view off the stage as an embarrassing throwback to old-fashioned vitalism, we might pause to note that there is a respectable, if not very interesting, way of defending this claim. Vitalism is deservedly dead; as biochemistry has shown in matchless detail, the powers of organic compounds are themselves all mechanistically reducible and hence mechanistically reproducible at one scale or another in alternative physical media. But it is conceivable, if unlikely, that the sheer speed and compactness of biochemically engineered processes in the brain are in fact unreproducible in other physical media (Dennett 1987). So there might be straightforward reasons of engineering that showed that any robot that could not make use of organic tissues of one sort or another within its fabric would be too ungainly to execute some task critical for consciousness. If making a conscious robot were conceived of as a sort of sporting event – like the America's Cup – rather than a scientific endeavour, this could raise a curious conflict over the official rules. Team A wants to use artificially constructed organic polymer 'muscles' to move its robot's limbs, because otherwise the motor noise wreaks havoc with the robot's artificial ears. Should this be allowed? Is a robot with 'muscles' instead of motors a robot within the meaning of the act? If muscles are allowed, what about lining the robot's artificial retinas with genuine organic rods and cones instead of relying on relatively clumsy colour-TV technology?

I take it that no serious scientific or philosophical thesis links its fate to the fate of the proposition that a *protein-free* conscious robot can be made, for example. The standard understanding that a robot shall be made of metal, silicon chips, glass, plastic, rubber, and such, is an expression of the willingness of theorists to bet on a

simplification of the issues: their conviction is that the crucial functions of intelligence can be achieved by one high-level simulation or another, so that it would be no undue hardship to restrict themselves to these materials, the readily available cost-effective ingredients in any case. But if somebody were to invent some sort of cheap artificial neural network fabric that could usefully be spliced into various tight corners in a robot's control system, the embarrassing fact that this fabric was made of organic molecules would not and should not dissuade serious robotics from using it – and simply taking on the burden of explaining to the uninitiated why this did not constitute 'cheating' in any important sense.

I have discovered that some people are attracted by a third reason for believing in the impossibility of conscious robots:

3. Robots are artefacts, and consciousness abhors an artefact; only something natural, born not manufactured, could exhibit genuine consciousness.

Once again, it is tempting to dismiss this claim with derision, and in some of its forms, derision is just what it deserves. Consider the general category of creed we might call *origin essentialism*: only wine made under the direction of the proprietors of Château Plonque counts as genuine Château Plonque; only a canvas every blotch on which was caused by the hand of Cezanne counts as a genuine Cezanne; only someone 'with Cherokee blood' can be a real Cherokee. There are perfectly respectable reasons, eminently defensible in a court of law, for maintaining such distinctions, so long as they are understood to be protections of rights growing out of historical processes. If they are interpreted, however, as indicators of 'intrinsic properties' that set their holders apart from their otherwise indistinguishable counterparts, they are pernicious nonsense. Let us dub *origin chauvinism* the category of view that holds out for some mystic difference (a difference of value, typically) due simply to such a fact about origin. Perfect imitation Château Plonque is exactly as good a wine as the real thing, counterfeit though it is, and the same holds for the fake Cezanne, if it is really indistinguishable by experts. And of course no person is intrinsically better or worse in any regard just for having or not having Cherokee (or Jewish, or African) 'blood'.

And to take a threadbare philosophical example, an atom-for-atom duplicate of a human being, an artefactual counterfeit of you, let us say, might not *legally* be you,

and hence might not be entitled to your belongings, or deserve your punishments, but the suggestion that such a being would not be a feeling, conscious, alive *person* as genuine as any born of woman is preposterous nonsense, all the more deserving of our ridicule because if taken seriously it might seem to lend credibility to the racist drivel with which it shares a bogus 'intuition'.

If consciousness abhors an artefact, it cannot be because being born gives a complex of cells a property (aside from that historic property itself) that it could not otherwise have 'in principle'. There might, however, be a question of practicality. We have just seen how, as a matter of exigent practicality, it could turn out after all that organic materials were needed to make a conscious robot. For similar reasons, it could turn out that any conscious robot had to be, if not born, at least the beneficiary of a longish period of infancy. Making a fully-equipped conscious adult robot might just be too much work. It might be vastly easier to make an initially unconscious or non-conscious 'infant' robot and let it 'grow up' into consciousness, more or less the way we all do. This hunch is not the disreputable claim that a certain sort of historic process puts a mystic stamp of approval on its product, but the more interesting and plausible claim that a certain sort of process is the only practical way of designing all the things that need designing in a conscious being.

Such a claim is entirely reasonable. Compare it to the claim one might make about the creation of Steven Spielberg's film, *Schindler's List*: it could not have been created entirely by computer animation, without the filming of real live actors. This impossibility claim must be false 'in principle', since every frame of that film is nothing more than a matrix of grey-scale pixels of the sort that computer animation can manifestly create, at any level of detail or 'realism' you are willing to pay for. There is nothing mystical, however, about the claim that it would be practically impossible to render the nuances of that film by such a bizarre exercise of technology. How much easier it is, practically, to put actors in the relevant circumstances, in a concrete simulation of the scenes one wishes to portray, and let them, via ensemble activity and re-activity, provide the information to the cameras that will then fill in all the pixels in each frame. This little exercise of the imagination helps to drive home just how much information there is in a 'realistic' film, but even a great film, such as *Schindler's List*, for all its complexity, is a simple, non-interactive artefact many orders of magnitude less complex than a conscious being.

When robot makers have claimed in the past that in principle they could construct 'by hand' a conscious

robot, this was a hubristic overstatement analogous to what Walt Disney might once have proclaimed: that his studio of animators could create a film so realistic that no one would be able to tell that it was a cartoon, not a 'live action' film. What Disney couldn't do in fact, computer animators still cannot do, perhaps only for the time being. Robot makers, even with the latest high-tech innovations, also fall far short of their hubristic goals, now and for the foreseeable future. The comparison serves to expose the likely source of the outrage so many sceptics feel when they encounter the manifestos of the 'Artificial Intelligentsia'. Anyone who seriously claimed that *Schindler's List* could in fact have been made by computer animation could be seen to betray an obscenely impoverished sense of what is conveyed in that film. An important element of the film's power is the fact that it *is* a film made by assembling human actors to portray those events, and that it is not actually the newsreel footage that its black-and-white format reminds you of. When one juxtaposes in one's imagination a sense of what the actors must have gone through to make the film with a sense of what the people who actually lived the events went through, this reflection sets up reverberations in one's thinking that draw attention to the deeper meanings of the film. Similarly, when robot enthusiasts proclaim the likelihood that they can simply *construct* a conscious robot, there is an understandable suspicion that they are simply betraying an infantile grasp of the subtleties of conscious life. (I hope I have put enough feeling into the condemnation to satisfy the sceptics.)

But however justified that might be in some instances as an *ad hominem* suspicion, it is simply irrelevant to the important theoretical issues. Perhaps no cartoon could be a great film, but they are certainly real films – and some are indeed good films; if the best the roboticists can hope for is the creation of some crude, cheesy, second-rate, artificial consciousness, they still win. Still, it is not a foregone conclusion that even this modest goal is reachable. If you want to have a defensible reason for claiming that no conscious robot will ever be created, you might want to settle for this:

4. Robots will always be much too simple to be conscious.

After all, a normal human being is composed of trillions of parts (if we descend to the level of the macromolecules), and many of these rival in complexity and design cunning the fanciest artefacts that have ever been created. We consist of billions of cells, and a single human

cell contains within itself complex ‘machinery’ that is still well beyond the artefactual powers of engineers. We are composed of thousands of different kinds of cells, including thousands of different species of symbiont visitors, some of whom might be as important to our consciousness as others are to our ability to digest our food! If all that complexity was needed for consciousness to exist, then the task of making a single conscious robot would dwarf the entire scientific and engineering resources of the planet for millennia. And who would pay for it?

If no other reason can be found, this may do to ground your scepticism about conscious robots in your future, but one shortcoming of this last reason is that it is scientifically boring. If this is the only reason that there won’t be conscious robots, then consciousness isn’t that special, after all. Another shortcoming with this reason is that it is dubious on its face. Everywhere else we have looked, we have found higher-level commonalities of function that permit us to substitute relatively simple bits for fiendishly complicated bits. Artificial heart valves work really very well, but they are orders of magnitude simpler than organic heart valves, heart valves born of woman or sow, you might say. Artificial ears and eyes that will do a serviceable (if crude) job of substituting for lost perceptual organs are visible on the horizon, and anyone who doubts they are possible in principle is simply out of touch. Nobody ever said a prosthetic eye had to see as keenly, or focus as fast, or be as sensitive to colour gradations as a normal human (or other animal) eye in order to ‘count’ as an eye. If an eye, why not an optic nerve (or acceptable substitute thereof), and so forth, all the way in?

Some (Searle 1992; Mangan 1993) have supposed, most improbably, that this proposed, regress would somewhere run into a non-fungible medium of consciousness, a part of the brain that could not be substituted on pain of death or zombiehood. Once the implications of that view are spelled out (Dennett 1993a,b), one can see that it is a non-starter. There is no reason at all to believe that any part of the brain is utterly irreplaceable by a prosthesis, provided we allow that some crudity, some loss of function, is to be expected in most substitutions of the simple for the complex. An artificial brain is, on the face of it, as ‘possible in principle’ as an artificial heart, just much, much harder to make and hook up. Of course once we start letting crude forms of prosthetic consciousness – like crude forms of prosthetic vision or hearing – pass our litmus tests for consciousness (whichever tests we favour) the way is open for another boring debate, over whether the phenomena in question are too crude to count.

The Cog Project: A Humanoid Robot

A much more interesting tack to explore, in my opinion, is simply to set out to make a robot that is theoretically interesting independent of the philosophical conundrum about whether it is conscious. Such a robot would have to perform a lot of the feats that we have typically associated with consciousness in the past, but we would not need to dwell on that issue from the outset. Maybe we could even learn something interesting about what the truly hard problems are without ever settling any of the issues about consciousness.

Such a project is now underway at MIT. Under the direction of Professors Rodney Brooks and Lynn Andrea Stein of the AI Lab, a group of bright, hard-working young graduate students are labouring as I write to create Cog, the most humanoid robot yet attempted, and I am happy to be a part of the Cog team. Cog is just about life-size – that is, about the size of a human adult. Cog has no legs, but lives bolted at the hips, you might say, to its stand; It has two human-length arms, however, with somewhat simple hands on the wrists. It can bend at the waist and swing its torso, and its head moves with three degrees of freedom just about the way yours does. It has two eyes, each equipped with both a foveal high-resolution vision area and a low-resolution wide-angle parafoveal vision area, and these eyes saccade at almost human speed. That is, the two eyes can complete approximately three fixations a second, while you and I can manage four or five. Your foveas are at the centre of your retinas, surrounded by the grainier low-resolution parafoveal areas; for reasons of engineering simplicity, Cog’s eyes have their foveas mounted above their wide-angle vision areas.

This is typical of the sort of compromise that the Cog team is willing to make. It amounts to a wager that a vision system with the foveas moved out of the middle can still work well enough not to be debilitating, and the problems encountered will not be irrelevant to the problems encountered in normal human vision. After all, nature gives us examples of other eyes with different foveal arrangements. Eagles have three different foveas in each eye, for instance, and rabbit eyes are another story altogether. Cog’s eyes won’t give it visual information exactly like that provided to human vision by human eyes (in fact, of course, it will be vastly degraded), but the wager is that this will be plenty to give Cog the opportunity

to perform impressive feats of hand-eye coordination, identification, and search. At the outset, Cog will not have colour vision.

Since its eyes are video cameras mounted on delicate, fast-moving gimbals, it might be disastrous if Cog were inadvertently to punch itself in the eye, so part of the hard-wiring that must be provided in advance is an 'innate' if rudimentary 'pain' or 'alarm' system to serve roughly the same protective functions as the reflex eye-blink and pain-avoidance systems hard-wired into human infants.

Cog will not be an adult at first, in spite of its adult size. It is being designed to pass through an extended period of artificial infancy, during which it will have to learn from experience, experience it will gain in the rough-and-tumble environment of the real world. Like a human infant, however, it will need a great deal of protection at the outset, in spite of the fact that it will be equipped with many of the most crucial safety systems of a living being. It has limit switches, heat sensors, current sensors, strain gauges, and alarm signals in all the right places to prevent it from destroying its many motors and joints. It has enormous 'funny bones' – motors sticking out from its elbows in a risky way. These will be protected from harm not by being shielded in heavy armour, but by being equipped with patches of exquisitely sensitive piezoelectric membrane 'skin' which will trigger alarms when they make contact with anything. The goal is that Cog will quickly 'learn' to keep its funny bones from being bumped – if Cog cannot learn this in short order, it will have to have this high-priority policy hard-wired in. The same sensitive membranes will be used on its fingertips and elsewhere, and, like human tactile nerves, the 'meaning' of the signals sent along the attached wires will depend more on what the central control system 'makes of them' than on their 'intrinsic' characteristics. A gentle touch, signalling sought-for contact with an object to be grasped, will not differ, as an information packet, from a sharp pain, signalling a need for rapid countermeasures. It all depends on what the central system is designed to do with the packet, and this design is itself indefinitely revisable – something that can be adjusted either by Cog's own experience or by the tinkering of Cog's artificers.

One of its most interesting 'innate' endowments will be software for visual face recognition. Faces will 'pop out' from the background of other objects as items of special interest to Cog. It will further be innately designed to 'want' to keep its 'mother's' face in view, and to work hard to keep 'mother' from turning away.

The role of mother has not yet been cast, but several of the graduate students have been tentatively tapped for this role. Unlike a human infant, of course, there is no reason why Cog can't have a whole team of mothers, each of whom is innately distinguished by Cog as a face to please if possible. Clearly, even if Cog really does have a *Lebenswelt*, it will not be the same as *ours*.

Decisions have not yet been reached about many of the candidates for hard-wiring or innate features. Anything that can learn must be initially equipped with a great deal of unlearned design. That is no longer an issue; no *tabula rasa* could ever be impressed with knowledge from experience. But it is also not much of an issue which features ought to be innately fixed, for there is a convenient trade-off. I haven't mentioned yet that Cog will actually be a multigenerational series of ever-improved models (if all goes well), but of course that is the way any complex artefact gets designed. Any feature that is not innately fixed at the outset, but does get itself designed into Cog's control system through learning, can then be lifted whole into Cog-II, as a new bit of innate endowment designed by Cog itself, or rather by Cog's history of interactions with its environment. So even in cases in which we have the best of reasons for thinking that human infants actually come innately equipped with pre-designed gear, we may choose to try to get Cog to learn the design in question, rather than be born with it. In some instances, this is laziness or opportunism – we don't really know what might work well, but maybe Cog can train itself up. This insouciance about the putative nature/nurture boundary is already a familiar attitude among neural net modellers, of course. Although Cog is not specifically intended to demonstrate any particular neural net thesis, it should come as no surprise that Cog's nervous system is a massively parallel architecture capable of simultaneously training up an indefinite number of special-purpose networks or circuits, under various regimes.

How plausible is the hope that Cog can retrace the steps of millions of years of evolution in a few months or years of laboratory exploration? Note first that what I have just described is a variety of Lamarckian inheritance that no organic lineage has been able to avail itself of. The acquired design innovations of Cog-I can be immediately transferred to Cog-II, a speed-up of evolution of tremendous, if incalculable, magnitude. Moreover, if you bear in mind that, unlike the natural case, there will be a team of overseers ready to make patches whenever obvious shortcomings reveal themselves, and to jog the

systems out of ruts whenever they enter them, it is not so outrageous a hope, in our opinion. But then, we are all rather outrageous people.

One talent that we have hopes of teaching to Cog is a rudimentary capacity for human language. And here we run into the fabled innate language organ or Language Acquisition Device (LAD) made famous by Noam Chomsky. Is there going to be an attempt to build an innate LAD for our Cog? No. We are going to try to get Cog to build language the hard way, the way our ancestors must have done, over thousands of generations. Cog has ears (four, because it's easier to get good localization with four microphones than with carefully shaped ears like ours) and some special-purpose signal-analysing software is being developed to give Cog a fairly good chance of discriminating human speech sounds, and probably the capacity to distinguish different human voices. Cog must also have speech synthesis hardware and software, of course, but decisions have not yet been reached about the details. It is important to have Cog as well-equipped as possible for rich and natural interactions with human beings, for the team intends to take advantage of as much free labour as it can. Untrained people ought to be able to spend time – hours if they like, and we rather hope they do – trying to get Cog to learn this or that. Growing into an adult is a long, time-consuming business, and Cog – and the team that is building Cog – will need all the help it can get.

Obviously this will not work unless the team manages somehow to give Cog a motivational structure that can be at least dimly recognized, responded to, and exploited by naive observers. In short, Cog should be as human as possible in its wants and fears, likes and dislikes. If those anthropomorphic terms strike you as unwarranted, put them in scare-quotes or drop them altogether and replace them with tedious neologisms of your own choosing: Cog, you may prefer to say, must have *goal-registrations* and *preference-functions* that map in rough isomorphism to human desires. This is so for many reasons, of course. Cog won't work at all unless it has its act together in a daunting number of different regards. It must somehow delight in learning, abhor error, strive for novelty, recognize progress. It must be vigilant in some regards, curious in others, and deeply unwilling to engage in self-destructive activity. While we are at it, we might as well try to make it crave human praise and company, and even exhibit a sense of humour.

Let me switch abruptly from this heavily anthropomorphic language to a brief description of Cog's initial

endowment of information-processing hardware. The computer-complex that has been built to serve as a development platform for Cog's artificial nervous system consists of four backplanes, each with 16 nodes; each node is basically a Mac-II computer – a 68332 processor with a megabyte of RAM. In other words, you can think of Cog's brain as roughly equivalent to 64 Mac-IIs yoked in a custom parallel architecture. Each node is itself a multi-processor, and they all run a special version of parallel Lisp developed by Rodney Brooks, and called, simply, L. Each node has an interpreter for L in its ROM, so it can execute L files independently of every other node.

Each node has six assignable input-output (i-o) ports, in addition to the possibility of separate i-o to the motor boards directly controlling the various joints, as well as the all-important i-o to the experimenters' monitoring and control system, the Front End Processor or FEP (via another unit known as the Interfep). On a bank of separate monitors, one can see the current image in each camera (two foveas, two parafoveas), the activity in each of the many different visual processing areas, or the activities of any other nodes. Cog is thus equipped at birth with the equivalent of chronically implanted electrodes for each of its neurons; all its activities can be monitored in real time, recorded, and debugged. The FEP is itself a Macintosh computer in more conventional packaging. At startup, each node is awakened by an FEP call that commands it to load its appropriate files of L from a file server. These files configure it for whatever tasks it has currently been designed to execute. Thus the underlying hardware machine can be turned into any of a host of different virtual machines, thanks to the capacity of each node to run its current program. The nodes do not make further use of disk memory, however, during normal operation. They keep their transient memories locally, in their individual megabytes of RAM. In other words, Cog stores both its genetic endowment (the virtual machine) and its long-term memory on disk when it is shut down, but when it is powered on, it first configures itself and then stores all its short-term memory distributed one way or another among its 64 nodes.

The space of possible virtual machines made available and readily explorable by this underlying architecture is huge, of course, and it covers a volume in the space of all computations that has not yet been seriously explored by artificial intelligence researchers. Moreover, the space of possibilities it represents is manifestly much more realistic as a space to build brains in than is the space heretofore explored, either by the largely serial architectures of

GOFAI ('Good Old Fashioned AI, Haugeland 1985), or by parallel architectures simulated by serial machines. Nevertheless, it is arguable that every one of the possible virtual machines executable by Cog is minute in comparison to a real human brain. In short, Cog has a tiny brain. There is a big wager being made: the parallelism made possible by this arrangement will be sufficient to provide real-time control of importantly humanoid activities occurring on a human time scale. If this proves to be too optimistic by as little as an order of magnitude, the whole project will be forlorn, and the motivating insight for the project is that by confronting and solving *actual, real time* problems of self-protection, hand-eye coordination, and interaction with other animate beings, Cog's artificers will discover the *sufficient* conditions for higher cognitive functions in general – and maybe even for a variety of consciousness that would satisfy the sceptics.

It is important to recognize that although the theoretical importance of having a body has been appreciated ever since Alan Turing (1950) drew specific attention to it in his classic paper, 'Computing machines and intelligence', within the field of Artificial Intelligence there has long been a contrary opinion that robotics is largely a waste of time, money, and effort. According to this view, whatever deep principles of organization make cognition possible can be as readily discovered in the more abstract realm of pure simulation, at a fraction of the cost. In many fields, this thrifty attitude has proven to be uncontroversial wisdom. No economists have asked for the funds to implement their computer models of markets and industries in tiny robotic Wall Streets or Detroits, and civil engineers have largely replaced their scale models of bridges and tunnels with computer models that can do a better job of simulating all the relevant conditions of load, stress, and strain. Closer to home, simulations of ingeniously oversimplified imaginary organisms foraging in imaginary environments, avoiding imaginary predators, and differentially producing imaginary offspring are yielding important insights into the mechanisms of evolution and ecology in the new field of Artificial Life. So it is something of a surprise to find this AI group conceding, in effect, that there is indeed something to the sceptics' claim (e.g. Dreyfus and Dreyfus 1986) that genuine embodiment in a real world is crucial to consciousness. Not, I hasten to add, because genuine embodiment provides some special vital juice that mere virtual-world simulations cannot secrete, but for the more practical reason – or hunch – that unless you saddle yourself with

all the problems of making a concrete agent take care of itself in the real world, you will tend to overlook, underestimate, or misconstrue the deepest problems of design.

Besides, as I have already noted, there is the hope that Cog will be able to design itself in large measure, learning from infancy, and building its own representation of its world in the terms that it innately understands. Nobody doubts that any agent capable of interacting intelligently with a human being on human terms must have access to literally millions if not billions of logically independent items of world knowledge. Either these must be hand-coded individually by human programmers – a tactic being pursued, notoriously, by Douglas Lenat and his CYC team in Dallas – or some way must be found for the artificial agent to learn its world knowledge from (real) interactions with the (real) world. The potential virtues of this shortcut have long been recognized within AI circles (e.g. Waltz 1988). The unanswered question is whether taking on the task of solving the grubby details of real-world robotics will actually permit one to finesse the task of hand-coding the world knowledge. Brooks, Stein and their team – myself included – are gambling that it will.

At this stage of the project, most of the problems being addressed would never arise in the realm of pure, disembodied AI. How many separate motors might be used for controlling each hand? They will have to be mounted somehow on the forearms. Will there then be room to mount the motor boards directly on the arms, close to the joints they control, or would they get in the way? How much cabling can each arm carry before weariness or clumsiness overcome it? The arm joints have been built to be compliant – springy, like your own joints. This means that if Cog wants to do some fine-fingered manipulation, it will have to learn to 'burn' some of the degrees of freedom in its arm motion by temporarily bracing its elbows or wrists on a table or other convenient landmark, just as you would do. Such compliance is typical of the mixed bag of opportunities and problems created by real robotics. Another is the need for self-calibration or re-calibration in the eyes. If Cog's eyes jiggle away from their preset aim, thanks to the wear and tear of all that sudden saccading, there must be ways for Cog to compensate, short of trying continually to adjust its camera-eyes with its fingers. Software designed to tolerate this probable sloppiness in the first place may well be more robust and versatile in many other ways than software designed to work in a more 'perfect' world.

Earlier I mentioned a reason for using artificial muscles, not motors, to control a robot's joints, and the example was not imaginary. Brooks is concerned that the sheer noise of Cog's skeletal activities may seriously interfere with the attempt to give Cog humanoid hearing. There is research underway at the AI Lab to develop synthetic electromechanical muscle tissues, which would operate silently as well as being more compact, but this would not be available for early incarnations of Cog. For an entirely different reason, thought is being given to the option of designing Cog's visual control software *as if* its eyes were moved by muscles, not motors, building in a software interface that amounts to giving Cog a set of *virtual* eye-muscles. Why might this extra complication in the interface be wise? Because the 'opponent-process' control system exemplified by eye-muscle controls is apparently a deep and ubiquitous feature of nervous systems, involved in control of attention generally and disrupted in such pathologies as unilateral neglect. If we are going to have such competitive systems at higher levels of control, it might be wise to build them in 'all the way down', concealing the final translation into electric-motor-talk as part of the backstage implementation, not the model.

Other practicalities are more obvious, or at least more immediately evocative to the uninitiated. Three huge red 'emergency kill' buttons have already been provided in Cog's environment, to ensure that if Cog happens to engage in some activity that could injure or endanger a human interactor (or itself), there is a way of getting it to stop. But what is the appropriate response for Cog to make to the KILL button? If power to Cog's motors is suddenly shut off, Cog will slump, and its arms will crash down on whatever is below them. Is this what we want to happen? Do we want Cog to drop whatever it is holding? What should 'Stop!' *mean* to Cog? This is a real issue about which there is not yet any consensus.

There are many more details of the current and anticipated design of Cog that are of more than passing interest to those in the field, but I want to use the remaining space to address some overriding questions that have been much debated by philosophers, and that receive a ready treatment in the environment of thought made possible by Cog. In other words, let's consider Cog merely as a prosthetic aid to philosophical thought-experiments, a modest but by no means negligible role for Cog to play.

Some Philosophical Considerations

A recent criticism of 'strong AI' that has received quite a bit of attention is the so-called problem of 'symbol grounding' (Harnad 1990). It is all very well for large AI programs to have data structures that *purport* to refer to Chicago, milk, or the person to whom I am now talking, but such imaginary reference is not the same as real reference, according to this line of criticism. These internal 'symbols' are not properly 'grounded' in the world, and the problems thereby eschewed by pure, non-robotic, AI are not trivial or peripheral. As one who discussed, and ultimately dismissed, a version of this problem many year's ago (Dennett 1969, p. 182ff), I would not want to be interpreted as now abandoning my earlier view. I submit that Cog moots the problem of symbol grounding, without having to settle its status as a criticism of 'strong AI'. Anything in Cog that might be a candidate for symbolhood will automatically be 'grounded' in Cog's real predicament, as surely as its counterpart in any child, so the issue doesn't arise, except as a practical problem for the Cog team, to be solved or not, as fortune dictates. If the day ever comes for Cog to comment to anybody about Chicago, the question of whether Cog is in any position to do so will arise for exactly the same reasons, and be resolvable on the same considerations, as the parallel question about the reference of the word 'Chicago' in the idiolect of a young child.

Another claim that has often been advanced, most carefully by Haugeland (1985), is that nothing could properly 'matter' to an artificial intelligence, and mattering (it is claimed) is crucial to consciousness. Haugeland restricted his claim to traditional GOFAI systems, and left robots out of consideration. Would he concede that something could matter to Cog? The question, presumably, is how seriously to weight the import of the quite deliberate decision by Cog's creators to make Cog as much as possible responsible for its own welfare. Cog will be equipped with some 'innate' but not at all arbitrary preferences, and hence provided of necessity with the concomitant capacity to be 'bothered' by the thwarting of those preferences, and 'pleased' by the furthering of the ends it was innately designed to seek. Some may want to retort: 'This is not *real* pleasure or pain, but merely a simulacrum.' Perhaps, but on what grounds will they defend this claim? Cog may be said to have quite crude, simplistic, one-dimensional pleasure and pain, cartoon pleasure and pain if you like, but then the same

might also be said of the pleasure and pain of simpler organisms – clams or houseflies, for instance. Most, if not all, of the burden of proof is shifted by Cog, in my estimation. The reasons for saying that something *does* matter to Cog are not arbitrary; they are exactly parallel to the reasons we give for saying that things matter to us and to other creatures. Since we have cut off the dubious retreats to vitalism or origin chauvinism, it will be interesting to see if the sceptics have any good reasons for declaring Cog's pains and pleasures not to matter – at least to it, and for that very reason, to us as well. It will come as no surprise, I hope, that more than a few participants in the Cog project are already musing about what obligations they might come to have to Cog, over and above their obligations to the Cog team.

Finally, J.R. Lucas (1994) has raised the claim that if a robot were really conscious, we would have to be prepared to believe it about its own internal states. I would like to close by pointing out that this is a rather likely reality in the case of Cog. Although equipped with an optimal suite of monitoring devices that will reveal the details of its inner workings to the observing team, Cog's own pronouncements could very well come to be

a more trustworthy and informative source of information on what was really going on inside it. The information visible on the banks of monitors, or gathered by the gigabyte on hard disks, will be at the outset almost as hard to interpret, even by Cog's own designers, as the information obtainable by such 'third-person' methods as MRI and CT scanning in the neurosciences. As the observers refine their models, and their understanding of their models, their authority as interpreters of the data may grow, but it may also suffer eclipse. Especially since Cog will be designed from the outset to redesign itself as much as possible, there is a high probability that the designers will simply lose the standard hegemony of the artificer ('I made it, so I know what it is supposed to do, and what it is doing now!'). Into this epistemological vacuum Cog may very well thrust itself. In fact, I would gladly defend the conditional prediction: *if* Cog develops to the point where it can conduct what appear to be robust and well-controlled conversations in something like a natural language, it will certainly be in a position to rival its own monitors (and the theorists who interpret them) as a source of knowledge about what it is doing and feeling, and why.

References

- Dennett, D.C. (1969). *Content and consciousness*. Routledge and Kegan Paul, London.
- Dennett, D.C. (1987). Fast thinking. In *The Intentional Stance* (ed. D.C. Dennett), pp. 323–37. MIT Press, Cambridge, MA.
- Dennett, D.C. (1993a). *The rediscovery of the mind*. Review of John Searle. *Journal of Philosophy*, **90**, 193–205.
- Dennett, D.C. (1993b). Caveat Emptor. *Consciousness and Cognition*, **2**, 48–57.
- Dreyfus, H. and Dreyfus, S. (1986). *Mind over machine*. MacMillan, New York.
- Harnad, S. (1990). The symbol grounding problem. *Physica D*, **42**, 335–46.
- Haugeland, J. (1985). *Artificial intelligence: the very idea*. MIT Press, Cambridge, MA.
- Lucas, J.R. (1994). Presentation to the Royal Society, Conference on Artificial Intelligence, April 14, 1994.
- Mangan, B. (1993). Dennett, consciousness, and the sorrows of functionalism. *Consciousness and Cognition*, **2**, 1–17.
- Searle, J. (1992). *The rediscovery of the mind*. MIT Press, Cambridge, MA.
- Turing, A. (1950). Computing machinery and intelligence. *Mind*, **59**, 433–60.
- Waltz, D. (1988). The prospects for building truly intelligent machines. *Daedalus*, **117**, 191–222.

Why Heideggerian AI Failed and How Fixing It Would Require Making It More Heideggerian

Hubert L. Dreyfus

1. Symbolic AI as a Degenerating Research Program

When I was teaching at MIT in the 1960s, students from the Artificial Intelligence Laboratory would come to my Heidegger course and say in effect: “You philosophers have been reflecting in your armchairs for over 2000 years and you still don’t understand intelligence. We in the AI Lab have taken over and are succeeding where you philosophers have failed.” But in 1963, when I was invited to evaluate the work of Alan Newell and Herbert Simon on physical, symbol systems, I found to my surprise that, far from replacing philosophy, these pioneering researchers had learned a lot, directly and indirectly, from us philosophers: e.g., Hobbes’ claim that reasoning was calculating, Descartes’ mental representations, Leibniz’s idea of a ‘universal characteristic’ (a set of primitives in which all knowledge could be expressed), Kant’s claim that concepts were rules, Frege’s formalization of such rules, and Wittgenstein’s postulation of logical atoms in his *Tractatus*. In short, without realizing it, AI researchers were hard at work turning rationalist philosophy into a research program.

But I began to suspect that the insights formulated in existentialist armchairs, especially Heidegger’s and

Merleau-Ponty’s, were bad news for those working in AI laboratories – that, by combining representationalism, conceptualism, formalism, and logical atomism into a research program, AI researchers had condemned their enterprise to reenact a failure. Using Heidegger as a guide, I began looking for signs that the whole AI research program was degenerating. I was particularly struck by the fact that, among other troubles, researchers were running up against the problem of representing significance and relevance – a problem that Heidegger saw was implicit in Descartes’ understanding of the world as a set of meaningless facts to which the mind assigned values, which John Searle now calls function predicates.

Heidegger warned that values are just more meaningless facts. To say a hammer has the function, hammering, leaves out the defining relation of hammers to nails and other equipment, to the point of building things, to the skill required in actually using a hammer, etc. – all of which Heidegger called “readiness-to-hand” – so attributing functions to brute facts couldn’t capture the meaningful organization of the everyday world and so missed the way of being of equipment. “By taking refuge in ‘value’-characteristics,” Heidegger said, “we are ... far from even catching a glimpse of being as readiness-to-hand” (Heidegger, 1962, pp. 132–133).

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Head of MIT's AI Lab, Marvin Minsky, unaware of Heidegger's critique, was convinced that representing a few million facts about objects including their functions, would solve what had come to be called the commonsense knowledge problem. It seemed to me, however, that the real problem wasn't storing millions of facts; it was knowing which facts were relevant in any given situation. One version of this relevance problem is called the 'frame problem.' If the computer is running a representation of the current state of the world and something in the world changes, how does the program determine which of its represented facts can be assumed to have stayed the same, and which might have to be updated?

As Michael Wheeler puts it in *Reconstructing the Cognitive World*:

Given a dynamically changing world, how is a nonmagical system ... to take account of those state changes in that world ... that matter, and those unchanged states in that world that matter, while ignoring those that do not? And how is that system to retrieve and (if necessary) to revise, out of all the beliefs that it possesses, just those beliefs that are relevant in some particular context of action? (Wheeler, 2005, p. 179)

Minsky suggested as a solution that AI programmers could use descriptions of typical situations like going to a birthday party to list and organize those, and only those, facts that were normally relevant. He suggested a structure of essential features and default assignments – a structure Husserl had already proposed and called a "frame" (Husserl, 1973, p. 38).¹

But a system of frames isn't *in* a situation, so in order to identify the possibly relevant facts in the current situation one would need a frame for recognizing that situation, etc. It thus seemed to me obvious that any AI program using frames was going to be caught in a regress of frames for recognizing relevant frames for recognizing relevant facts, and that, therefore, the commonsense knowledge storage and retrieval problem wasn't just a *problem*; it was a sign that something was seriously wrong with the whole approach.

Unfortunately, what has always distinguished AI research from a science is its failure to face up to, and learn from, its failures. To avoid the relevance problem, AI programmers in the 1960s and early 1970s limited their programs to what they called 'micro-worlds' – artificial situations in which the small number of features that were possibly relevant was determined beforehand. It was assumed that the techniques used to construct

these micro-worlds could be made more realistic and generalized to cover commonsense knowledge – but there were no successful follow-ups, and the frame problem remains unsolved.

John Haugeland argues that symbolic AI has failed and refers to it as "Good Old Fashioned AI" (GOFAI). That name has been widely accepted as capturing symbolic AI's current status. Michael Wheeler goes further, arguing that a new paradigm is already taking shape: "A Heideggerian cognitive science is ... emerging right now, in the laboratories and offices around the world where embodied-embedded thinking is under active investigation and development" (Wheeler, 2005, p. 285).

Wheeler's well informed book could not have been more timely since there are now at least three versions of supposedly Heideggerian AI that might be thought of as articulating a new paradigm for the field: Rodney Brooks' behaviorist approach at MIT, Phil Agre's pragmatist model, and Walter Freeman's dynamic neural model. All three approaches accept Heidegger's critique of Cartesian internalist representationalism, and, instead, embrace John Haugeland's slogan that cognition is "embedded and embodied" (Haugeland, 1998).

2. Heideggerian AI, Stage One: Eliminating Representations by Building Behavior-Based Robots

Winograd (1989) notes the irony in the MIT AI Lab's becoming a cradle of "Heideggerian AI" after its initial hostility to my presentation of these ideas (as cited in Dreyfus, 1992, p. xxxi). Here's how it happened. In March 1986, the MIT AI Lab under its new director, Patrick Winston, reversed Minsky's attitude toward me and allowed, if not encouraged, several graduate students to invite me to give a talk I called "Why AI Researchers should study *Being and Time*." There I repeated the Heideggerian message of my *What Computers Can't Do*: "The meaningful objects ... among which we live are not a *model* of the world stored in our mind or brain; *they are the world itself*" (Dreyfus, 1972, pp. 265–266).

The year of my talk, Rodney Brooks published a paper criticizing the GOFAI robots that used representations of the world and problem solving techniques to plan their movements. He reported that, based on the idea that "the best model of the world is the world itself," he had "developed a different approach in which a

mobile robot uses the world itself as its own representation – continually referring to its sensors rather than to an internal world model” (Brooks, 1997b, p. 416). Looking back at the frame problem, he says: “And why could my simulated robot handle it? Because it was using the world as its own model. It never referred to an internal description of the world that would quickly get out of date if anything in the real world moved” (Brooks, 2002, p. 42). Although he doesn’t acknowledge the influence of Heidegger directly (and even denies it in 1997b, p. 415), Brooks gives me credit for “being right, about many issues such as the way in which people operate in the world is intimately coupled to the existence of their body” (Brooks, 2002, p. 168).

Brooks’ approach is an important advance, but his robots respond only to *fixed features* of the environment, not to context or changing significance. They are like ants, and Brooks aptly calls them “animats.” Brooks thinks he does not need to worry about learning, putting it off as a concern of possible future research. But by operating in a fixed world and responding only to the small set of possibly relevant features that their receptors can pick up, Brooks’ animats beg the question of changing relevance and so finesse rather than solve the frame problem.

Merleau-Ponty’s work, on the contrary, offers a nonrepresentational account of the way the body and the world are coupled that suggests a way of avoiding the frame problem. What the learner acquires through experience is not *represented* at all but is *presented* to the learner as more and more finely discriminated situations, and, if the situation does not clearly solicit a single response or if the response does not produce a satisfactory result, the learner is led to further refine his discriminations, which, in turn, solicit more refined responses. For example, what we have learned from our experience of finding our way around in a city is sedimented in how that city *looks* to us. Merleau-Ponty calls this feedback loop between the embodied agent and the perceptual world the “intentional arc” (Merleau-Ponty, 1962, p. 136).

Brooks comes close to a basic insight spelled out by Merleau-Ponty (1966), namely that intelligence is founded on and presupposes the more basic way of coping we share with animals: “The ‘simple’ things concerning perception and mobility in a dynamic environment ... are a necessary basis for ‘higher-level’ intellect Therefore, I proposed looking at simpler animals as a bottom-up model for building intelligence” (Brooks, 1997b, p. 418). Surprisingly, the modesty Brooks exhibited in choosing to first construct simple insect-like devices did not deter

Brooks and Daniel Dennett from deciding to leap ahead and “[embark] on a long-term project to design and build a humanoid robot, Cog, whose cognitive talents will include speech, eye-coordinated manipulation of objects, and a host of self-protective, self-regulatory and self-exploring activities” (Dennett, 1994, p. 133).

Of course, the “long term project” was short lived. Cog failed to achieve any of its goals and is already in a museum.² But, as far as I know, neither Dennett nor anyone connected with the project has published an account of the failure and asked what mistaken assumptions underlay their absurd optimism. In a personal communication, Dennett blamed the failure on a lack of graduate students and claimed “Progress was being made on all the goals, but slower than had been anticipated.” If progress was actually being made the graduate students wouldn’t have left, or others would have continued to work on the project. Clearly some specific assumptions must have been mistaken, but all we find in Dennett’s assessment is the implicit assumption that human intelligence is on a continuum with insect intelligence, and that therefore adding a bit of complexity to what has already been done with animats counts as progress toward humanoid intelligence. At the beginning of AI research, Yehoshua Bar-Hillel called this way of thinking the first-step fallacy, and my brother at RAND quipped, “it’s like claiming that the first monkey that climbed a tree was making progress towards flight to the moon.”

In contrast to Dennett’s assessment, Brooks is prepared to entertain the possibility that he is barking up the wrong tree, making the sober comment that:

Perhaps there is a way of looking at biological systems that will illuminate an inherent necessity in some aspect of the interactions of their parts that is completely missing from our artificial systems ... perhaps at this point we simply do not *get it*, and that there is some fundamental change necessary in our thinking in order that we might build artificial systems that have the levels of intelligence, emotional interactions, long term stability and autonomy, and general robustness that we might expect of biological systems. (Brooks, 1997a, p. 301)

Heidegger and Merleau-Ponty would say that, in spite of the breakthrough of giving up internal symbolic representations, Brooks, indeed, doesn’t get it – that what AI researchers have to face and understand is not only why our everyday coping couldn’t be understood in terms of inferences from symbolic representations, as Minsky’s intellectualist approach assumed, but also why

it can't be understood in terms of responses caused by fixed features of the environment, as in Brooks' empiricist approach. AI researchers need to consider the possibility that embodied beings like us take as input energy from the physical universe and respond in such a way as to open them to a world organized in terms of their needs, interests, and bodily capacities, without their *minds* needing to impose meaning on a meaningless given, as Minsky's frames require, nor their *brains* converting stimulus input into reflex responses, as in Brooks' animats.

Later I'll suggest that Walter Freeman's neurodynamics offers a radically new basis for a Heideggerian/Merleau-Pontian approach to human intelligence – an approach compatible with physics and grounded in the neuroscience of perception and action. But first we need to examine another approach to AI contemporaneous with Brooks' that actually calls itself Heideggerian.

3. Heideggerian AI, Stage 2: Programming the Ready-To-Hand

In my talk at the MIT AI Lab, I introduced Heidegger's nonrepresentational account of the relation of Dasein (human being) and the world. I also explained that Heidegger distinguished two modes of being: the *readiness-to-hand* of equipment when we are involved in using it, and the *presence-at-hand* of objects when we contemplate them. Out of that explanation and the lively discussion that followed, grew the second type of Heideggerian AI—the first to acknowledge its lineage.

This new approach took the form of Phil Agre's and David Chapman's program, *Pengi*, which guided a virtual agent playing a computer game called *Pengo*, in which the player and penguins kick large and deadly blocks of ice at each other (Agre, 1988, Ch. AI, part Ala, p. 9). Agre's approach, called "interactionism," was more self-consciously Heideggerian than Brooks' in that Agre tried explicitly to capture "Heidegger's phenomenological analysis of routine activity" (Agre, 1997, p. 5).

Agre's interesting new idea is that the world of the game in which the Pengi agent acts is made up, not of present-at-hand objects with properties, but of possibilities for action that trigger appropriate responses from the agent. To program this situated approach Agre used what he called "deictic representations." He tells us: "This proposal is based on a rough analogy with Heidegger's analysis of everyday intentionality in Division I of *Being and Time*, with objective intentionality corresponding to the present-

at-hand and deictic intentionality corresponding to the ready-to-hand" (Agre, 1997, p. 332). And he explains: "[Deictic representations] designate, not a particular object in the world, but rather a role that an object might play in a certain time-extended pattern of interaction between an agent and its environment. Different objects might occupy this role at different times, but the agent will treat all of them in the same way" (Agre, 1997, p. 251).

Looking back on my talk at MIT and rereading Agre's book, I now see that, in a way, Agre understood Heidegger's account of readiness-to-hand better than I did at the time. I thought of the ready-to-hand as a special class of *entities*, viz. equipment, whereas the Pengi program treats what the agent responds to purely as *functions*. For Heidegger and Agre the ready-to-hand is not a *what* but a *for-what*.³

As Agre saw, Heidegger wants to get at something more basic than simply a class of objects defined by their use. At his best, Heidegger would, I think, deny that a hammer in a drawer has readiness-to-hand as its way of being. Rather, he sees that, *for the user*, equipment is a solicitation to act, not an entity with a function feature. Heidegger also notes that to observe a hammer or to observe ourselves hammering undermines our skillful coping. We can and do observe our surroundings while we cope, and sometimes, if we are learning, monitoring our performance as we learn improves our performance in the long run, but, in the short run, such attention interferes with our performance.

Heidegger struggles to describe the special, and he claims, basic, way of being he calls the ready-to-hand. The Gestaltists would later talk of "solicitations." In *Phenomenology of Perception*, Merleau-Ponty speaks of "motivations," and later, of "the flesh." All these terms point at what is not objectifiable – a situation's way of drawing one into it. Indeed, in his 1925 course, *Logic: The Question of Truth*, Heidegger describes our most basic experience of what he later calls "pressing into possibilities" not as dealing with the desk, the door, the lamp, the chair and so forth, but as directly responding to a "what for":

What is first of all "given" ... is the "for writing," the "for going in and out," the "for illuminating," the "for sitting." That is, writing, going-in-and-out, sitting, and the like are what we are a priori involved with. What we know when we "know our way around" and what we learn are these "for-what's." (1976, p. 144; for the translation, see Heidegger, 2010.)

It's clear here, unlike what some people take Heidegger to suggest in *Being and Time*, that this basic experience has no as-structure. That is, when absorbed in coping,

I can be described *objectively* as using the door *as* a door, but I'm not *experiencing* the door *as* a door. In coping at my best, I'm not *experiencing the door* at all but simply pressing into the possibility of going out. The important thing to realize is that, when we are pressing into possibilities, there is no experience of an *entity* doing the soliciting; just the solicitation. Such solicitations disclose the world on the basis of which we sometimes do step back and perceive things *as* things.

But Agre's Heideggerian AI did not try to program this experiential aspect of being drawn in by an affordance. Rather, with his deictic representations, Agre *objectified* both the functions and their situational relevance for the agent. In *Pengi*, when a virtual ice cube defined by its function is close to the virtual player, a rule dictates the response (e.g., kick it). No skill is involved and no learning takes place.

So Agre had something right that I was missing – the transparency of the ready-to-hand – but he nonetheless fell short of being fully Heideggerian. For Heidegger the ready-to-hand is not a fixed function, encountered in a predefined type of situation that triggers a predetermined response that either succeeds or fails. Rather, as we have begun to see and will, soon see further, readiness-to-hand is experienced as a solicitation that calls forth a flexible response to the *significance* of the current situation – a response which is experienced as either improving the situation or making it worse.

Moreover, although he proposed to program Heidegger's account of everyday routine activities, Agre doesn't even try to account for how our experience feeds back and changes our sense of the significance of the next situation and what is relevant in *it*. In putting his virtual agent in a virtual world where all possibly relevance is determined beforehand, Agre doesn't account for how we learn to respond to new relevancies, and so, like Brooks, he finesses rather than solves the frame problem. Thus, sadly, his Heideggerian AI turned out to be a dead end. Happily, however, Agre never claimed he was making progress towards building a human being.

4. Pseudo Heideggerian AI: Situated Cognition and the Embedded, Embodied, Extended Mind

Wheeler (2005) praises me for putting the confrontation between Cartesian and Heideggerian ontologies to the test in the empirical realm. Wheeler claims, however, that

I only made negative predictions about the viability of GOFAI and cognitive science research programs. The time has come, he says, for a positive Heideggerian approach and that the emerging embodied-embedded paradigm in the field is a thoroughly Heideggerian one.

As if taking up from where Agre left off with his objectified version of the ready-to-hand, Wheeler tells us: "Our global project requires a defense of action-oriented representation. . . . action-oriented representation may be interpreted as the subagential reflection of online practical problem solving, as conceived by the Heideggerian phenomenologist. Embodied-embedded cognitive science is implicitly a Heideggerian venture" (Wheeler, 2005, pp. 222–223). He further notes: "As part of its promise, this nascent, Heideggerian paradigm would need to indicate that it might plausibly be able either to solve or to dissolve the frame problem" (p. 187). And he suggests: "The good news for the reoriented Heideggerian is that the kind of evidence called for here may already exist in the work of recent *embodied-embedded cognitive science*" (Wheeler, 2005, p. 188). He concludes:

Let's be clear about the general relationships at work here. Dreyfus is right that the philosophical impasse between a Cartesian and a Heideggerian metaphysics can be resolved empirically via cognitive science. However, he looks for resolution in the wrong place. For it is not any alleged empirical failure on the part of orthodox cognitive science, but rather the concrete empirical success of a cognitive science with Heideggerian credentials, that, if sustained and deepened, would ultimately vindicate a Heideggerian position in cognitive theory. (Wheeler, 2005, pp. 188–189)

I agree it is time for a positive account of how Heideggerian AI and an underlying Heideggerian neuroscience could solve the frame problem, but I think Wheeler is the one looking in the wrong place. Merely in supposing that Heidegger is concerned with subagential *problem solving* and action oriented *representations*, Wheeler's project reflects not a step beyond Agre but a regression to pre-Brooks GOFAI. Heidegger, indeed, claims that that skillful coping is basic, but he is also clear that, all coping takes place on the background coping he calls "being-in-the world" which doesn't involve any form of representation at all.⁴

Wheeler's cognitivist misreading of Heidegger leads to an overestimation of the importance of Clark and Chalmers' (1998) attempt to free us from the Cartesian idea that the mind is essentially inner by pointing out that in thinking we sometimes make use of external artifacts like pencil, paper, and computers. Unfortunately,

this argument for the extended mind preserves the Cartesian assumption that our basic way of relating to the world is by using representations such as beliefs and memories, be they in the mind or in notebooks in the world. In effect, while Brooks and Agre dispense with representations where coping is concerned, all Clark, Chalmers, and Wheeler give us as a supposedly radical new Heideggerian approach to the human way of being in the world is the observation that memories and beliefs are not necessarily *inner* entities and that, therefore, *thinking bridges the distinction between inner and outer representations*.⁵

Heidegger's important insight is not that, when we solve problems, we sometimes make use of representational equipment outside our bodies, but that *being-in-the-world* is more basic than *thinking* and solving problems; it is not representational at all. That is, when we are coping at our best, we are drawn in by solicitations and respond directly to them, so that the distinction between us and our equipment vanishes. As Heidegger sums it up: "I *live* in the understanding of writing, illuminating, going-in-and-out, and the like. More precisely: as Dasein I am – in speaking, going, and understanding – an act of understanding dealing-with. My being in the world *is* nothing other than this already-operating-with-understanding in this mode of being" (Heidegger, 1976, p. 146).⁶

Heidegger's and Merleau-Ponty's understanding of embedded-embodied coping, therefore, is not that the *mind* is sometimes *extended into the world* but rather that, in our most basic way of being – i.e., as skillful copers – we are not minds at all but *one with the world*. Heidegger sticks to the phenomenon, when he says that, in its most basic way of being, "Dasein is its world existingly" (Heidegger, 1962, p. 416). (To make sense of this slogan, it's important to be clear that Heidegger distinguishes the human *world* from the physical *universe*.)

When you stop thinking that mind is what characterizes us most basically but, rather, that most basically we are absorbed copers, the inner-outer distinction becomes problematic. There's no easily askable question about where the absorbed coping is – in me or in the world. Thus, for a Heideggerian all forms of *cognitivist* externalism presuppose a more basic *existentialist* externalism where even to speak of "externalism" is misleading since such talk presupposes a contrast with the internal. Compared to this genuinely Heideggerian view, extended-mind externalism is contrived, trivial, and irrelevant.

5. What Motivates Embedded-Embodied Coping?

But why is Dasein called to cope at all? According to Heidegger, we are constantly solicited to improve our familiarity with the world: "Caring takes the form of a looking around and seeing, and as this circumspective caring it is at the same time anxiously concerned about developing its circumspection, that is, about *securing and expanding* its *familiarity* with the objects of its dealings" (2002, p. 115).⁷ This pragmatic perspective is developed by Merleau-Ponty, and by Samuel Todes (2001). These heirs to Heidegger's account of familiarity and coping describe how an organism, animal or human, interacts with what is objectively speaking the meaningless physical universe in such a way as to experience it as an environment organized in terms of what that organism needs in order to find its way around. All such coping beings are motivated to get a more and more refined and secure sense of their environment and of the specific objects of their dealings. According to Merleau-Ponty (1962): "My body is geared into the world when my perception presents me with a spectacle as varied and as clearly articulated as possible. . . . (p. 250, translation modified).

In short, in our skilled activity we are drawn to move so as to achieve a better and better grip on our situation. For this movement towards maximal grip to take place, one doesn't need a mental representation of one's goal nor any subagential problem solving as would a GOFAI robot. Rather, acting is experienced as a steady flow of skillful activity in response to one's sense of the situation. When one's situation deviates from some optimal body-environment gestalt, one's activity takes one closer to that optimum and thereby relieves the "tension" of the deviation. One does not need to know what that optimum is in order to move towards it. One's body is simply solicited by the situation to lower the tension. As Merleau-Ponty puts it: "Our body is not an object for an 'I think', it is a grouping of lived-through meanings that moves towards its equilibrium" (Merleau-Ponty, 1962, p. 153).

6. Modeling Situated Coping as a Dynamical System

Describing the phenomenon of everyday coping as being "geared into" the world and moving towards "equilibrium" suggests a *dynamic* relation between the

cooper and the environment. Timothy van Gelder calls this dynamic relation “coupling,” explaining its importance as follows:

The post-Cartesian agent manages to cope with the world without necessarily representing it. A dynamical approach suggests how this might be possible by showing how the internal operation of a system interacting with an external world can be so subtle and complex as to *defy* description in representational terms – how, in other words, cognition can *transcend* representation, (van Gelder, 1997, p. 448)

Van Gelder shares with Brooks the idea that thought is grounded in a more basic relation of agent and world. As van Gelder puts it: “Cognition can, in sophisticated cases, involve representation and sequential processing; but such phenomena are best understood as emerging from a dynamical substrate, rather than as constituting the basic level of cognitive performance” (van Gelder, 1997, p. 439). This dynamical substrate is precisely the subagential causal basis of the skillful coping first described by Heidegger and worked out in detail by Merleau-Ponty.

Van Gelder importantly contrasts the rich interactive temporality of real-time online coupling of coper and world with the austere step by step temporality of thought. Wheeler helpfully explains:

Whilst the computational architectures proposed within computational cognitive science require that inner events happen in the right order, and (in theory) fast enough to get a job done, there are, in general, no constraints on how long each operation within the overall cognitive process takes, or on how long the gaps between the individual operations are. Moreover, the transition events that characterize those inner operations are not related in any systematic way to the real-time dynamics of either neural biochemical processes, non-neural bodily events, or environmental phenomena (dynamics which surely involve rates and rhythms). (Wheeler, 2002, p. 345)

Computation is thus paradigmatically austere. Wheeler adds: “Turing machine computing is digital, deterministic, discrete, effective (in the technical sense that behavior is always the result of an algorithmically specified finite number of operations), and temporally austere (in that time is reduced to mere sequence)” (Wheeler, 2002, pp. 344–345).

Ironically, Wheeler’s highlighting the contrast between rich and austere temporality enables us to see clearly that

his appeal to extended minds as a Heideggerian response to Cartesianism leaves out the essential embodied embedding. Clark and Chalmers’ examples of extended minds dealing with representations are clearly a case of computational austerity – no rates and rhythms are involved. Wheeler is aware of this possible objection to his backing of both the *dynamical systems* model and the *extended mind* approach. He asks: “What about the apparent clash between continuous reciprocal causation and action orientated representations? On the face of it this clash is a worry for our emerging cognitive science” (Wheeler, 2005, p. 280). But instead of facing up to the incompatibility of these two opposed models of ground level intelligence, Wheeler suggests that we must somehow combine them and that “this is the biggest of the many challenges that lie ahead” (p. 280).

Wheeler’s ambivalence as to which model is more basic, the representational or the dynamic, undermines his Heideggerian approach. For, as Wheeler himself sees, the Heideggerian claim is that action-oriented coping, as long as it is involved (online, Wheeler would say), is not representational at all and does not involve any problem solving, and that all representational problem solving takes place later offline.⁸ Showing in detail how the representational un-ready-to-hand in all its forms is derivative from the nonrepresentational ready-to-hand is exactly the Heideggerian project. It requires a basic choice of ontology, phenomenology, and brain model, between a cognitivist model that gives a basic role to representations, and a dynamical model like Merleau-Ponty’s and van Gelder’s that denies a basic role to any sort of representation – even action oriented ones – and gives a primordial place to equilibrium and in general to rich coupling.

Ultimately, we have to choose which sort of AI and which sort of neuroscience to back, and so we are led to the questions: could the brain in its causal support of our active coping instantiate a richly coupled dynamical system, and is there any evidence it actually does so? If so, could this coupling be modeled on a digital computer to give us Heideggerian AI?

7. Walter Freeman’s Heideggerian/ Merleau-Pontian Neurodynamics

We have seen that our experience of the everyday world is organized in terms of significance and relevance and that this significance can’t be constructed by giving

meaning to brute facts – both because we don't experience brute facts and, even if we did, no value predicate could do the job of giving them situational significance. Yet, all that the organism can receive as input is mere physical energy. How can such senseless physical stimulation be experienced directly as significant? If we can't answer this question, the phenomenological observation that the world is its own best representation, and that the significance we find in our world is constantly enriched by our experience in it, seems to require that the brain be what Dennett derisively calls "wonder tissue."

Fortunately, there is at least one model of how the brain could provide the causal basis for the intentional arc. Walter Freeman, a founding figure in neuroscience and the first to take seriously the idea of the brain as a nonlinear dynamical system, has worked out an account of how the brain of an active animal can find and augment significance in its world. On the basis of years of work on olfaction, vision, touch, and hearing in alert and moving rabbits, Freeman proposes a model of rabbit learning based on the coupling of the brain and the environment. [...]

Freeman (2000) claims his read out from the rabbit's brain shows that each learning experience that is significant in a new way sets up a new attractor and rearranges all the other attractor basins in the landscape:

I have observed that brain activity patterns are constantly dissolving, reforming and changing, particularly in relation to one another. When an animal learns to respond to a new odor, there is a shift in all other patterns, even if they are not directly involved with the learning. There are no fixed representations, as there are in [GOFAL] computers; there are only significances. (Freeman, 2000, p. 22)

Freeman (1995) adds:

I conclude that context dependence is an essential property of the cerebral memory system, in which each new experience must change all of the existing store by some small amount, in order that a new entry be incorporated and fully deployed in the existing body of experience. This property contrasts with memory stores in computers ... in which each item is positioned by an address or a branch of a search tree. There, each item has a compartment, and new items don't change the old ones. Our data indicate that in brains the store has no boundaries or compartments.... Each new state transition ... initiates the construction of a local pattern that impinges on and modifies the whole intentional structure. (Freeman, 1995, p. 99)

The whole constantly updated pattern of attractors is correlated with the agent's experience of the changing significance of things in the world. Merleau-Ponty likewise concludes that, thanks to the intentional arc, no two experiences of the world are ever exactly alike.

The important point is that Freeman offers a model of learning which is not an associationist model according to which, as one learns, one adds more and more fixed connections, nor a cognitivist model based on offline representations of objective facts about the world that enable offline inferences as to which facts to expect next, and what they mean. Rather, Freeman's model instantiates a genuine intentional arc according to which there are no linear casual connections nor a fixed library of data, but where, each time a new significance is encountered, the whole perceptual world of the animal changes so that significance as directly displayed is contextual, global, and continually enriched. [...]

Such systems are self-organizing. Freeman explains:

Macroscopic ensembles exist in many materials, at many scales in space and time, ranging from ... weather systems such as hurricanes and tornadoes, even to galaxies. In each case, the behavior of the microscopic elements or particles is constrained by the embedding ensemble, and microscopic behavior cannot be understood except with reference to the macroscopic patterns of activity. (Freeman, 2000, p. 52)

Thus, the cortical field controls the neurons that create the field. In Freeman's terms, in this sort of circular causality the overall activity "enslaves" the elements. As he emphasizes:

Having attained through dendritic and axonal growth a certain density of anatomical connections, the neurons cease to act individually and start participating as part of a group, to which each contributes and from which each accepts direction The activity level is now determined by the population, not by the individuals. This is the first building block of neurodynamics. (Freeman, 2000, p. 53)

Given the way the whole brain can be tuned by past experience to influence individual neuron activity, Freeman can claim: "Measurements of the electrical activity of brains show that dynamical states of Neuroactivity emerge like vortices in a weather system, triggered by physical energies impinging onto sensory receptors. ... These dynamical states determine the structures of intentional actions" (Freeman, 1995, p. 111). Merleau-Ponty seems to anticipate Freeman's neurodynamics

when he says: “It is necessary only to accept the fact that the physico-chemical actions of which the organism is in a certain manner composed, instead of unfolding in parallel and independent sequences, are constituted ... in relatively stable ‘vortices’” (Merleau-Ponty, 1966, p. 153).

In its dynamic coupling with the environment the brain tends towards equilibrium but continually (discontinuously) switching from one attractor basin to another. The discreteness of these global state transitions from one attractor basin to another makes it possible to model the brain’s activity on a computer. Freeman notes that: “At macroscopic levels each perceptual pattern of Neuroactivity is discrete, because it is marked by state transitions when it is formed and ended.... I conclude that brains don’t use numbers as symbols, but they do use discrete events in time and space, so we can represent them ... by numbers in order to model brain states with digital computers” (Freeman, 1995, p. 105). That is, the computer can model the input and the series of discrete transitions from basin to basin they trigger in the brain, thereby modeling how, on the basis of past experiences of success or failure, physical input acquires significance for the organism. When one actually programs such a model of the brain as a dynamic physical system, one has an explanation of how the brain does what Merleau-Ponty thinks the brain must be doing, and, since Merleau-Ponty is working out of Heidegger’s ontology, one has developed Freeman’s neurodynamics into Heideggerian AI.

Freeman has actually programmed his model of the brain as a dynamic physical system, and so claims to have shown what the brain is doing to provide the material substrate for Heidegger’s and Merleau-Ponty’s phenomenological account of everyday perception and action. This may well be the new paradigm for the cognitive sciences that Wheeler proposes to present in *his book* but which he fails to find. It would show how the emerging embodied-embedded approach could be a step towards a genuinely existential AI. Although, as we shall see, it would still be a very long way from programming human intelligence. Meanwhile, the job of phenomenologists is to get clear concerning the phenomena that must be explained. That would include an account of how human beings, unlike the so-called Heideggerian computer models we have discussed, don’t just ignore the frame problem nor solve it, but show why it doesn’t occur.

Time will tell whether Freeman’s Merleau-Pontian model is on the right track for explaining how the brain finds and feeds back significance into the meaningless

physical universe. Only then will we find out if one can actually produce intelligent behavior by programming a model of the physical state transitions taking place in the brain. That would be the positive Heideggerian contribution to the cognitive sciences that Wheeler proposes to present but foils to find. It would show how the emerging embodied-embedded approach, when fully understood, could, indeed, be a step towards a genuinely Heideggerian AI. Meanwhile, the job of phenomenologists is to get clear concerning the phenomena that need to be explained. That includes an account of how *we*, unlike classical representational computer models, avoid the frame problem.

8. How Would Heideggerian AI Dissolve the Frame Problem?

As we have seen, Wheeler rightly thinks that the simplest test of the viability of any proposed AI program is whether it can solve the frame problem. We’ve also seen that the two current supposedly Heideggerian approaches to AI avoid the frame problem. Brooks’ empiricist/behaviorist approach in which the environment directly causes responses avoids it by leaving out significance and learning altogether, while Agre’s action-oriented approach, which includes only a small fixed set of possibly relevant responses, fails to face the problem of changing relevance.

Wheeler’s approach, however, by introducing flexible action-oriented *representations*, like any representational approach, has to face the frame problem head on. To see why, we need only slightly revise his statement of the problem (quoted earlier), substituting ‘representation’ for ‘belief’: “Given a dynamically changing world, how is a nonmagical system ... to retrieve and (if necessary) to revise, out of all the *representations* that it possesses, just those *representations* that are relevant in some particular context of action?” (Wheeler, 2005, p. 179). Wheeler’s frame problem, then, is to explain how his allegedly Heideggerian system can determine in some systematic way which of the action-oriented representations it contains or can generate are relevant in any current situation, and to keep track of how this relevance changes with changes in the situation. Not surprisingly, in the concluding chapter of his book where Wheeler returns to the frame problem to test his proposed Heideggerian AI, he offers no solution or dissolution of the problem.

Rather he asks us to “give some credence to [his] informed intuitions” (Wheeler, 2005, p. 279).

I agree with Wheeler’s general intuition, which I take to be on the scent of Freeman’s account of rabbit olfaction, viz., that nonrepresentational causal coupling must play a crucial role. But I take issue with his conclusion that:

In extreme cases the neural contribution will be nonrepresentational in character. In other cases, representations will be active partners alongside certain additional factors, but those representations will be action-oriented in character, and so will realize the same content-sparse, action-specific, egocentric, context-dependent profile that Heideggerian phenomenology reveals to be distinctive of online representational states at the agential level. (Wheeler, 2005, p. 276)

All representational states are part of the problem. Therefore, Wheeler as I understand him, cannot give an explanation of how online dynamic coupling will dissolve the online frame problem. Nor does it help to bring in, as Wheeler does, action-oriented representations and the extended mind. Any attempt to solve the frame problem by giving any role to any sort of representational states, even online ones, has so far proved to be a dead end. It looks like nonrepresentational neural activity can’t be understood to be the “extreme case” as Wheeler claims it is. Rather, such activity must be, as Heidegger, Merleau-Ponty and Freeman claim, our basic way of responding directly to relevance in the everyday world so that the frame problem does not arise.

Heidegger and Merleau-Ponty argue that, thanks to our embodied coping and the intentional arc it makes possible, our skill in directly sensing and responding to relevant changes in the world is constantly improved. In coping in a particular context, say a classroom, we learn to ignore most of what is in the room, but, if it gets too warm, the windows solicit us to open them. We ignore the chalk dust in the corners and chalk marks on the desks but we attend to the chalk marks on the blackboard. We take for granted that what we write on the board doesn’t affect the windows, even if we write ‘open windows’, and what we do with the windows doesn’t affect what’s on the board. And as we constantly refine this background know-how, the things in the room and its layout take on more and more significance. In general, given our experience in the world, whenever there is a change in the current context we respond to it only if in the past it has turned out to be significant, and when we

sense a significant change we treat everything else as unchanged except what our familiarity with the world suggests might also have changed and so needs to be checked out. Thus a local version of the frame problem does not arise.

But the frame problem reasserts itself when we need to change contexts. How do we sense when a situation on the margin of our current activity has become relevant to our current tasks? Merleau-Ponty has a suggestion. When speaking of one’s attention being drawn by an affordance on the margin of one’s current experience, Merleau-Ponty uses the term ‘summons’ to describe the influence of the affordance on the perceiver: “To see an object is either to have it on the fringe of the visual field and be able to concentrate on it, or else respond to this *summons* by actually concentrating on it” (Merleau-Ponty, 1962, p. 67, italics added). Thus, for example, as one faces the front of a house, one’s body is already being *summoned* (not just *prepared*) to go around the house to get a better look at its back (Kelly, 2005).

Merleau-Ponty’s treatment of what Husserl calls the *inner* horizon of the perceptual object, e.g., its insides and back, applies equally to our experience of a situation’s *outer* horizon of other potential situations. As I cope with a familiar task in a specific situation, other situations that have in the past been relevant are *right now* present on the horizon of my experience summoning my attention as potentially (not merely possibly) relevant to the current situation. If Freeman is right, the attraction of familiar-but-not-currently-fully-present aspects of what is currently ready-to-hand (inner horizon) as well as the attraction of potentially relevant other familiar situations on the outer horizon of the current situation might well be correlated with the fact that our brains are not simply in one attractor basin at a time but are influenced by other attractor basins in the same landscape, and by other attractor landscapes.

According to Freeman, what makes us open to the horizontal influences of other attractors instead of our being stuck in the current attractor is that the whole system of attractor landscapes collapses and is rebuilt with each new rabbit sniff, or in our case, presumably with each shift in our attention. And once one correlates Freeman’s neurodynamic account with Merleau-Ponty’s description of the way the intentional arc feeds back our past experience into the way the world appears ever more familiar to us and solicits from us ever more appropriate responses to its changing significance, the frame problem of how we can deal with changing relevance by

seeing what will change and what will stay the same no longer seems unsolvable.

But there is a generalization of the problem of relevance, and thus of the frame problem, that seems intractable. In *What Computers Can't Do* I gave as an example how, in placing a racing bet, we can usually restrict ourselves to such facts as the horse's age, jockey, past performance, and competition, but there are always other factors such as whether the horse is allergic to goldenrod or whether the jockey has just had a fight with the owner, which may in some cases be decisive. Human handicappers are capable of recognizing the relevance of such facts when they come across them (Dreyfus, 1997, p. 258). But since anything in experience can be relevant to anything else, such an ability seems magical.

Jerry Fodor follows up on my pessimistic remark:

The problem is to get the structure of an entire belief system to bear on individual occasions of belief fixation. We have, to put it bluntly, no computational formalisms that show us how to do this, and we have no idea how such formalisms might be developed ... If someone – a Dreyfus, for example – were to ask us why we should even suppose that the digital computer is a plausible mechanism for the simulation of global cognitive processes, the answering silence would be deafening. (Fodor, 1983, pp. 128–129)

However, once we give up computational cognitivism, and see ourselves instead as basically coupled copers, we can see how the frame problem can be dissolved by an appeal to existential phenomenology and neurodynamics. In the light of how learning our way around in the world modifies our brain so that relevance is directly experienced in the way tasks summon us, even the general problem raised by the fact that anything in our experience could in principle be related to anything else no longer seems a mystery.

Notes

This review essay is a revised version of my Barwise Prize talk delivered at the 2006 Pacific Division meeting of the American Philosophical Association, published [in a more detailed version] in Philip Husbands, Owen Holland and Michael Wheeler (eds.), *The Mechanical Mind in History* (Cambridge, MA: MIT Press, 2008), pp. 331–372.

9. Conclusion

It would be satisfying if we could now conclude that, with the help of Merleau-Ponty and Freeman, we can fix what is wrong with current allegedly Heideggerian AI by making it more Heideggerian. There is, however, a big remaining problem. Merleau-Ponty's and Freeman's account of how we directly pick up significance and improve our sensitivity to relevance depends on our responding to what is significant for *us* given our needs, body size, ways of moving, and so forth, not to mention our personal and cultural self-interpretation. Thus, to program Heideggerian AI, we would not only need a model of the brain functioning underlying coupled coping such as Freeman's, but we would also need – and here's the rub – a model of our particular way of being embedded and embodied such that what we experience is significant for us in the particular way that it is. That is, we would have to include in our program a model of a body very much like ours with our needs, desires, pleasures, pains, ways of moving, cultural background, etc. If we can't make our brain model responsive to the significance in the environment as it shows up specifically for human beings, the project of developing an embedded and embodied Heideggerian AI can't get off the ground.

So, according to the view I have been presenting, even if the Heideggerian/Merleau-Pontian approach to AI suggested by Freeman is ontologically sound in a way that GOFAI and the subsequent supposedly Heideggerian models proposed by Brooks, Agre, and Wheeler are not, a neurodynamic computer model would still have to be given a detailed description of our body and motivations like ours if things were to count as significant for it so that it could learn to act intelligently in our world. The idea of super-computers containing detailed models of human bodies and brains may seem to make sense in the wild imaginations of a Ray Kurzweil or Bill Joy, but they haven't a chance of being realized in the real world.

- 1 Roger Schank proposed what he called "scripts." He tells us: "A script is a structure that describes appropriate sequences of events in a particular context. A script is made up of slots and requirements about what can fill those slots. The structure is an interconnected whole, and what is in one slot affects what can be in another."

- A script is a predetermined, stereotyped sequence of actions that defines a well-known situation” (Schank & Abelson, 1977, p. 41; as cited in Preston & Bishop, 2002, p. 17).
- 2 Although you couldn't tell it from the Cog web page: <http://www.ai.mit.edu/projects/humanoid-robotics-group/cog/cog.html>
 - 3 Heidegger himself is unclear about the status of the ready-to-hand. When he is stressing the holism of equipmental relations, he thinks of the ready-to-hand as equipment, and of equipment as things like lamps, tables, doors, and rooms that have a place in a whole nexus of other equipment. Furthermore, he holds that breakdown reveals that these interdefined pieces of equipment are made of present-at-hand stuff that was there all along (1962, p. 97). At one point Heidegger even goes so far as to include the ready-to-hand under the same categories that characterize the present-at-hand: “We call ‘categories’ – characteristics of being for entities whose character is not that of Dasein. . . . Any entity is either a ‘who’ (existence) or a what (present-at-hand in the broadest sense)” (p. 71, italics added).
 - 4 Merleau-Ponty (1962) says the same: “[T]o move one's body is to aim at things through it; it is to allow oneself to respond to their call, which is made upon it independently of any representation” (p. 139).
 - 5 According to Heidegger, intentional content isn't in the mind, nor in some third realm (as it is for Husserl), *nor in the world*; it isn't anywhere. It's a way of being-towards.
 - 6 It's important to realize that when he introduces the term ‘understanding’, Heidegger (1982, p. 276) explains that he means a kind of know-how.
 - 7 This way of putting the source of *significance* covers both animals and people. By the time he published *Being and Time*, however, Heidegger was interested exclusively in the special kind of significance found in the world opened up by human beings who are defined by the stand they take on their own being. We might call this *meaning*. In this paper I'm putting the question of uniquely human meaning aside to concentrate on the sort of *significance* we share with animals.
 - 8 I'm over simplifying here. Wheeler does note that Heidegger has an account of online, involved problem solving that Heidegger calls dealing with the “un-ready-to-hand.” But while for Heidegger and for Wheeler coping at its best deals directly with the ready-to-hand with no place for representations of any sort, for Heidegger but not for Wheeler *all* un-ready-to-hand coping takes place on the background of an even more basic nonrepresentational holistic coping which allows copers to orient themselves in the world. As we shall see, it is this basic coping, not any kind of problem solving, agential or subagential, that enables Heideggerian AI to avoid the frame problem.

References

- Agre, P.E. (1988). *The dynamic structure of everyday life* (Technical Report 1085). Cambridge, MA: MIT Artificial Intelligence Lab.
- Agre, P.E. (1997). *Computation and human experience*. Cambridge, England: Cambridge University Press.
- Brooks, R. A. (1997a). From earwigs to humans. *Robotics and Autonomous Systems*, 20, 291–304.
- Brooks, R. A. (1997b). Intelligence without representation. In J. Haugeland (Ed.), *Mind design II: Philosophy, psychology, and artificial intelligence* (pp. 395–420). Cambridge, MA: MIT Press, (Original work published 1991).
- Brooks, R. A. (2002). *Flesh and machines: How robots will change us*. New York: Vintage Books.
- Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis*, 58, 7–19.
- Dennett, D. (1994). The practical requirements for making a conscious robot. *Philosophical Transactions of the Royal Society of London, Series A*, 349, 133–146.
- Dennett, D. (1997). Consciousness in human and robot minds. In M. Ito, Y. Miyashita & E. T. Rolls (Eds.), *Cognition, computation and consciousness* (pp. 17–30). Oxford, England: Oxford University Press.
- Dreyfus, H. (1972). *What computers can't do: A critique of artificial reason*. New York: Harper & Row.
- Dreyfus, H. (1992). *What computers still can't do: A critique of artificial reason*. Cambridge, MA: MIT Press.
- Dreyfus, H. L. (1997). *What computers can't do*. New York: Harper and Row.
- Fodor, J. A. (1983). *The modularity of mind*. Cambridge, MA: MIT Press.
- Freeman, W. J. (1995). *Societies of brains: A study in the neuroscience of love and hate*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Freeman, W. J. (2000). *How brains make up their minds*. New York: Columbia University Press.
- Freeman, W. J., & Grajski, K. A. (1987). Relation of olfactory EEG to behavior: Factor analysis. *Behavioral Neuroscience*, 101, 766–777.
- Haugeland, J. (1998). Mind embodied and embedded. *Having thought: Essays in the metaphysics of mind* (pp. 207–237). Cambridge, MA: Harvard University Press.
- Heidegger, M. (1962). *Being and time* (J. Macquarrie & E. Robinson, Trans.). New York: Harper & Row.
- Heidegger, M. (1976). *Gesamtausgabe: Vol. 21. Logik: die Frage nach der Wahrheit*. Frankfurt am Main: Vittorio Klostermann.
- Heidegger, M. (1982). *The basic problems of phenomenology* (A. Hofstadter, Trans.). Bloomington, IN: Indian University Press. 276.

- Heidegger, M. (2002). Phenomenological interpretations in connection with Aristotle. In J. Van Buren (Ed.), *Supplements: From the earliest essays to being and time and beyond* (pp. 111–146). Albany, NY: State University of New York Press.
- Heidegger, M. (2010). *Logic: The question of truth* (Thomas Sheehan, Trans.). Bloomington: Indiana University Press.
- Husserl, E. (1973). *Experience and judgment*. Evanston, IL: Northwestern University Press.
- Kelly, S. D. (2005). Seeing things in Merleau-Ponty. In T. Carman & M. B. N. Hansen (Eds.), *The Cambridge companion to Merleau-Ponty* (pp. 74–110). Cambridge, England: Cambridge University Press.
- Kozma, R., & Freeman, W. J. (2003). Basic principles of the KIV model and its application to the navigation problem. *Journal of Integrative Neuroscience*, 2, 125–145.
- Merleau-Ponty, M. (1962). *Phenomenology of perception* (C. Smith, Trans.). London: Routledge & Kegan Paul.
- Merleau-Ponty, M. (1966). *The structure of behavior* (A. L. Fisher, Trans., 2nd ed.). Boston: Beacon Press.
- Preston, J., & Bishop, M. (Eds.) (2002). *Views into the Chinese room: New essays on Searle and artificial intelligence*. Oxford, England: Clarendon Press.
- Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals and understanding: An inquiry into human knowledge structures*. Hillsdale, NJ: Lawrence Erlbaum.
- Todes, S. (2001). *Body and world*. Cambridge, MA: MIT Press.
- van Gelder, T. (1997). Dynamics and cognition. In J. Haugeland (Ed.), *Mind design II* (pp. 421–450). Cambridge, MA: MIT Press.
- Wheeler, M. (2002). Change in the rules: Computers, dynamical systems, and Searle. In J. Preston & M. Bishop (Eds.), *Views into the Chinese room: New essays on Searle and artificial intelligence* (pp. 338–359). Oxford, England: Clarendon Press.
- Wheeler, M. (2005). *Reconstructing the cognitive world: The next step*. Cambridge, MA: MIT Press.
- Winograd, T. (1976). Artificial intelligence and language comprehension. *Artificial intelligence and language comprehension* (pp. 1–26). Washington, DC: National Institute of Education.
- Winograd, T. (1989, September). *Heidegger and the design of computer systems. Paper delivered at Applied Heidegger Conference*, Berkeley, CA.
- Winograd, T. (2000). Foreword. In M. Wrathall (Ed.), *Essays in honor of Hubert L. Dreyfus: Vol. 2. Heidegger, coping, and cognitive science* (pp. vii–x). Cambridge, MA: MIT Press.

A Cyborg Manifesto: Science, Technology, and Socialist Feminism in the Late Twentieth Century

Donna Haraway

An Ironic Dream of a Common Language for Women in the Integrated Circuit

This chapter is an effort to build an ironic political myth faithful to feminism, socialism, and materialism. Perhaps more faithful as blasphemy is faithful, than as reverent worship and identification. Blasphemy has always seemed to require taking things very seriously. I know no better stance to adopt from within the secular-religious, evangelical traditions of United States politics, including the politics of socialist feminism. Blasphemy protects one from the moral majority within, while still insisting on the need for community. Blasphemy is not apostasy. Irony is about contradictions that do not resolve into larger wholes, even dialectically, about the tension of holding incompatible things together because both or all are necessary and true. Irony is about humour and serious play. It is also a rhetorical strategy and a political method, one I would like to see more honoured within socialist-feminism. At the centre of my ironic faith, my blasphemy, is the image of the cyborg.

A cyborg is a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature

of fiction. Social reality is lived social relations, our most important political construction, a world-changing fiction. The international women's movements have constructed "women's experience", as well as uncovered or discovered this crucial collective object. This experience is a fiction and fact of the most crucial, political kind. Liberation rests on the construction of the consciousness, the imaginative apprehension, of oppression, and so of possibility. The cyborg is a matter of fiction and lived experience that changes what counts as women's experience in the late twentieth century. This is a struggle over life and death, but the boundary between science fiction and social reality is an optical illusion.

Contemporary science fiction is full of cyborgs – creatures simultaneously animal and machine, who populate worlds ambiguously natural and crafted. Modern medicine is also full of cyborgs, of couplings between organism and machine, each conceived as coded devices, in an intimacy and with a power that was not generated in the history of sexuality. Cyborg "sex" restores some of the lovely replicative baroque of ferns and invertebrates (such nice organic prophylactics against heterosexism). Cyborg replication is uncoupled from organic reproduction. Modern production seems like a dream of cyborg colonization work, a dream that makes the nightmare of

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Taylorism seem idyllic. And modern war is a cyborg orgy, coded by C³I, command-control-communication-intelligence, an \$84 billion item in 1984's US defence budget. I am making an argument for the cyborg as a fiction mapping our social and bodily reality and as an imaginative resource suggesting some very fruitful couplings. Michel Foucault's biopolitics is a flaccid premonition of cyborg politics, a very open field.

By the late twentieth century, our time, a mythic time, we are all chimeras, theorized and fabricated hybrids of machine and organism; in short, we are cyborgs. The cyborg is our ontology; it gives us our politics. The cyborg is a condensed image of both imagination and material reality, the two joined centres structuring any possibility of historical transformation. In the traditions of "Western" science and politics – the tradition of racist, male-dominant capitalism; the tradition of progress; the tradition of the appropriation of nature as resource for the productions of culture; the tradition of reproduction of the self from the reflections of the other – the relation between organism and machine has been a border war. The stakes in the border war have been the territories of production, reproduction, and imagination. This essay is an argument for *pleasure* in the confusion of boundaries and for *responsibility* in their construction. It is also an effort to contribute to socialist-feminist culture and theory in a postmodernist, non-naturalist mode and in the utopian tradition of imagining a world without gender, which is perhaps a world without genesis, but maybe also a world without end. The cyborg incarnation is outside salvation history. Nor does it mark time on an oedipal calendar, attempting to heal the terrible cleavages of gender in an oral symbiotic utopia or post-oedipal apocalypse. As Zoë Sofoulis argues in her unpublished manuscript on Jacques Lacan, Melanie Klein, and nuclear culture, *Lacklein*, the most terrible and perhaps the most promising monsters in cyborg worlds are embodied in non-oedipal narratives with a different logic of repression, which we need to understand for our survival.

The cyborg is a creature in a post-gender world; it has no truck with bisexuality, pre-oedipal symbiosis, unalienated labour, or other seductions to organic wholeness through a final appropriation of all the powers of the parts into a higher unity. In a sense, the cyborg has no origin story in the Western sense – a "final" irony since the cyborg is also the awful apocalyptic *telos* of the "West's" escalating dominations of abstract individuation, an ultimate self untied at last from all dependency, a man in space. An origin story in the "Western", humanist

sense depends on the myth of original unity, fullness, bliss and terror, represented by the phallic mother from whom all humans must separate, the task of individual development and of history, the twin potent myths inscribed most powerfully for us in psychoanalysis and Marxism. Hilary Klein has argued that both Marxism and psychoanalysis, in their concepts of labour and of individuation and gender formation, depend on the plot of original unity out of which difference must be produced and enlisted in a drama of escalating domination of woman/nature. The cyborg skips the step of original unity, of identification with nature in the Western sense. This is its illegitimate promise that might lead to subversion of its teleology as star wars.

The cyborg is resolutely committed to partiality, irony, intimacy, and perversity. It is oppositional, utopian, and completely without innocence. No longer structured by the polarity of public and private, the cyborg defines a technological polis based partly on a revolution of social relations in the *oikos*, the household. Nature and culture are reworked; the one can no longer be the resource for appropriation or incorporation by the other. The relationships for forming wholes from parts, including those of polarity and hierarchical domination, are at issue in the cyborg world. Unlike the hopes of Frankenstein's monster, the cyborg does not expect its father to save it through a restoration of the garden; that is, through the fabrication of a heterosexual mate, through its completion in a finished whole, a city and cosmos. The cyborg does not dream of community on the model of the organic family, this time without the oedipal project. The cyborg would not recognize the Garden of Eden; it is not made of mud and cannot dream of returning to dust. Perhaps that is why I want to see if cyborgs can subvert the apocalypse of returning to nuclear dust in the manic compulsion to name the Enemy. Cyborgs are not reverent; they do not re-member the cosmos. They are wary of holism, but needy for connection – they seem to have a natural feel for united front politics, but without the vanguard party. The main trouble with cyborgs, of course, is that they are the illegitimate offspring of militarism and patriarchal capitalism, not to mention state socialism. But illegitimate offspring are often exceedingly unfaithful to their origins. Their fathers, after all, are inessential.

I will return to the science fiction of cyborgs at the end of this essay, but now I want to signal three crucial boundary breakdowns that make the following political-fictional (political-scientific) analysis possible. By the late twentieth century in United States scientific culture, the

boundary between human and animal is thoroughly breached. The last beachheads of uniqueness have been polluted if not turned into amusement parks – language, tool use, social behaviour, mental events, nothing really convincingly settles the separation of human and animal. And many people no longer feel the need for such a separation; indeed, many branches of feminist culture affirm the pleasure of connection of human and other living creatures. Movements for animal rights are not irrational denials of human uniqueness; they are a clear-sighted recognition of connection across the discredited breach of nature and culture. Biology and evolutionary theory over the last two centuries have simultaneously produced modern organisms as objects of knowledge and reduced the line between humans and animals to a faint trace re-etched in ideological struggle or professional disputes between life and social science. Within this framework, teaching modern Christian creationism should be fought as a form of child abuse.

Biological-determinist ideology is only one position opened up in scientific culture for arguing the meanings of human animality. There is much room for radical political people to contest the meanings of the breached boundary.¹ The cyborg appears in myth precisely where the boundary between human and animal is transgressed. Far from signalling a walling off of people from other living beings, cyborgs signal disturbingly and pleasurably tight coupling. Bestiality has a new status in this cycle of marriage exchange.

The second leaky distinction is between animal-human (organism) and machine. Pre-cybernetic machines could be haunted; there was always the spectre of the ghost in the machine. This dualism structured the dialogue between materialism and idealism that was settled by a dialectical progeny, called spirit or history, according to taste. But basically machines were not self-moving, self-designing, autonomous. They could not achieve man's dream, only mock it. They were not man, an author to himself, but only a caricature of that masculinist reproductive dream. To think they were otherwise was paranoid. Now we are not so sure. Late twentieth-century machines have made thoroughly ambiguous the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines. Our machines are disturbingly lively, and we ourselves frighteningly inert.

Technological determination is only one ideological space opened up by the reconceptions of machine and organism as coded texts through which we engage in the

play of writing and reading the world.² “Textualization” of everything in poststructuralist, postmodernist theory has been damned by Marxists and socialist feminists for its utopian disregard for the lived relations of domination that ground the “play” of arbitrary reading.³ It is certainly true that postmodernist strategies, like my cyborg myth, subvert myriad organic wholes (for example, the poem, the primitive culture, the biological organism). In short, the certainty of what counts as nature – a source of insight and promise of innocence – is undermined, probably fatally. The transcendent authorization of interpretation is lost, and with it the ontology grounding “Western” epistemology. But the alternative is not cynicism or faithlessness, that is, some version of abstract existence, like the accounts of technological determinism destroying “man” by the “machine” or “meaningful political action” by the “text”. Who cyborgs will be is a radical question; the answers are a matter of survival. Both chimpanzees and artefacts have politics, so why shouldn't we (de Waal, 1982; Winner, 1980)?

The third distinction is a subset of the second: the boundary between physical and non-physical is very imprecise for us. Pop physics books on the consequences of quantum theory and the indeterminacy principle are a kind of popular scientific equivalent to Harlequin romances⁴ as a marker of radical change in American white heterosexuality: they get it wrong, but they are on the right subject. Modern machines are quintessentially microelectronic devices: they are everywhere and they are invisible. Modern machinery is an irreverent upstart god, mocking the Father's ubiquity and spirituality. The silicon chip is a surface for writing; it is etched in molecular scales disturbed only by atomic noise, the ultimate interference for nuclear scores. Writing, power, and technology are old partners in Western stories of the origin of civilization, but miniaturization has changed our experience of mechanism. Miniaturization has turned out to be about power; small is not so much beautiful as pre-eminently dangerous, as in cruise missiles. Contrast the TV sets of the 1950s or the news cameras of the 1970s with the TV wrist bands or hand-sized video cameras now advertised. Our best machines are made of sunshine; they are all light and clean because they are nothing but signals, electromagnetic waves, a section of a spectrum, and these machines are eminently portable, mobile – a matter of immense human pain in Detroit and Singapore. People are nowhere near so fluid, being both material and opaque. Cyborgs are ether, quintessence.

The ubiquity and invisibility of cyborgs is precisely why these sunshine-belt machines are so deadly. They are as hard to see politically as materially. They are about consciousness – or its simulation.⁵ They are floating signifiers moving in pickup trucks across Europe, blocked more effectively by the witch-weavings of the displaced and so unnatural Greenham women, who read the cyborg webs of power so very well, than by the militant labour of older masculinist politics, whose natural constituency needs defence jobs. Ultimately the “hardest” science is about the realm of greatest boundary confusion, the realm of pure number, pure spirit, C³I, cryptography, and the preservation of potent secrets. The new machines are so clean and light. Their engineers are sun-worshippers mediating a new scientific revolution associated with the night dream of post-industrial society. The diseases evoked by these clean machines are “no more” than the minuscule coding changes of an antigen in the immune system, “no more” than the experience of stress. The nimble fingers of “Oriental” women, the old fascination of little Anglo-Saxon Victorian girls with doll’s houses, women’s enforced attention to the small take on quite new dimensions in this world. There might be a cyborg Alice taking account of these new-dimensions. Ironically, it might be the unnatural cyborg women making chips in Asia and spiral dancing in Santa Rita jail⁶ whose constructed unities will guide effective oppositional strategies.

So my cyborg myth is about transgressed boundaries, potent fusions, and dangerous possibilities which progressive people might explore as one part of needed political work. One of my premises is that most American socialists and feminists see deepened dualisms of mind and body, animal and machine, idealism and materialism in the social practices, symbolic formulations, and physical artefacts associated with “high technology” and scientific culture. From *One-Dimensional Man* (Marcuse, 1964) to *The Death of Nature* (Merchant, 1980), the analytic resources developed by progressives have insisted on the necessary domination of technics and recalled us to an imagined organic body to integrate our resistance. Another of my premises is that the need for unity of people trying to resist world-wide intensification of domination has never been more acute. But a slightly perverse shift of perspective might better enable us to contest for meanings, as well as for other forms of power and pleasure in technologically mediated societies.

From one perspective, a cyborg world is about the final imposition of a grid of control on the planet, about the final abstraction embodied in a Star Wars

apocalypse waged in the name of defence, about the final appropriation of women’s bodies in a masculinist orgy of war (Sofia, 1984). From another perspective, a cyborg world might be about lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints. The political struggle is to see from both perspectives at once because each reveals both dominations and possibilities unimaginable from the other vantage point. Single vision produces worse illusions than double vision or many-headed monsters. Cyborg unities are monstrous and illegitimate; in our present political circumstances, we could hardly hope for more potent myths for resistance and recoupling. I like to imagine LAG, the Livermore Action Group, as a kind of cyborg society, dedicated to realistically converting the laboratories that most fiercely embody and spew out the tools of technological apocalypse, and committed to building a political form that actually manages to hold together witches, engineers, elders, perverts, Christians, mothers, and Leninists long enough to disarm the state. Fission Impossible is the name of the affinity group in my town. (Affinity: related not by blood but by choice, the appeal of one chemical nuclear group for another, avidity.)⁷

[...]

The Informatics of Domination

In this attempt at an epistemological and political position, I would like to sketch a picture of possible unity, a picture indebted to socialist and feminist principles of design. The frame for my sketch is set by the extent and importance of rearrangements in world-wide social relations tied to science and technology. I argue for a politics rooted in claims about fundamental changes in the nature of class, race, and gender in an emerging system of world order analogous in its novelty and scope to that created by industrial capitalism; we are living through a movement from an organic, industrial society to a polymorphous, information system – from all work to all play, a deadly game. Simultaneously material and ideological, the dichotomies may be expressed in the following chart of transitions from the comfortable old hierarchical dominations to the scary new networks I have called the informatics of domination:

Representation	Simulation
Bourgeois novel, realism	Science fiction, postmodernism
Organism	Biotic component
Depth, integrity	Surface, boundary
Heat	Noise
Biology as clinical practice	Biology as inscription
Physiology	Communications engineering
Small group	Subsystem
Perfection	Optimization
Eugenics	Population Control
Decadence, <i>Magic Mountain</i>	Obsolescence, <i>Future Shock</i>
Hygiene	Stress Management
Microbiology, tuberculosis	Immunology, AIDS
Organic division of labour	Ergonomics/cybernetics of labour
Functional specialization	Modular construction
Reproduction	Replication
Organic sex role specialization	Optimal genetic strategies
Biological determinism	Evolutionary inertia, constraints
Community ecology	Ecosystem
Racial chain of being	Neo-imperialism, United Nations humanism
Scientific management in home/factory	Global factory/Electronic cottage
Family/Market/Factory	Women in the Integrated Circuit
Family wage	Comparable worth
Public/Private	Cyborg citizenship
Nature/Culture	Fields of difference
Co-operation	Communications enhancement
Freud	Lacan
Sex	Genetic engineering
Labour	Robotics
Mind	Artificial Intelligence
Second World War	Star Wars
White Capitalist Patriarchy	Informatics of Domination

This list suggests several interesting things.⁸ First, the objects on the right-hand side cannot be coded as “natural”, a realization that subverts naturalistic coding for the left-hand side as well. We cannot go back ideologically or materially. It’s not just that “god” is dead; so is the “goddess”. Or both are

revivified in the worlds charged with microelectronic and biotechnological politics. In relation to objects like biotic components, one must think not in terms of essential properties, but in terms of design, boundary constraints, rates of flows, systems logics, costs of lowering constraints. Sexual reproduction is one kind of reproductive strategy among many, with costs and benefits as a function of the system environment. Ideologies of sexual reproduction can no longer reasonably call on notions of sex and sex role as organic aspects in natural objects like organisms and families. Such reasoning will be unmasked as irrational, and ironically corporate executives reading *Playboy* and anti-porn radical feminists will make strange bedfellows in jointly unmasking the irrationalism.

Likewise for race, ideologies about human diversity have to be formulated in terms of frequencies of parameters, like blood groups or intelligence scores. It is “irrational” to invoke concepts like primitive and civilized. For liberals and radicals, the search for integrated social systems gives way to a new practice called “experimental ethnography” in which an organic object dissipates in attention to the play of writing. At the level of ideology, we see translations of racism and colonialism into languages of development and under-development, rates and constraints of modernization. Any objects or persons can be reasonably thought of in terms of disassembly and reassembly; no “natural” architectures constrain system design. The financial districts in all the world’s cities, as well as the export-processing and free-trade zones, proclaim this elementary fact of “late capitalism”. The entire universe of objects that can be known scientifically must be formulated as problems in communications engineering (for the managers) or theories of the text (for those who would resist). Both are cyborg semiologies.

One should expect control strategies to concentrate on boundary conditions and interfaces, on rates of flow across boundaries – and not on the integrity of natural objects. “Integrity” or “sincerity” of the Western self gives way to decision procedures and expert systems. For example, control strategies applied to women’s capacities to give birth to new human beings will be developed in the languages of population control and maximization of goal achievement for individual decision-makers. Control strategies will be formulated in terms of rates, costs of constraints, degrees of freedom. Human beings, like any other component or subsystem, must be localized in a system architecture whose basic modes of operation are probabilistic, statistical. No objects, spaces, or bodies are sacred in themselves; any component can be interfaced

with any other if the proper standard, the proper code, can be constructed for processing signals in a common language. Exchange in this world transcends the universal translation effected by capitalist markets that Marx analysed so well. The privileged pathology affecting all kinds of components in this universe is stress – communications breakdown (Hogness, 1983). The cyborg is not subject to Foucault's biopolitic; the cyborg simulates politics, a much more potent field of operations.

This kind of analysis of scientific and cultural objects of knowledge which have appeared historically since the Second World War prepares us to notice some important inadequacies in feminist analysis which has proceeded as if the organic, hierarchical dualisms ordering discourse in “the West” since Aristotle still ruled. They have been cannibalized, or as Zoë Sofia (Sofoulis) might put it, they have been “techno-digested”. The dichotomies between mind and body, animal and human, organism and machine, public and private, nature and culture, men and women, primitive and civilized are all in question ideologically. The actual situation of women is their integration/exploitation into a world system of production/reproduction and communication called the informatics of domination. The home, workplace, market, public arena, the body itself – all can be dispersed and interfaced in nearly infinite, polymorphous ways, with large consequences for women and others – consequences that themselves are very different for different people and which make potent oppositional international movements difficult to imagine and essential for survival. One important route for reconstructing socialist-feminist politics is through theory and practice addressed to the social relations of science and technology, including crucially the systems of myth and meanings structuring our imaginations. The cyborg is a kind of disassembled and reassembled, postmodern collective and personal self. This is the self feminists must code.

Communications technologies and biotechnologies are the crucial tools recrafting our bodies. These tools embody and enforce new social relations for women world-wide. Technologies and scientific discourses can be partially understood as formalizations, i.e., as frozen moments, of the fluid social interactions constituting them, but they should also be viewed as instruments for enforcing meanings. The boundary is permeable between tool and myth, instrument and concept, historical systems of social relations and historical anatomies of possible bodies, including objects of knowledge. Indeed, myth and tool mutually constitute each other.

Furthermore, communications sciences and modern biologies are constructed by a common move – *the translation of the world into a problem of coding*, a search for a common language in which all resistance to instrumental control disappears and all heterogeneity can be submitted to disassembly, reassembly, investment, and exchange.

In communications sciences, the translation of the world into a problem in coding can be illustrated by looking at cybernetic (feedback-controlled) systems theories applied to telephone technology, computer design, weapons deployment, or data base construction and maintenance. In each case, solution to the key questions rests on a theory of language and control; the key operation is determining the rates, directions, and probabilities of flow of a quantity called information. The world is subdivided by boundaries differentially permeable to information. Information is just that kind of quantifiable element (unit, basis of unity) which allows universal translation, and so unhindered instrumental power (called effective communication). The biggest threat to such power is interruption of communication. Any system breakdown is a function of stress. The fundamentals of this technology can be condensed into the metaphor C³I, command-control-communication-intelligence, the military's symbol for its operations theory.

In modern biologies, the translation of the world into a problem in coding can be illustrated by molecular genetics, ecology, sociobiological evolutionary theory, and immunobiology. The organism has been translated into problems of genetic coding and read-out. Biotechnology, a writing technology, informs research broadly.⁹ In a sense, organisms have ceased to exist as objects of knowledge, giving way to biotic components, i.e., special kinds of information-processing devices. The analogous moves in ecology could be examined by probing the history and utility of the concept of the ecosystem. Immunobiology and associated medical practices are rich exemplars of the privilege of coding and recognition systems as objects of knowledge, as constructions of bodily reality for us. Biology here is a kind of cryptography. Research is necessarily a kind of intelligence activity. Ironies abound. A stressed system goes awry; its communication processes break down; it fails to recognize the difference between self and other. Human babies with baboon hearts evoke national ethical perplexity – for animal rights activists at least as much as for the guardians of human purity. In the US gay men and intravenous drug users are the “privileged” victims of an awful immune system disease that marks

(inscribes on the body) confusion of boundaries and moral pollution (Treichler, 1987).

But these excursions into communications sciences and biology have been at a rarefied level; there is a mundane, largely economic reality to support my claim that these sciences and technologies indicate fundamental transformations in the structure of the world for us. Communications technologies depend on electronics. Modern states, multinational corporations, military power, welfare state apparatuses, satellite systems, political processes, fabrication of our imaginations, labour-control systems, medical constructions of our bodies, commercial pornography, the international division of labour, and religious evangelism depend intimately upon electronics. Microelectronics is the technical basis of simulacra; that is, of copies without originals.

Microelectronics mediates the translations of labour into robotics and word processing, sex into genetic engineering and reproductive technologies, and mind into artificial intelligence and decision procedures. The new biotechnologies concern more than human reproduction. Biology as a powerful engineering science for redesigning materials and processes has revolutionary implications for industry, perhaps most obvious today in areas of fermentation, agriculture, and energy. Communications sciences and biology are constructions of natural-technical objects of knowledge in which the difference between machine and organism is thoroughly blurred; mind, body, and tool are on very intimate terms. The "multinational" material organization of the production and reproduction of daily life and the symbolic organization of the production and reproduction of culture and imagination seem equally implicated. The boundary-maintaining images of base and superstructure, public and private, or material and ideal never seemed more feeble.

I have used Rachel Grossman's (1980) image of women in the integrated circuit to name the situation of women in a world so intimately restructured through the social relations of science and technology.¹⁰ I used the odd circumlocution, "the social relations of science and technology," to indicate that we are not dealing with a technological determinism, but with a historical system depending upon structured relations among people. But the phrase should also indicate that science and technology provide fresh sources of power, that we need fresh sources of analysis and political action (Latour, 1984). Some of the rearrangements of race, sex, and class rooted in high-tech-facilitated social relations can make socialist-feminism more relevant to effective progressive politics.

The "Homework Economy" Outside "the Home"

The "New Industrial Revolution" is producing a new world-wide working class, as well as new sexualities and ethnicities. The extreme mobility of capital and the emerging international division of labour are intertwined with the emergence of new collectivities, and the weakening of familiar groupings. These developments are neither gender- nor race-neutral. White men in advanced industrial societies have become newly vulnerable to permanent job loss, and women are not disappearing from the job rolls at the same rates as men. It is not simply that women in Third World countries are the preferred labour force for the science-based multinationals in the export-processing sectors, particularly in electronics. The picture is more systematic and involves reproduction, sexuality, culture, consumption, and production. In the prototypical Silicon Valley, many women's lives have been structured around employment in electronics-dependent jobs, and their intimate realities include serial heterosexual monogamy, negotiating childcare, distance from extended kin or most other forms of traditional community, a high likelihood of loneliness and extreme economic vulnerability as they age. The ethnic and racial diversity of women in Silicon Valley structures a microcosm of conflicting differences in culture, family, religion, education, and language.

Richard Gordon has called this new situation the "homework economy".¹¹ Although he includes the phenomenon of literal homework emerging in connection with electronics assembly, Gordon intends "homework economy" to name a restructuring of work that broadly has the characteristics formerly ascribed to female jobs, jobs literally done only by women. Work is being redefined as both literally female and feminized, whether performed by men or women. To be feminized means to be made extremely vulnerable; able to be disassembled, reassembled, exploited as a reserve labour force; seen less as workers than as servers; subjected to time arrangements on and off the paid job that make a mockery of a limited work day; leading an existence that always borders on being obscene, out of place, and reducible to sex. Deskilling is an old strategy newly applicable to formerly privileged workers. However, the homework economy does not refer only to large-scale deskilling, nor does it deny that new areas of high skill are emerging, even for women and men previously excluded from

skilled employment. Rather, the concept indicates that factory, home, and market are integrated on a new scale and that the places of women are crucial – and need to be analysed for differences among women and for meanings for relations between men and women in various situations.

The homework economy as a world capitalist organizational structure is made possible by (not caused by) the new technologies. The success of the attack on relatively privileged, mostly white, men's unionized jobs is tied to the power of the new communications technologies to integrate and control labour despite extensive dispersion and decentralization. The consequences of the new-technologies are felt by women both in the loss of the family (male) wage (if they ever had access to this white privilege) and in the character of their own jobs, which are becoming capital-intensive; for example, office work and nursing.

The new economic and technological arrangements are also related to the collapsing welfare state and the ensuing intensification of demands on women to sustain daily life for themselves as well as for men, children, and old people. The feminization of poverty – generated by dismantling the welfare state, by the homework economy where stable jobs become the exception, and sustained by the expectation that women's wages will not be matched by a male income for the support of children – has become an urgent focus. The causes of various women-headed households are a function of race, class, or sexuality; but their increasing generality is a ground for coalitions of women on many issues. That women regularly sustain daily life partly as a function of their enforced status as mothers is hardly new; the kind of integration with the overall capitalist and progressively war-based economy is new. The particular pressure, for example, on US black women, who have achieved an escape from (barely) paid domestic service and who now hold clerical and similar jobs in large numbers, has large implications for continued enforced black poverty *with* employment. Teenage women in industrializing areas of the Third World increasingly find themselves the sole or major source of a cash wage for their families, while access to land is ever more problematic. These developments must have major consequences in the psychodynamics and politics of gender and race.

Within the framework of three major stages of capitalism (commercial/early industrial, monopoly, multinational) – tied to nationalism, imperialism, and multinationalism, and related to Jameson's three domi-

nant aesthetic periods of realism, modernism, and post-modernism – I would argue that specific forms of families dialectically relate to forms of capital and to its political and cultural concomitants. Although lived problematically and unequally, ideal forms of these families might be schematized as (1) the patriarchal nuclear family, structured by the dichotomy between public and private and accompanied by the white bourgeois ideology of separate spheres and nineteenth-century Anglo-American bourgeois feminism; (2) the modern family mediated (or enforced) by the welfare state and institutions like the family wage, with a flowering of a-feminist heterosexual ideologies, including their radical versions represented in Greenwich Village around the First World War; and (3) the "family" of the homework economy with its oxymoronic structure of women-headed households and its explosion of feminisms and the paradoxical intensification and erosion of gender itself. This is the context in which the projections for world-wide structural unemployment stemming from the new technologies are part of the picture of the homework economy. As robotics and related technologies put men out of work in "developed" countries and exacerbate failure to generate male jobs in Third World "development", and as the automated office becomes the rule even in labour-surplus countries, the feminization of work intensifies. Black women in the United States have long known what it looks like to face the structural underemployment ("feminization") of black men, as well as their own highly vulnerable position in the wage economy. It is no longer a secret that sexuality, reproduction, family, and community life are interwoven with this economic structure in myriad ways which have also differentiated the situations of white and black women. Many more women and men will contend with similar situations, which will make cross-gender and race alliances on issues of basic life support (with or without jobs) necessary, not just nice.

The new technologies also have a profound effect on hunger and on food production for subsistence world-wide. Rae Lesser Blumberg (1983) estimates that women produce about 50 per cent of the world's subsistence food.¹² Women are excluded generally from benefiting from the increased high-tech commodification of food and energy crops, their days are made more arduous because their responsibilities to provide food do not diminish, and their reproductive situations are made more complex. Green Revolution technologies interact with other high-tech industrial

production to alter gender divisions of labour and differential gender migration patterns.

The new technologies seem deeply involved in the forms of “privatization” that Ros Petchesky (1981) has analysed, in which militarization, right-wing family ideologies and policies, and intensified definitions of corporate (and state) property as private synergistically interact.¹³ The new communications technologies are fundamental to the eradication of “public life” for everyone. This facilitates the mushrooming of a permanent high-tech military establishment at the cultural and economic expense of most people, but especially of women. Technologies like video games and highly miniaturized televisions seem crucial to production of modern forms of “private life”. The culture of video games is heavily orientated to individual competition and extraterrestrial warfare. High-tech, gendered imaginations are produced here, imaginations that can contemplate destruction of the planet and a sci-fi escape from its consequences. More than our imaginations is militarized; and the other realities of electronic and nuclear warfare are inescapable. These are the technologies that promise ultimate mobility and perfect exchange – and incidentally enable tourism, that perfect practice of mobility and exchange, to emerge as one of the world’s largest single industries.

The new technologies affect the social relations of both sexuality and of reproduction, and not always in the same ways. The close ties of sexuality and instrumentality, of views of the body as a kind of private satisfaction- and utility-maximizing machine, are described nicely in sociobiological origin stories that stress a genetic calculus and explain the inevitable dialectic of domination of male and female gender roles.¹⁴ These sociobiological stories depend on a high-tech view of the body as a biotic component or cybernetic communications system. Among the many transformations of reproductive situations is the medical one, where women’s bodies have boundaries newly permeable to both “visualization” and “intervention”. Of course, who controls the interpretation of bodily boundaries in medical hermeneutics is a major feminist issue. The speculum served as an icon of women’s claiming their bodies in the 1970s; that handcraft tool is inadequate to express our needed body politics in the negotiation of reality in the practices of cyborg reproduction. Self-help is not enough. The technologies of visualization recall the important cultural practice of hunting with the camera and the deeply predatory nature of a photographic consciousness.¹⁵ Sex, sexuality,

and reproduction are central actors in high-tech myth systems structuring our imaginations of personal and social possibility.

Another critical aspect of the social relations of the new technologies is the reformulation of expectations, culture, work, and reproduction for the large scientific and technical work-force. A major social and political danger is the formation of a strongly bimodal social structure, with the masses of women and men of all ethnic groups, but especially people of colour, confined to a homework economy, illiteracy of several varieties, and general redundancy and impotence, controlled by high-tech repressive apparatuses ranging from entertainment to surveillance and disappearance. An adequate socialist-feminist politics should address women in the privileged occupational categories, and particularly in the production of science and technology that constructs scientific-technical discourses, processes, and objects.¹⁶

This issue is only one aspect of enquiry into the possibility of a feminist science, but it is important. What kind of constitutive role in the production of knowledge, imagination, and practice can new groups doing science have? How can these groups be allied with progressive social and political movements? What kind of political accountability can be constructed to tie women together across the scientific-technical hierarchies separating us? Might there be ways of developing feminist science/technology politics in alliance with anti-military science facility conversion action groups? Many scientific and technical workers in Silicon Valley, the high-tech cowboys included, do not want to work on military science.¹⁷ Can these personal preferences and cultural tendencies be welded into progressive politics among this professional middle class in which women, including women of colour, are coming to be fairly numerous?

Women in the Integrated Circuit

Let me summarize the picture of women’s historical locations in advanced industrial societies, as these positions have been restructured partly through the social relations of science and technology. If it was ever possible ideologically to characterize women’s lives by the distinction of public and private domains – suggested by images of the division of working-class life into factory and home, of bourgeois life into market and home, and of gender existence into personal and political realms – it is now a totally misleading ideology, even to show how both terms

of these dichotomies construct each other in practice and in theory. I prefer a network ideological image, suggesting the profusion of spaces and identities and the permeability of boundaries in the personal body and in the body politic. “Networking” is both a feminist practice and a multinational corporate strategy – weaving is for oppositional cyborgs.

So let me return to the earlier image of the informatics of domination and trace one vision of women’s “place” in the integrated circuit, touching only a few idealized social locations seen primarily from the point of view of advanced capitalist societies: Home, Market, Paid Work Place, State, School, Clinic-Hospital, and Church. Each of these idealized spaces is logically and practically implied in every other locus, perhaps analogous to a holographic photograph. I want to suggest the impact of the social relations mediated and enforced by the new technologies in order to help formulate needed analysis and practical work. However, there is no “place” for women in these networks, only geometrics of difference and contradiction crucial to women’s cyborg identities. If we learn how to read these webs of power and social life, we might learn new couplings, new coalitions. There is no way to read the following list from a standpoint of “identification”, of a unitary self. The issue is dispersion. The task is to survive in the diaspora.

Home: Women-headed households, serial monogamy, flight of men, old women alone, technology of domestic work, paid homework, reemergence of home sweat-shops, home-based businesses and telecommuting, electronic cottage, urban homelessness, migration, module architecture, reinforced (simulated) nuclear family, intense domestic violence.

Market: Women’s continuing consumption work, newly targeted to buy the profusion of new production from the new technologies (especially as the competitive race among industrialized and industrializing nations to avoid dangerous mass unemployment necessitates finding ever bigger new markets for ever less clearly needed commodities); bimodal buying power, coupled with advertising targeting of the numerous affluent groups and neglect of the previous mass markets; growing importance of informal markets in labour and commodities parallel to high-tech, affluent market structures; surveillance systems through electronic funds transfer; intensified market abstraction (commodification) of experience, resulting in ineffective utopian or equivalent cynical theories of community; extreme mobility (abstrac-

tion) of marketing/financing systems; interpenetration of sexual and labour markets; intensified sexualization of abstracted and alienated consumption.

Paid Work Place: Continued intense sexual and racial division of labour, but considerable growth of membership in privileged occupational categories for many white women and people of colour; impact of new technologies on women’s work in clerical, service, manufacturing (especially textiles), agriculture, electronics; international restructuring of the working classes; development of new time arrangements to facilitate the homework economy (flex time, part time, over time, no time); homework and out work; increased pressures for two-tiered wage structures; significant numbers of people in cash-dependent populations world-wide with no experience or no further hope of stable employment; most labour “marginal” or “feminized”.

State: Continued erosion of the welfare state; decentralizations with increased surveillance and control; citizenship by telematics; imperialism and political power broadly in the form of information rich/information poor differentiation; increased high-tech militarization increasingly opposed by many social groups; reduction of civil service jobs as a result of the growing capital intensification of office work, with implications for occupational mobility for women of colour; growing privatization of material and ideological life and culture; close integration of privatization and militarization, the high-tech forms of bourgeois capitalist personal and public life; invisibility of different social groups to each other, linked to psychological mechanisms of belief in abstract enemies.

School: Deepening coupling of high-tech capital needs and public education at all levels, differentiated by race, class, and gender; managerial classes involved in educational reform and refunding at the cost of remaining progressive educational democratic structures for children and teachers; education for mass ignorance and repression in technocratic and militarized culture; growing anti-science mystery cults in dissenting and radical political movements; continued relative scientific illiteracy among white women and people of colour; growing industrial direction of education (especially higher education) by science-based multinationals (particularly in electronics- and biotechnology-dependent companies); highly educated, numerous élites in a progressively bimodal society.

Clinic-hospital: Intensified machine-body relations, renegotiations of public metaphors which channel personal experience of the body, particularly in relation to reproduction, immune system functions, and “stress” phenomena; intensification of reproductive politics in response to world historical implications of women’s unrealized, potential control of their relation to reproduction; emergence of new, historically specific diseases; struggles over meanings and means of health in environments pervaded by high technology products and processes; continuing feminization of health work; intensified struggle over state responsibility for health; continued ideological role of popular health movements as a major form of American politics.

Church: Electronic fundamentalist “super-saver” preachers solemnizing the union of electronic capital and automated fetish gods; intensified importance of churches in resisting the militarized state; central struggle over women’s meanings and authority in religion; continued relevance of spirituality, intertwined with sex and health, in political struggle.

The only way to characterize the informatics of domination is as a massive intensification of insecurity and cultural impoverishment, with common failure of subsistence networks for the most vulnerable. Since much of this picture interweaves with the social relations of science and technology, the urgency of a socialist-feminist politics addressed to science and technology is plain. There is much now being done, and the grounds for political work are rich. For example, the efforts to develop forms of collective struggle for women in paid work, like SEIU’s District 925,¹⁸ should be a high priority for all of us. These efforts are profoundly tied to technical restructuring of labour processes and reformations of working classes. These efforts also are providing understanding of a more comprehensive kind of labour organization, involving community, sexuality, and family issues never privileged in the largely white male industrial unions.

The structural rearrangements related to the social relations of science and technology evoke strong ambivalence. But it is not necessary to be ultimately depressed by the implications of late twentieth-century women’s relation to all aspects of work, culture, production of knowledge, sexuality, and reproduction. For excellent reasons, most Marxisms see domination best and have trouble understanding

what can only look like false consciousness and people’s complicity in their own domination in late capitalism. It is crucial to remember that what is lost, perhaps especially from women’s points of view, is often virulent forms of oppression, nostalgically naturalized in the face of current violation. Ambivalence towards the disrupted unities mediated by high-tech culture requires not sorting consciousness into categories of “clear-sighted critique grounding a solid political epistemology” versus “manipulated false consciousness”, but subtle understanding of emerging pleasures, experiences, and powers with serious potential for changing the rules of the game.

There are grounds for hope in the emerging bases for new kinds of unity across race, gender, and class, as these elementary units of socialist-feminist analysis themselves suffer protean transformations. Intensifications of hardship experienced worldwide in connection with the social relations of science and technology are severe. But what people are experiencing is not transparently clear, and we lack sufficiently subtle connections for collectively building effective theories of experience. Present efforts – Marxist, psychoanalytic, feminist, anthropological – to clarify even “our” experience are rudimentary.

I am conscious of the odd perspective provided by my historical position – a PhD in biology for an Irish Catholic girl was made possible by Sputnik’s impact on US national science-education policy. I have a body and mind as much constructed by the post-Second World War arms race and cold war as by the women’s movements. There are more grounds for hope in focusing on the contradictory effects of politics designed to produce loyal American technocrats, which also produced large numbers of dissidents, than in focusing on the present defeats.

The permanent partiality of feminist points of view has consequences for our expectations of forms of political organization and participation. We do not need a totality in order to work well. The feminist dream of a common language, like all dreams for a perfectly true language, of perfectly faithful naming of experience, is a totalizing and imperialist one. In that sense, dialectics too is a dream language, longing to resolve contradiction. Perhaps, ironically, we can learn from our fusions with animals and machines how not to be Man, the embodiment of Western logos. From the point of view of pleasure in these potent and taboo fusions, made inevitable by the social relations of science and technology, there might indeed be a feminist science.

Cyborgs: A Myth of Political Identity

I want to conclude with a myth about identity and boundaries which might inform late twentieth-century political imaginations. I am indebted in this story to writers like Joanna Russ, Samuel R. Delany, John Varley, James Tiptree, Jr, Octavia Butler, Monique Wittig, and Vonda McIntyre.¹⁹ These are our story-tellers exploring what it means to be embodied in high-tech worlds. They are theorists for cyborgs. Exploring conceptions of bodily boundaries and social order, the anthropologist Mary Douglas (1966, 1970) should be credited with helping us to consciousness about how fundamental body imagery is to world view, and so to political language. French feminists like Luce Irigaray and Monique Wittig, for all their differences, know how to write the body; how to weave eroticism, cosmology, and politics from imagery of embodiment, and especially for Wittig, from imagery of fragmentation and reconstitution of bodies.²⁰

American radical feminists like Susan Griffin, Audre Lorde, and Adrienne Rich have profoundly affected our political imaginations – and perhaps restricted too much what we allow as a friendly body and political language.²¹ They insist on the organic, opposing it to the technological. But their symbolic systems and the related positions of eco-feminism and feminist paganism, replete with organicisms, can only be understood in Sandoval's terms as oppositional ideologies fitting the late twentieth century. They would simply bewilder anyone not preoccupied with the machines and consciousness of late capitalism. In that sense they are part of the cyborg world. But there are also great riches for feminists in explicitly embracing the possibilities inherent in the breakdown of clean distinctions between organism and machine and similar distinctions structuring the Western self. It is the simultaneity of breakdowns that cracks the matrices of domination and opens geometric possibilities. What might be learned from personal and political "technological" pollution? I look briefly at two overlapping groups of texts for their insight into the construction of a potentially helpful cyborg myth: constructions of women of colour and monstrous selves in feminist science fiction.

Earlier I suggested that "women of colour" might be understood as a cyborg identity, a potent subjectivity synthesized from fusions of outsider identities and in the complex political-historical layerings of her "biomythography", *Zami* (Lorde, 1982; King, 1987a, 1987b).

There are material and cultural grids mapping this potential, Audre Lorde (1984) captures the tone in the title of her *Sister Outsider*. In my political myth, Sister Outsider is the offshore woman, whom US workers, female and feminized, are supposed to regard as the enemy preventing their solidarity, threatening their security. Onshore, inside the boundary of the United States, Sister Outsider is a potential amidst the races and ethnic identities of woman manipulated for division, competition, and exploitation in the same industries. "Women of colour" are the preferred labour force for the science-based industries, the real women for whom the worldwide sexual market, labour market, and politics of reproduction kaleidoscope into daily life. Young Korean women hired in the sex industry and in electronics assembly are recruited from high schools, educated for the integrated circuit. Literacy, especially in English, distinguishes the "cheap" female labour so attractive to the multinationals.

Contrary to orientalist stereotypes of the "oral primitive", literacy is a special mark of women of colour, acquired by US black women as well as men through a history of risking death to learn and to teach reading and writing. Writing has a special significance for all colonized groups. Writing has been crucial to the Western myth of the distinction between oral and written cultures, primitive and civilized mentalities, and more recently to the erosion of that distinction in "post-modernist" theories attacking the phallogocentrism of the West, with its worship of the monotheistic, phallic, authoritative, and singular work, the unique and perfect name.²² Contests for the meanings of writing are a major form of contemporary political struggle. Releasing the play of writing is deadly serious. The poetry and stories of US women of colour are repeatedly about writing, about access to the power to signify; but this time that power must be neither phallic nor innocent. Cyborg writing must not be about the Fall, the imagination of a once-upon-a-time wholeness before language, before writing, before Man. Cyborg writing is about the power to survive, not on the basis of original innocence, but on the basis of seizing the tools to mark the world that marked them as other.

The tools are often stories, retold stories, versions that reverse and displace the hierarchical dualisms of naturalized identities. In retelling origin stories, cyborg authors subvert the central myths of origin of Western culture. We have all been colonized by those origin myths, with their longing for fulfilment in apocalypse. The phallogocentric

origin stories most crucial for feminist cyborgs are built into the literal technologies – technologies that write the world, biotechnology and microelectronics – that have recently textualized our bodies as code problems on the grid of C³I. Feminist cyborg stories have the task of recoding communication and intelligence to subvert command and control.

Figuratively and literally, language politics pervade the struggles of women of colour; and stories about language have a special power in the rich contemporary writing by US women of colour. For example, retellings of the story of the indigenous woman Malinche, mother of the mestizo “bastard” race of the new world, master of languages, and mistress of Cortés, carry special meaning for Chicana constructions of identity. Cherríe Moraga (1983) in *Loving in the War Years* explores the themes of identity when one never possessed the original language, never told the original story, never resided in the harmony of legitimate heterosexuality in the garden of culture, and so cannot base identity on a myth or a fall from innocence and right to natural names, mother’s or father’s.²³ Moraga’s writing, her superb literacy, is presented in her poetry as the same kind of violation as Malinche’s mastery of the conqueror’s language – a violation, an illegitimate production, that allows survival. Moraga’s language is not “whole”; it is self-consciously spliced, a chimera of English and Spanish, both conqueror’s languages. But it is this chimeric monster, without claim to an original language before violation, that crafts the erotic, competent, potent identities of women of colour. Sister Outsider hints at the possibility of world survival not because of her innocence, but because of her ability to live on the boundaries, to write without the founding myth of original wholeness, with its inescapable apocalypse of final return to a deathly oneness that Man has imagined to be the innocent and all-powerful Mother, freed at the End from another spiral of appropriation by her son. Writing marks Moraga’s body, affirms it as the body of a woman of colour, against the possibility of passing into the unmarked category of the Anglo father or into the orientalist myth of “original illiteracy” of a mother that never was. Malinche was mother here, not Eve before eating the forbidden fruit. Writing affirms Sister Outsider, not the Woman-before-the-Fall-into-Writing needed by the phallogocentric Family of Man.

Writing is pre-eminently the technology of cyborgs, etched surfaces of the late twentieth century. Cyborg politics is the struggle for language and the struggle against perfect communication, against the one code that

translates all meaning perfectly, the central dogma of phallogocentrism. That is why cyborg politics insist on noise and advocate pollution, rejoicing in the illegitimate fusions of animal and machine. These are the couplings which make Man and Woman so problematic, subverting the structure of desire, the force imagined to generate language and gender, and so subverting the structure and modes of reproduction of “Western” identity, of nature and culture, of mirror and eye, slave and master, body and mind. “We” did not originally choose to be cyborgs, but choice grounds a liberal politics and epistemology that imagines the reproduction of individuals before the wider replications of “texts”.

From the perspective of cyborgs, freed of the need to ground politics in “our” privileged position of the oppression that incorporates all other dominations, the innocence of the merely violated, the ground of those closer to nature, we can see powerful possibilities. Feminisms and Marxisms have run aground on Western epistemological imperatives to construct a revolutionary subject from the perspective of a hierarchy of oppressions and/or a latent position of moral superiority, innocence, and greater closeness to nature. With no available original dream of a common language or original symbiosis promising protection from hostile “masculine” separation, but written into the play of a text that has no finally privileged reading or salvation history, to recognize “oneself” as fully implicated in the world, frees us of the need to root politics in identification, vanguard parties, purity, and mothering. Stripped of identity, the bastard race teaches about the power of the margins and the importance of a mother like Malinche. Women of colour have transformed her from the evil mother of masculinist fear into the originally literate mother who teaches survival.

This is not just literary deconstruction, but liminal transformation. Every story that begins with original innocence and privileges the return to wholeness imagines the drama of life to be individuation, separation, the birth of the self, the tragedy of autonomy, the fall into writing, alienation; that is, war, tempered by imaginary respite in the bosom of the Other. These plots are ruled by a reproductive politics – rebirth without flaw, perfection, abstraction. In this plot women are imagined either better or worse off, but all agree they have less selfhood, weaker individuation, more fusion to the oral, to Mother, less at stake in masculine autonomy. But there is another route to having less at stake in masculine autonomy, a route that does not pass through Woman, Primitive, Zero,

the Mirror Stage and its imaginary. It passes through women and other present-tense, illegitimate cyborgs, not of Woman born, who refuse the ideological resources of victimization so as to have a real life. These cyborgs are the people who refuse to disappear on cue, no matter how many times a “Western” commentator remarks on the sad passing of another primitive, another organic group done in by “Western” technology, by writing.²⁴ These real-life cyborgs (for example, the Southeast Asian village women workers in Japanese and US electronics firms described by Aihwa Ong) are actively rewriting the texts of their bodies and societies. Survival is the stakes in this play of readings.

To recapitulate, certain dualisms have been persistent in Western traditions; they have all been systemic to the logics and practices of domination of women, people of colour, nature, workers, animals – in short, domination of all constituted as others, whose task is to mirror the self. Chief among these troubling dualisms are self/other, mind/body, culture/nature, male/female, civilized/primitive, reality/appearance, whole/part, agent/resource, maker/made, active/passive, right/wrong, truth/illusion, total/partial, God/man. The self is the One who is not dominated, who knows that by the service of the other, the other is the one who holds the future, who knows that by the experience of domination, which gives the lie to the autonomy of the self. To be One is to be autonomous, to be powerful, to be God; but to be One is to be an illusion, and so to be involved in a dialectic of apocalypse with the other. Yet to be other is to be multiple, without clear boundary, frayed, insubstantial. One is too few, but two are too many.

High-tech culture challenges these dualisms in intriguing ways. It is not clear who makes and who is made in the relation between human and machine. It is not clear what is mind and what body in machines that resolve into coding practices. In so far as we know ourselves in both formal discourse (for example, biology) and in daily practice (for example, the homework economy in the integrated circuit), we find ourselves to be cyborgs, hybrids, mosaics, chimeras. Biological organisms have become biotic systems, communications devices like others. There is no fundamental, ontological separation in our formal knowledge of machine and organism, of technical and organic. The replicant Rachel in the Ridley Scott film *Blade Runner* stands as the image of a cyborg culture’s fear, love, and confusion.

One consequence is that our sense of connection to our tools is heightened. The trance state experienced by

many computer users has become a staple of science-fiction film and cultural jokes. Perhaps paraplegics and other severely handicapped people can (and sometimes do) have the most intense experiences of complex hybridization with other communication devices.²⁵ Anne McCaffrey’s pre-feminist *The Ship Who Sang* (1969) explored the consciousness of a cyborg, hybrid of girl’s brain and complex machinery, formed after the birth of a severely handicapped child. Gender, sexuality, embodiment, skill: all were reconstituted in the story. Why should our bodies end at the skin, or include at best other beings encapsulated by skin? From the seventeenth century till now, machines could be animated – given ghostly souls to make them speak or move or to account for their orderly development and mental capacities. Or organisms could be mechanized – reduced to body understood as resource of mind. These machine/organism relationships are obsolete, unnecessary. For us, in imagination and in other practice, machines can be prosthetic devices, intimate components, friendly selves. We don’t need organic holism to give impermeable wholeness, the total woman and her feminist variants (mutants?). Let me conclude this point by a very partial reading of the logic of the cyborg monsters of my second group of texts, feminist science fiction.

The cyborgs populating feminist science fiction make very problematic the statuses of man or woman, human, artefact, member of a race, individual entity, or body. Katie King clarifies how pleasure in reading these fictions is not largely based on identification. Students facing Joanna Russ for the first time, students who have learned to take modernist writers like James Joyce or Virginia Woolf without flinching, do not know what to make of *The Adventures of Alyx* or *The Female Man*, where characters refuse the reader’s search for innocent wholeness while granting the wish for heroic quests, exuberant eroticism, and serious politics. *The Female Man* is the story of four versions of one genotype, all of whom meet, but even taken together do not make a whole, resolve the dilemmas of violent moral action, or remove the growing scandal of gender. The feminist science fiction of Samuel R. Delany, especially *Tales of Nevèrÿon*, mocks stories of origin by redoing the neolithic revolution, replaying the founding moves of Western civilization to subvert their plausibility. James Tiptree, Jr, an author whose fiction was regarded as particularly manly until her “true” gender was revealed, tells tales of reproduction based on non-mammalian technologies like alternation of generations of male brood pouches and male nurturing.

John Varley constructs a supreme cyborg in his arch-feminist exploration of Gaea, a mad goddess-planet-trickster-old woman-technological device on whose surface an extraordinary array of post-cyborg symbioses are spawned. Octavia Butler writes of an African sorceress pitting her powers of transformation against the genetic manipulations of her rival (*Wild Seed*), of time warps that bring a modern US black woman into slavery where her actions in relation to her white master-ancestor determine the possibility of her own birth (*Kindred*), and of the illegitimate insights into identity and community of an adopted cross-species child who came to know the enemy as self (*Survivor*). In *Dawn* (1987), the first instalment of a series called *Xenogenesis*, Butler tells the story of Lilith Iyapo, whose personal name recalls Adam's first and repudiated wife and whose family name marks her status as the widow of the son of Nigerian immigrants to the US. A black woman and a mother whose child is dead, Lilith mediates the transformation of humanity through genetic exchange with extra-terrestrial lovers/rescuers/destroyers/genetic engineers, who reform earth's habitats after the nuclear holocaust and coerce surviving humans into intimate fusion with them. It is a novel that interrogates reproductive, linguistic, and nuclear politics in a mythic field structured by late twentieth-century race and gender.

Because it is particularly rich in boundary transgressions, Vonda McIntyre's *Superluminal* can close this truncated catalogue of promising and dangerous monsters who help redefine the pleasures and politics of embodiment and feminist writing. In a fiction where no character is "simply" human, human status is highly problematic. Orca, a genetically altered diver, can speak with killer whales and survive deep ocean conditions, but she longs to explore space as a pilot, necessitating bionic implants jeopardizing her kinship with the divers and cetaceans. Transformations are effected by virus vectors carrying a new developmental code, by transplant surgery, by implants of microelectronic devices, by analogue doubles, and other means. Laenea becomes a pilot by accepting a heart implant and a host of other alterations allowing survival in transit at speeds exceeding that of light. Radu Dracul survives a virus-caused plague in his outerworld planet to find himself with a time sense that changes the boundaries of spatial perception for the whole species. All the characters explore the limits of language; the dream of communicating experience; and the necessity of limitation, partiality, and intimacy even in this world of protean transformation and connection. *Superluminal* stands also

for the defining contradictions of a cyborg world in another sense; it embodies textually the intersection of feminist theory and colonial discourse in the science fiction I have alluded to in this essay. This is a conjunction with a long history that many "First World" feminists have tried to repress, including myself in my readings of *Superluminal* before being called to account by Zoë Sofoulis, whose different location in the world system's informatics of domination made her acutely alert to the imperialist moment of all science fiction cultures, including women's science fiction. From an Australian feminist sensitivity, Sofoulis remembered more readily McIntyre's role as writer of the adventures of Captain Kirk and Spock in TV's *Star Trek* series than her rewriting the romance in *Superluminal*.

Monsters have always defined the limits of community in Western imaginations. The Centaurs and Amazons of ancient Greece established the limits of the centred polis of the Greek male human by their disruption of marriage and boundary pollutions of the warrior with animality and woman. Unseparated twins and hermaphrodites were the confused human material in early modern France who grounded discourse on the natural and supernatural, medical and legal, portents and diseases – all crucial to establishing modern identity.²⁶ The evolutionary and behavioural sciences of monkeys and apes have marked the multiple boundaries of late twentieth-century industrial identities. Cyborg monsters in feminist science fiction define quite different political possibilities and limits from those proposed by the mundane fiction of Man and Woman.

There are several consequences to taking seriously the imagery of cyborgs as other than our enemies. Our bodies, ourselves; bodies are maps of power and identity. Cyborgs are no exception. A cyborg body is not innocent; it was not born in a garden; it does not seek unitary identity and so generate antagonistic dualisms without end (or until the world ends); it takes irony for granted. One is too few, and two is only one possibility. Intense pleasure in skill, machine skill, ceases to be a sin, but an aspect of embodiment. The machine is not an *it* to be animated, worshipped, and dominated. The machine is us, our processes, an aspect of our embodiment. We can be responsible for machines; *they* do not dominate or threaten us. We are responsible for boundaries; we are they. Up till now (once upon a time), female embodiment seemed to be given, organic, necessary; and female embodiment seemed to mean skill in mothering and its metaphoric extensions. Only by being out of place could

we take intense pleasure in machines, and then with excuses that this was organic activity after all, appropriate to females. Cyborgs might consider more seriously the partial, fluid, sometimes aspect of sex and sexual embodiment. Gender might not be global identity after all, even if it has profound historical breadth and depth.

The ideologically charged question of what counts as daily activity, as experience, can be approached by exploiting the cyborg image. Feminists have recently claimed that women are given to dailiness, that women more than men somehow sustain daily life, and so have a privileged epistemological position potentially. There is a compelling aspect to this claim, one that makes visible unvalued female activity and names it as the ground of life. But *the* ground of life? What about all the ignorance of women, all the exclusions and failures of knowledge and skill? What about men's access to daily competence, to knowing how to build things, to take them apart, to play? What about other embodiments? Cyborg gender is a local possibility taking a global vengeance. Race, gender, and capital require a cyborg theory of wholes and parts. There is no drive in cyborgs to produce total theory, but there is an intimate experience of boundaries, their construction and deconstruction. There is a myth system waiting to become a political language to ground one way of looking at science and technology and challenging the informatics of domination – in order to act potently.

One last image: organisms and organismic, holistic politics depend on metaphors of rebirth and invariably call on the resources of reproductive sex. I would suggest that cyborgs have more to do with regeneration

and are suspicious of the reproductive matrix and of most birthing. For salamanders, regeneration after injury, such as the loss of a limb, involves regrowth of structure and restoration of function with the constant possibility of twinning or other odd topographical productions at the site of former injury. The regrown limb can be monstrous, duplicated, potent. We have all been injured, profoundly. We require regeneration, not rebirth, and the possibilities for our reconstitution include the utopian dream of the hope for a monstrous world without gender.

Cyborg imagery can help express two crucial arguments in this essay: first, the production of universal, totalizing theory is a major mistake that misses most of reality, probably always, but certainly now; and second, taking responsibility for the social relations of science and technology means refusing an anti-science metaphysics, a demonology of technology, and so means embracing the skilful task of reconstructing the boundaries of daily life, in partial connection with others, in communication with all of our parts. It is not just that science and technology are possible means of great human satisfaction, as well as a matrix of complex dominations. Cyborg imagery can suggest a way out of the maze of dualisms in which we have explained our bodies and our tools to ourselves. This is a dream not of a common language, but of a powerful infidel heteroglossia. It is an imagination of a feminist speaking in tongues to strike fear into the circuits of the super-savers of the new right. It means both building and destroying machines, identities, categories, relationships, space stories. Though both are bound in the spiral dance, I would rather be a cyborg than a goddess.

Notes

- 1 Useful references to left and/or feminist radical science movements and theory and to biological/biotechnical issues include: Bleier (1984, 1986), Harding (1986), Fausto-Sterling (1985), Gould (1981), Hubbard et al. (1982), Keller (1985), Lewontin et al. (1984), *Radical Science Journal* (became *Science as Culture* in 1987), 26 Freegrove Road, London N7 9RQ; *Science for the People*, 897 Main St, Cambridge, MA 02139.
- 2 Starting points for left and/or feminist approaches to technology and politics include: Cowan (1983), Rothschild (1983), Traweek (1988), Young and Levidow (1981, 1985), Weizenbaum (1976), Winner (1977, 1986), Zimmerman (1983), Athanasiou (1987), Cohn (1987a, 1987b), Winograd and Flores (1986), Edwards (1985), *Global Electronics*

Newsletter, 500 N 56th St: Suite 15, Chandler, AZ 85226; *Processed World*, 1310 Mission St, San Francisco, CA 94103; ISIS, Women's International Information and Communication Service, 3 Marunong St, Brgy. Central, Quezon City, Philippines. Fundamental approaches to modern social studies of science that do not continue the liberal mystification that it all started with Thomas Kuhn, include: Knorr-Cetina (1981), Knorr-Cetina and Mulkay (1983), Latour and Woolgar (1979), Young (1979). The 1984 Directory of the Network for the Ethnographic Study of Science, Technology, and Organizations lists a wide range of people and projects crucial to better radical analysis; available from NESSTO, PO Box 11442, Stanford, CA 94305. [No longer listed, 2013. eds.]

- 3 A provocative, comprehensive argument about the politics and theories of “postmodernism” is made by Fredric Jameson (1984), who argues that postmodernism is not an option, a style among others, but a cultural dominant, requiring radical reinvention of left politics from within; there is no longer any place from without that gives meaning to the comforting fiction of critical distance. Jameson also makes clear why one cannot be for or against postmodernism, an essentially moralist move. My position is that feminists (and others) need continuous cultural reinvention, postmodernist critique, and historical materialism, only a cyborg would have a chance. The old dominations of white capitalist patriarchy seem nostalgically innocent now: they normalized heterogeneity, into man and woman, white and black, for example. “Advanced capitalism” and postmodernism release heterogeneity without a norm, and we are flattened, without subjectivity, which requires depth, even unfriendly and drowning depths. It is time to write *The Death of the Clinic*. The clinic’s methods required bodies and works; we have texts and surfaces. Our dominations don’t work by medicalization and normalization any more; they work by networking, communications redesign, stress management. Normalization gives way to automation, utter redundancy. Michel Foucault’s *Birth of the Clinic* (1963), *History of Sexuality* (1976), and *Discipline and Punish* (1975) name a form of power at its moment of implosion. The discourse of biopolitics gives way to technobabble, the language of the spliced substantive; no noun is left whole by the multinationals. These are their names, listed from one issue of *Science*: Tech-Knowledge, Genentech, Allergen, Hybritech, Compupro, Genen-cor, Syntex, Allelix, Agrigenetics Corp., Syntro, Codon, Repligen, MicroAngelo from Scion Corp., Percom Data, Inter Systems, Cyborg Corp., Statcom Corp., Intertec. If we are imprisoned by language, then escape from that prison-house requires language poets, a kind of cultural restriction enzyme to cut the code; cyborg heteroglossia is one form of radical cultural politics. For cyborg poetry, see Perloff (1984); Fraser (1984). For feminist modernist/postmodernist “cyborg” writing, see HOW(ever), 871 Corbett Ave, San Francisco, CA 94131.
- 4 The US equivalent of Mills & Boon. [Ed.]
- 5 Baudrillard (1983). Jameson (1984, p. 66) points out that Plato’s definition of the simulacrum is the copy for which there is no original, i.e., the world of advanced capitalism, of pure exchange. See *Discourse 9* (Spring/Summer 1987) for a special issue on technology (cybernetics, ecology, and the postmodern imagination).
- 6 A practice at once both spiritual and political that linked guards and arrested anti-nuclear demonstrators in the Alameda County jail in California in the early 1980s. [Ed.]
- 7 For ethnographic accounts and political evaluations, see Epstein (forthcoming), Sturgeon (1986). Without explicit irony, adopting the spaceship earth/whole earth logo of the planet photographed from space, set off by the slogan “Love Your Mother”, the May 1987 Mothers and Others Day action at the nuclear weapons testing facility in Nevada none the less took account of the tragic contradictions of views of the earth. Demonstrators applied for official permits to be on the land from officers of the Western Shoshone tribe, whose territory was invaded by the US government when it built the nuclear weapons test ground in the 1950s. Arrested for trespassing, the demonstrators argued that the police and weapons facility personnel, without authorization from the proper officials, were the trespassers. One affinity group at the women’s action called themselves the Surrogate Others; and in solidarity with the creatures forced to tunnel in the same ground with the bomb, they enacted a cyborgian emergence from the constructed body of a large, non-heterosexual desert worm.
- 8 This chart was published in 1985. My previous efforts to understand biology as a cybernetic command-control discourse and organisms as “natural-technical objects of knowledge” were Haraway (1979, 1983, 1984). The 1979 version of this dichotomous chart appears in Haraway 1991, ch. 3; for a 1989 version, see *ibid.*, ch. 10. The differences indicate shifts in argument.
- 9 For progressive analyses and action on the biotechnology debates: *GeneWatch, a Bulletin of the Committee for Responsible Genetics*, 5 Doane St, 4th Floor, Boston, MA 02109; Genetic Screening Study Group (formerly the Sociobiology Study Group of Science for the People), Cambridge, MA; Wright (1982, 1986); Yoxen (1983).
- 10 Starting references for “women in the integrated circuit”: D’Onofrio-Flores and Pfafflin (1982), Fernandez-Kelly (1983), Fuentes and Ehrenreich (1983), Grossman (1980), Nash and Fernandez-Kelly (1983), Ong (1982), Science Policy Research Unit (1982).
- 11 For the “homework economy outside the home” and related arguments: Gordon (1983); Gordon and Kimball (1985); Stacey (1987); Reskin and Hartmann (1986); *Women and Poverty* (1984); Rose (1986); Collins (1982); Burr (1982); Gregory and Nussbaum (1982); Piven and Coward (1982); Microelectronics Group (1980); Stallard et al (1983) which includes a useful organization and resource list.
- 12 The conjunction of the Green Revolution’s social relations with biotechnologies like plant genetic engineering makes the pressures on land in the Third World increasingly intense. AID’s estimates (*New York Times*, 14 October 1984) used at the 1984 World Food Day are that in Africa, women produce about 90 per cent of rural food supplies, about 60–80 per cent in Asia, and provide 40 per cent of agricultural

- labour in the Near East and Latin America. Blumberg charges that world organizations' agricultural politics, as well as those of multinationals and national governments in the Third World, generally ignore fundamental issues in the sexual division of labour. The present tragedy of famine in Africa might owe as much to male supremacy as to capitalism, colonialism, and rain patterns. More accurately, capitalism and racism are usually structurally male dominant. See also Blumberg (1981); Hacker (1984); Hacker and Bovit (1981); Busch and Lacy (1983); Wilfred (1982); Sachs (1983); International Fund for Agricultural Development (1985); Bird (1984).
- 13 See also Enloe (1983a, b).
 - 14 For a feminist version of this logic, see Hrdy (1981). For an analysis of scientific women's story-telling practices, especially in relation to sociobiology in evolutionary debates around child abuse and infanticide, see Haraway 1991, ch. 5.
 - 15 For the moment of transition of hunting with guns to hunting with cameras in the construction of popular meanings of nature for an American urban immigrant public, see Haraway (1984–5, 1989), Nash (1979), Sontag (1977), Preston (1984).
 - 16 For guidance for thinking about the political/cultural/racial implications of the history of women doing science in the United States see: Haas and Perucci (1984); Hacker (1981); Keller (1983); National Science Foundation (1988); Rossiter (1982); Schiebinger (1987); Haraway (1989).
 - 17 Markoff and Siegel (1983). High Technology Professionals for Peace and Computer Professionals for Social Responsibility are promising organizations.
 - 18 Service Employees International Union's office workers' organization in the US. [Ed.]
 - 19 King (1984). An abbreviated list of feminist science fiction underlying themes of this essay: Octavia Butler, *Wild Seed*, *Mind of My Mind*, *Kindred*, *Survivor*, Suzy McKee Charnas, *Motherliness*, Samuel R. Delany, the Nevèrÿon series; Anne McCaffery, *The Ship Who Sang*, *Dinosaur Planet*, Vonda McIntyre, *Superluminal*, *Dreamsnake*, Joanna Russ, *Adventures of Alix*, *The Female Man*; James Tiptree, Jr, *Star Songs of an Old Primate*, *Up the Walls of the World*; John Varley, *Titan*, *Wizard*, *Demon*.
 - 20 French feminisms contribute to cyborg heteroglossia. Burke (1981); Irigaray (1977, 1979); Marks and de Courtivron (1980); *Signs* (Autumn 1981); Wittig (1973), Duchon (1986). For English translation of some currents of francophone feminism see *Feminist Issues: A Journal of Feminist Social and Political Theory*, 1980.
 - 21 But all these poets are very complex, not least in their treatment of themes of lying and erotic, decentred collective and personal identities. Griffin (1978), Lorde (1984), Rich (1978).
 - 22 Derrida (1976, especially part II); Lévi-Strauss (1971, especially "The Writing Lesson"); Gates (1985); Kahn and Neumaier (1985); Ong (1982); Kramarae and Treichler (1985).
 - 23 The sharp relation of women of colour to writing as theme and politics can be approached through: Program for "The Black Woman and the Diaspora: Hidden Connections and Extended Acknowledgments", An International Literary Conference, Michigan State University, October 1985; Evans (1984); Christian (1985); Carby (1987); Fisher (1980); *Frontiers* (1980, 1983); Kingston (1977); Lerner (1973), Giddings (1985); Moraga and Anzaldúa (1981); Morgan (1984). Anglophone European and Euro-American women have also crafted special relations to their writing as a potent sign: Gilbert and Gubar (1979), Russ (1983).
 - 24 The convention of ideologically taming militarized high technology by publicizing its applications to speech and motion problems of the disabled/differently abled takes on a special irony in monotheistic, patriarchal, and frequently anti-semitic culture when computer-generated speech allows a boy with no voice to chant the Haftorah at his bar mitzvah. See Sussman (1986). Making the always context-relative social definitions of "ableness" particularly clear, military high-tech has a way of making human beings disabled by definition, a perverse aspect of much automated battlefield and Star Wars R&D. See Welford (1 July 1986).
 - 25 James Clifford (1985, 1988) argues persuasively for recognition of continuous cultural reinvention, the stubborn non-disappearance of those "marked" by Western imperializing practices.
 - 26 DuBois (1982), Daston and Park (n.d.), Park and Daston (1981). The noun *monster* shares its root with the verb *to demonstrate*.

Bibliography

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- Athanasios, Tom (1987) "High-tech politics: the case of artificial intelligence", *Socialist Review* 92: 7–35.
- Baudrillard, Jean (1983) *Simulations*, P. Foss, P. Patton, P. Beitchman, trans. New York: Semiotext[e].
- Bird, Elizabeth (1984) "Green Revolution imperialism, I & II", papers delivered at the University of California, Santa Cruz.
- Bleier, Ruth (1984) *Science and Gender: A Critique of Biology and Its Themes on Women*. New York: Pergamon.
- Bleier, Ruth ed. (1986) *Feminist Approaches to Science*. New York: Pergamon.
- Blumberg, Rae Lessor (1981) *Stratification: Socioeconomic and Sexual Inequality*. Boston: Brown.

- Blumberg, Rae Lesser (1983) "A general theory of sex stratification and its application to the positions of women in today's world economy", paper delivered to Sociology Board, University of California at Santa Cruz.
- Burke, Carolyn (1981) "Irigaray through the looking glass", *Feminist Studies* 7(2): 288–306.
- Burr, Sara G. (1982) "Women and work", in Barbara K. Haber, ed. *The Women's Annual, 1981*. Boston: G.K. Hall.
- Busch, Lawrence and Lacy, William (1983) *Science, Agriculture, and the Politics of Research*. Boulder, CO: West-view.
- Butler, Octavia (1987) *Dawn*. New York: Warner.
- Carby, Hazel (1987) *Reconstructing Womanhood: The Emergence of the Afro-American Woman Novelist*. New York: Oxford University Press.
- Christian, Barbara (1985) *Black Feminist Criticism: Perspectives on Black Women Writers*. New York: Pergamon.
- Clifford, James (1985) "On ethnographic allegory", in James Clifford and George Marcus, eds *Writing Culture: The Poetics and Politics of Ethnography*. Berkeley: University of California Press.
- Clifford, James (1988) *The Predicament of Culture: Twentieth-Century Ethnography, Literature, and Art*. Cambridge, MA: Harvard University Press.
- Cohn, Carol (1987a) "Nuclear language and how we learned to pat the bomb", *Bulletin of Atomic Scientists*, pp. 17–24.
- Cohn, Carol (1987b) "Sex and death in the rational world of defense intellectuals", *Signs* 12(4): 687–718.
- Collins, Patricia Hill (1982) "Third World women in America", in Barbara K. Haber, ed. *The Women's Annual, 1981*. Boston: G.K. Hall.
- Cowan, Ruth Schwartz (1983) *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave*. New York: Basic.
- Daston, Lorraine and Park, Katherine (n.d.) "Hermaphrodites in Renaissance France", unpublished paper.
- de Waal, Frans (1982) *Chimpanzee Politics: Power and Sex among the Apes*. New York: Harper & Row.
- Derrida, Jacques (1976) *Of Grammatology*, G. C. Spivak, trans, and introd. Baltimore: Johns Hopkins University Press.
- D'Onofrio-Flores, Pamela and Pfafflin, Sheila M., eds (1982) *Scientific-Technological Change and the Role of Women in Development*. Boulder: Westview.
- Douglas, Mary (1966) *Purity and Danger*. London: Routledge & Kegan Paul.
- Douglas, Mary (1970) *Natural Symbols*. London: Cresset Press.
- DuBois, Page (1982) *Centaurs and Amazons*. Ann Arbor: University of Michigan Press.
- Duchen, Claire (1986) *Feminism in France from May '68 to Mitterrand*. London: Routledge & Kegan Paul.
- Edwards, Paul (1985) "Border wars: the science and politics of artificial intelligence", *Radical America* 19(6): 39–52.
- Enloe, Cynthia (1983a) "Women textile workers in the militarization of Southeast Asia", in Nash and Fernandez-Kelly (1983), pp. 407–25.
- Epstein, Barbara (forthcoming) *Political Protest and Cultural Revolution: Nonviolent Direct Action in the Seventies and Eighties*. Berkeley: University of California Press.
- Evans, Mari, ed. (1984) *Black Women Writers: A Critical Evaluation*. Garden City, NY: Doubleday/Anchor.
- Fausto-Sterling, Anne (1985) *Myths of Gender: Biological Theories about Women and Men*. New York: Basic.
- Fernandez-Kelly, Maria Patricia (1983) *For We Are Sold, I and My People*. Albany: State University of New York Press.
- Fisher, Dexter, ed. (1980) *The Third Woman: Minority Women Writers of the United States*. Boston: Houghton Mifflin.
- Foucault, Michel (1963) *The Birth of the Clinic: An Archaeology of Medical Perception*, A.M. Smith, trans. New York: Vintage, 1975.
- Foucault, Michel (1975) *Discipline and Punish: The Birth of the Prison*, Alan Sheridan, trans. New York: Vintage, 1979.
- Foucault, Michel (1976) *The History of Sexuality*. Vol. 1: *An Introduction*, Robert Hurley, trans. New York: Pantheon, 1978.
- Fraser, Kathleen (1984) *Something Even Human Voices*. In *The Foreground, a Lake*. Berkeley, CA: Kelsey St Press.
- Fuentes, Annette and Ehrenreich, Barbara (1983) *Women in the Global Factory*. Boston: South End.
- Gates, Henry Louis (1985) "Writing 'race' and the difference it makes", in "Race", *Writing, and Difference*, special issue, *Critical Inquiry* 12(1): 1–20.
- Giddings, Paula (1985) *When and Where I Enter: The Impact of Black Women on Race and Sex in America*. Toronto: Bantam.
- Gilbert, Sandra M. and Gubar, Susan (1979) *The Mad-Woman in the Attic: The Woman Writer and the Nineteenth-Century Literary Imagination*. New Haven, CT: Yale University Press.
- Gordon, Richard (1983) "The computerization of daily life, the sexual division of labor, and the homework-economy", Silicon Valley Workshop conference, University of California at Santa Cruz.
- Gordon, Richard and Kimball, Linda (1985) "High-technology, employment and the challenges of education", Silicon Valley Research Project, Working Paper, no. 1.
- Gould, Stephen J. (1981) *Mismeasure of Man*. New York: Norton.
- Gregory, Judith and Nussbaum, Karen (1982) "Race against time: automation of the office", *Office: Technology and People* 1: 197–236.
- Griffin, Susan (1978) *Woman and Nature: The Roaring Inside Her*. New York: Harper & Row.
- Grossman, Rachel (1980) "Women's place in the integrated circuit", *Radical America* 14(1): 29–50.
- Haas, Violet and Perucci, Carolyn, eds (1984) *Women in Scientific and Engineering Professions*. Ann Arbor: University of Michigan Press.
- Hacker, Sally (1981) "The culture of engineering: women, workplace, and machine", *Women's Studies International Quarterly* 4(3): 341–53.

- Hacker, Sally (1984) "Doing it the hard way: ethnographic studies in the agribusiness and engineering classroom", paper delivered at the California American Studies Association, Pomona.
- Hacker, Sally and Bovit, Liza (1981) "Agricuture to agribusiness: technical imperatives and changing roles", paper delivered at the Society-for the History of Technology, Milwaukee.
- Haraway, Donna J. (1979) "The biological enterprise: sex, mind, and profit from human engineering to sociobiology", *Radical History Review* 20: 206–37.
- Haraway, Donna J. (1983) "Signs of dominance: from a physiology to a cybernetics of primate society", *Studies in History of Biology* 6: 129–219.
- Haraway, Donna J. (1984) "Class, race, sex, scientific objects of knowledge: a socialist-feminist perspective on the social construction of productive knowledge and some political consequences", in Haas and Perucci (1984), pp. 212–29.
- Haraway, Donna J. (1984–5) "Teddy bear patriarchy: taxidermy in the Garden of Eden, New York City, 1908–36", *Social Text* 11: 20–64.
- Haraway, Donna J. (1989) *Primate Visions: Gender, Race, and Nature in the World of Modern Science*. New York: Routledge.
- Haraway, Donna J. (1991) *Simians, Cyborgs and Women: The Reinvention of Nature*. New York: Routledge.
- Harding, Sandra (1986) *The Science Question in Feminism*. Ithaca Cornell University Press.
- Hogness, E. Rusten (1983) "Why stress? A look at the making of stress, 1936–56", unpublished paper available from the author, 4437 Mill Creek Rd, Healdsburg, CA 95448.
- Hrды, Sarah Blaffer (1981) *The Woman That Never Evolved*. Cambridge, MA: Harvard University Press.
- Hubbard, Ruth, Henifin, Mary Sue, and Fried, Barbara, eds (1982) *Biological Woman, the Convenient Myth*. Cambridge, MA: Schenkman.
- International Fund for Agricultural Development (1985) *IFAD Experience Relating to Rural Women, 1977–84*. Rome: IFAD, 37.
- Irigaray, Luce (1977) *Ce sexe qui n'en est pas un*. Paris: Minuit.
- Jameson, Fredric (1984) "Post-modernism, or the cultural logic of late capitalism", *New Left Review* 146: 53–92.
- Kahn, Douglas and Neumaier, Diane, eds (1985) *Cultures in Contention*. Seattle: Real Cornet.
- Keller, Evelyn Fox (1983) *A Feeling for the Organism*. San Francisco: Freeman.
- Keller, Evelyn Fox (1985) *Reflection on Gender and Science*. New Haven: Yale university Press.
- King, Katie (1984) "The pleasure of repetition and the limits of identification in feminist science fiction: reimaginings of the body after the cyborg", paper delivered at the California American Studies Association, Pomona.
- King, Katie (1987a) "Canos without innocence", University of California at Cruz, PhD thesis.
- King, Katie (1987b) *The passing Dreams of choice ... Once Before and After: Audre Lorde and the Apparatus of Literary Production*, book prospectus, University of Maryland at College Park.
- Kingston, Maxine Hong (1977) *China Men*. New York: Knopf.
- Knorr-Cetina, Karin (1981) *The Manufacture of Knowledge*. Oxford: Pergamon.
- Knorr-Cetina and Mulkay, Michael, eds (1983) *Science Observed: Perspectives on the Social Study of Science*. Beverly Hills: Sage.
- Kramarae, Cheris and Treichler, Paula (1985) *A Feminist Dictionary*. Boston: Pandora.
- Latour, Bruno (1984) *Les microbes, guerre et paix, suivi des irrédutions*. Paris: Métailié.
- Latour, Bruno and Woolgar, Steve (1979) *Laboratory Life: The Social Construction of Scientific Facts*. Beverly Hills: Sage.
- Lerner, Gerda, ed. (1973) *Black Woman in White America: A Documentary History*. New York: Vintage
- Lévi-Strauss, Claude (1971) *Tristes Tropiques*, John Russell, trans. New York: Atheneum.
- Lewontin, R. C., Rose, Steven, and Kamin, Leon J. (1984) *Not in Our Genes: Biology, Ideology, and Human Nature*. New York: Pantheon.
- Lorde, Audre (1982) *Zami, a New Spelling of My Name*. Trumansberg, NY: Crossing, 1983.
- Lorde, Audre (1984) *Sister Outsider*. Trumansberg, NY: Crossing.
- McCaffrey, Anne (1969) *The Ship Who Sang*. New York: Ballantine.
- Marcuse, Herbert (1964) *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society*. Boston: Beacon.
- Markoff, John and Siegel, Lenny (1983) "Military micros", paper presented at Silicon Valley Research Project conference, University of California at Santa Cruz.
- Marks, Elaine and de Courtivron, Isabelle, eds (1980) *New French Feminisms*. Amherst: University of Massachusetts Press.
- Merchant, Carolyn (198U) *The Death of Nature: Women, Ecology, and the Scientific Revolution*. New York: Harper & Row.
- Microelectronics Group (1980) *Microelectronics: Capitalist Technology and the Working Class*. London: CSE.
- Moraga, Cherríe (1983) *Loving in the War Years: lo que nunca pasó por sus labios*. Boston: South End.
- Moraga, Cherríe and Anzaldúa, Gloria, eds (1981) *This Bridge Called My Back: Writings by Radical Women of Color*. Water-town: Persephone.
- Morgan, Robin, ed. (1984) *Sisterhood Is Global*. Garden City, NY: Anchor/Doubleday.
- Nash, June and Fernandez-Kelly, Maria Patricia, eds (1983) *Women and Men and the International Division of Labor*. Albany: State University of New York Press.
- Nash, Roderick (1979) "The exporting and importing of nature: nature-appreciation as a commodity, 1850–1980", *Perspectives in American History* 3: 517–60.
- National Science Foundation (1988) *Women and Minorities in Science and Engineering*. Washington: NSF.
- Ong, Walter (1982) *Orality and Literacy: The Technologizing of the Word*. New York: Methuen.
- Park, Katherine and Daston, Lorraine J. (1981) "Unnatural conceptions: the study of monsters in sixteenth- and seventeenth-century France and England", *Past and Present* 92: 20–54.

- Perloff, Marjorie (1984) "Dirty language and scramble systems", *Sulfur* 11: 178–83.
- Petchesky, Rosalind Pollack (1981) "Abortion, anti-feminism and the rise of the New Right", *Feminist Studies* 7(2): 206–46.
- Piven, Frances Fox and Cloward, Richard (1982) *The New Class War: Reagan's Attack on the Welfare State and Its Consequences*. New York: Pantheon.
- Preston, Douglas (1984) "Shooting in paradise", *Natural History* 93(12): 14–19.
- Reskin, Barbara F. and Hartmann, Heidi, eds (1986) *Women's Work, Men's Work*. Washington: National Academy of Sciences.
- Rich, Adrienne (1978) *The Dream of a Common Language*. New York: Norton.
- Rose, Stephen (1986) *The American Profile Poster: Who Owns What, Who Makes How Much, Who Works Where, and Who Lives with Whom?* New York: Pantheon.
- Rossiter, Margaret (1982) *Women Scientists in America*. Baltimore: Johns Hopkins University Press.
- Rothschild, Joan, ed. (1983) *Machina ex Dea: Feminist Perspectives on Technology*. New York: Pergamon.
- Russ, Joanna (1983) *How to Suppress Women's Writing*. Austin: University of Texas Press.
- Sachs, Carolyn (1983) *The Invisible Farmers: Women in Agricultural Production*. Totowa: Rowman & Littlefield.
- Schiebinger, Londa (1987) "The history and philosophy of women in science: a review essay", *Signs* 12(2): 305–32.
- Science Policy Research Unit (1982) *Microelectronics and Women's Employment in Britain*. University of Sussex.
- Sofia, Zoë (also Zoë Sofoulis) (1984) "Exterminating fetuses: abortion, disarmament, and the sexo-semiotics of extra-terrestrialism", *Diacritics* 14(2): 47–59.
- Sontag, Susan (1977) *On Photography*. New York: Dell.
- Stacey, Judith (1987) "Sexism by a subtler name? Post-industrial conditions and postfeminist consciousness", *Socialist Review* 96: 7–28.
- Stallard, Karin, Ehrenreich, Barbara, and Sklar, Holly (1983) *Poverty in the American Dream*. Boston: South End.
- Sturgeon, Noel (1986) "Feminism, anarchism, and nonviolent direct action politics", University of California at Santa Cruz, PhD qualifying essay.
- Sussman, Vic (1986) "Personal tech. Technology lends a hand", *The Washington Post Magazine*, 9 November, pp. 45–56.
- Traweek, Sharon (1988) *Beamtimes and Lifetimes: The World of High Energy Physics*. Cambridge, MA: Harvard University Press.
- Treichler, Paula (1987) "AIDS, homophobia, and biomedical discourse: an epidemic of signification", *October* 43: 31–70.
- Weizenbaum, Joseph (1976) *Computer Power and Human Reason*. San Francisco: Freeman.
- Welford, John Noble (1 July, 1986) "Pilot's helmet helps interpret high speed world", *New York Times*, pp. 21, 24.
- Wilfred, Denis (1982) "Capital and agriculture, a review of Marxian problematics", *Studies in Political Economy* 1: 127–54.
- Winner, Langdon (1977) *Autonomous Technology: Technics out of Control as a Theme in Political Thought*. Cambridge, MA: MIT Press.
- Winner, Langdon (1980) "Do artifacts have politics?", *Daedalus* 109(1): 121–36.
- Winner, Langdon (1986) *The Whale and the Reactor*. Chicago: University of Chicago Press.
- Winograd, Terry and Flores, Fernando (1986) *Understanding Computers and Cognition: A New Foundation for Design*. Norwood, NJ: Ablex.
- Wittig, Monique (1973) *The Lesbian Body*, David LeVay, trans. New York: Avon, 1975 (*Le corps lesbien*, 1973).
- Wittig, Monique (1984) *Women and Poverty*, special issue (1984) *Signs* 10(2).
- Wright, Susan (1982, July/August) "Recombinant DNA: the status of hazards and controls", *Environment* 24(6): 12–20, 51–53.
- Wright, Susan (1986) "Recombinant DNA technology and its social transformation, 1972–82", *Osiris*, 2nd series, 2: 303–60.
- Young, Robert M. (1979, March) "Interpreting the production of science", *New Scientist* 29: 1026–8.
- Young, Robert M. and Levidow, Les, eds (1981, 1985) *Science, Technology and the Labour Process*, 2 vols. London: CSE and Free Association Books.
- Yoxen, Edward (1983) *The Gene Business*. New York: Harper & Row.
- Zimmerman, Jan, ed. (1983) *The Technological Woman: Interfacing with Tomorrow*. New York: Praeger.

A Moratorium on Cyborgs: Computation, Cognition, and Commerce

Evan Selinger and Timothy Engström

Technology and Metaphors of Mind

Many of us have grown accustomed to looking and thinking like cyborgs. Immersive and portable, commercial and personalized digital devices routinely connect us to a range of functions and, *vis-à-vis* those functions, to other people. They also routinely connect us to archives of digitized information, blurring the boundary between “internal” cognition and “external” data. Both cosmetically and functionally, then, the cyborg label seems to be an apt and commercially hip description of how people regularly appear and, thus, appear to think about themselves – as beings who move about with portable electronic devices that press metal, plastic, and wire against – sometimes into – their flesh. The popular Bluetooth wireless headsets, for example, do more than enable consumers to enjoy the convenience of hands-free communication, now seamlessly integrated into a peripatetic and automotive lifestyle. The striking metal that is attached to and which protrudes from a user’s ear transforms one’s appearance. Users appear to be part human and part machine, stylishly “wired” and always busy. New designs in “smart clothing” – clothing that stores an array of portable electronic devices – further accentuates this techno-chic. Advertisements for iPods successfully eroticize digital aesthetics and link the device-aesthetic and identity even more dramatically.

But cyborgian ontology is the result of more than effective promotional advertising.

In *The World Is Flat*, Thomas Friedman (2006) characterizes these new mobile and digital technologies as devices that enable individuals to shape, manipulate, and transmit information at very high speeds and with total ease, as “steroids” that “amplify” and “turbocharge” the central forces of contemporary globalization. Friedman further speculates that in the “mobile me” period, people will “move seamlessly around the town, the country, or the world” with whatever devices they choose, and a “full flattening effect” of time and space will occur.

If we accept Friedman’s characterization of the invention of mobile computing and its integration into daily practice as a revolutionary and global event, two questions readily arise:

- (1) What antecedent conditions were required to propel the occurrence of this revolution?
- (2) How can the cultural and ontological consequences of this revolution best be conceptualized and, thereby, evaluated?¹

As a historian and journalist, Friedman answers the first question by discussing a variety of technological, economic, and political factors that have led up to the “mobile me” revolution. While his narrative is informative,

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and certainly optimistic, it does not provide a sustained ontological focus; and it yields, therefore, an incomplete account of how technological innovation occurs and how technological metaphors, in turn, shape ontological description. Friedman's purpose is not to engage the question of whether the basic human capacity for successfully integrating into a dynamic world of mobile telecommunications technologies is a capacity that lies at the very heart of *human nature* and *human cognition*. In short, Friedman does not ask if this stage of globalization arose, at least in part, because humans are and have always been, in fundamental and evolutionary ways, cyborgs by nature.

If human nature and human cognition – mind – are underlying forces to reckon with, then we must consider one of the dominant theoretical models being touted for capturing the “essential nature” of mind. What we need to examine, therefore, are the contributions of and interconnections between the computational theory of mind (henceforth, CTM) and cyborg theory. As will soon be made evident, this *contingent alliance* – one can be enthusiastic about cyborg-talk without endorsing CTM, and one can be excited about CTM while being skeptical about the virtues of cyborg-identity – is an alliance made in metaphor.² Digital cyborg-technologies are predicated upon computational processes. The computational theory of mind latches onto computation as the master metaphor shaping its entire model of nature and, therefore, its discourse on mind – its underlying nature, functions, capacities, and the forms of inquiry to which “mind” does and should, therefore, lend itself. By examining mobile computing and cyborg-talk in light of this shared metaphoric, we can shed some light not only on one of the forces propelling technological innovation, but also on the role the computational theory of mind might be playing in unwittingly facilitating and translating the commercial forces of technological innovation into cyborg-talk of identity. In effect, “mind” and its technological enhancements are already seen, on this view, as sharing the conviction that we are computational all the way down.

Mechanizing Humanity and Literalizing Metaphor

In order to get the body out from under the Church and into the lab, Descartes had already lent a large part of us to the metaphors of machinery – that part, at least, which seemed to lend itself to being considered in terms of parts.

There was, of course, further to go. Steven Pinker (1997) goes so far as to tout CTM as “one of the greatest ideas in intellectual history” (p. 24). He claims that it “has solved millennia-old problems in philosophy, kicked off the computer revolution, posed the significant questions of neuroscience, and provided psychology with a magnificently fruitful agenda” (p. 77). Without CTM, Pinker argues, “it is impossible to make sense of the evolution of the mind” (p. 24, p. 27). Pinker distills this view in the following way: “The computational theory of mind...says that beliefs and desires are *information*, incarnated as configurations of symbols. The symbols are the physical brain states of bits of matter, like chips in a computer or neurons in the brain” (p. 25). Likewise, he insists: “The mind is a system of organs of computation designed by natural selection to solve the kind of problems our ancestors faced in their foraging way of life” (p. 24). In one instance the mind *is* such a system and in the next it's *like* a chip: claims of identity and literary simile are seamlessly exchanged.

Advocates of CTM appropriate an army of machine and machine-related metaphors to describe cognitive functions and biological properties. Some of these metaphors have been in use for a long time. Others are more recent and have arisen in connection with the advent of digital computers. Pinker, for example, claims that because “the tree of dendrites (input fibers) on each neuron appears to perform the basic logical and statistical operations underlying computation,” the language of neuroscience has come to be suffused with “information-theoretic terms such as ‘signals,’ ‘codes,’ ‘representations,’ ‘transformations,’ and ‘processing’” (p. 83). Thus, we find that:

- (1) thinking is a kind of “computation”;
- (2) the body is a “wonderfully complex machine”;
- (3) intelligent behavior correlates with “core truths and a set of rules to deduce their implications”;
- (4) “reverse engineering,” i.e., looking to natural evolution to discern the emergent events of the “Blind Programmer,” unravels the complexity of the human mind;
- (5) the basic building blocks of life are “a contraption of tiny jigs, springs, hinges, rods, sheets, magnets, zippers, and trapdoors assembled by a data tape whose information is copied, downloaded, and scanned”;
- (6) a “genetic program” organizes our “mental modules”;
- (7) mental modules run “mental software.”

Pinker acknowledges that metaphors have limits, but his concerns about metaphor are restricted to discerning

which technological terms are appropriate for designating aspects of human cognition, embodiment, and evolution. Thus, on Pinker's account, Galen wasn't wrong for applying hydraulics to cardiology, nor Sigmund Freud for modeling his account of psychic pressure on engineering models. Rather, Freud's view of the psyche is untenable, according to Pinker, because it mirrors engineering systems that do not correspond to how physicists understand the discharge of energy in the brain (p. 65).

Thus, Pinker's view exacerbates some long-standing and representative epistemological confusions: It suggests that technological metaphors can slip their metaphoricality and serve as mirrors of nature, as points of correspondence with the real. This equivocation between insisting on this or that technology, metaphor, or model – on something we invent – and insisting at the same time that we treat them not as successful inventions but as “accurate representations” – as something we discover – simply evades some of the analysis that is needed. For example, it does not offer critical consideration of how trends in technology shape the models and metaphors adopted by scientists and philosophers for describing and managing our relations with phenomena in the first place, in this case “mind.” It evades the question of whether unjustified anachronism results from using contemporary technological terms to describe longstanding “natural” processes, such as evolution.

It is easy, therefore, to imagine that Pinker would not object to humans being classified as cyborgs, at least under some circumstances. In one thought-experiment, Pinker asks us to imagine a case in which surgeons continually replace more and more of a patient's neurons with sophisticated microchips that allow that patient to “feel and behave exactly as before.” Given the functionalism underlying CTM, Pinker would have to characterize this act of technological replacement and integration as cognitively trivial, if not irrelevant. Indeed, Pinker insists: “Information and computation reside in patterns of data and in relations of logic that are independent of the physical medium that carries them” (p. 24).

Computation and the Cyborg-Imaginary

Although Pinker does not speak of cyborgs directly, many others do. Consider the following claims.

- (1) In “A Manifesto for Cyborgs” Donna Haraway (1991) declares: “A cyborg is a cybernetic organism, a hybrid machine and organism, a creature of social reality as well as a creature of fiction ... By the late twentieth century, our time, a mythic time, we are all chimeras, theorized and fabricated hybrids of machine and organism; in short, we are cyborgs.”
- (2) Chris Gray (1995), editor of the *Cyborg Handbook*, insists: “Cyborgology has become a central concept for academics, not only people in science and technology studies, but also political theorists, military historians, literary critics, human factors engineers, computer scientists, medical sociologists, psychologists, and cultural observers of all types” (p. 7).
- (3) The editors (Davis-Floyd and Dumit 1998) of *Cyborg Babies* contend: “We are immersed in cyborgs; they saturate our language, our media, our technology, and our ways of being” (p. 1).

While the term “cyborg” means different things to different theorists, it tends to coalesce around computational metaphors. John Horgan (2005) refers to a number of these theorists as “cyber-evangelists.” Their proposals for linking minds to machines range from ideas about downloading books into brains to transhumanist visions of pursuing immortality by downloading consciousness into computers. In “Brain Chips and Other Dreams of the Cyber-Evangelists,” Horgan contends that all of these evangelical proposals are conceptually anchored in CTM:

What ... [none of the] cyber-evangelists consider in any depth is the implicit assumption of all their scenarios, that the brain is a digital computer. According to that view, the minute “action potentials” emitted by individual nerve cells are analogous to the electrical pulses that represent information in computers, and just as computers operate according to a machine code, so action potentials are arranged according to a “neural code.” Given the right interface and knowledge of the neural code, brains and computers should be able to communicate as easily as iMacs and PC's.

Once the human mind is conceived as a computer and the human body as a machine, it becomes easy to view the successful integration of the human organism with digital computational technologies as a transformation that parallels natural processes of evolution: tools have evolved to upgrade themselves by connecting with other tools. Also, once the advent of digital computational technologies is conceptualized as an act of human

innovation that is so powerful it can improve upon the historical trajectory initiated by the “blind programming” of natural adaptation, it becomes easy to see the present moment in time as a revolutionary “species leap” in which reasonable people will enhance their cognitive capacities to the fullest extent that technology makes possible. In other words, CTM does not simply collapse any sense of difference between humans and machines. It also promotes a particular cultural commitment to specific tools and *their* purposes. For example, Pinker states that until now the “Blind Programming” of nature has yielded better feats of engineering than human engineers. But it is only with the recent invention of the digital computer that we have allegedly come to appreciate how nature has designed us. By framing matters in this way, the CTM argument comes with an implicit Baconian challenge: Since up until now nature has been the best technician, and since we now have unprecedented conceptual and technical resources at our disposal, the time has come for us to do better.

One prominent cyber-evangelist discussed by Horgan is the cybernetics expert Kevin Warwick. He is an instructive example of a theorist whose rhetoric enthusiastically endorses the feedback-loop that links academic theorizing with technological marketing, as well as ontological opportunity with purchasing power.

Upgrading the Human Form

Warwick (2004) provocatively begins his book *I, Cyborg* with the following declaration:

I was born human. This was merely due to the hand of fate acting at a particular place and time. But while fate made me human, it also gave me the power to do something about it. The ability to change myself, to *upgrade my human form* with the aid of technology. To link my body directly with silicon. To become a cyborg – part human, part machine (p. 1; emphasis added).

These claims are given iconic form on the cover of the February 2000 *Wired Magazine* where Warwick strikes an evocative pose. His left shirtsleeve is rolled up, and a superimposed X-ray image reveals the existence of a surgically implanted microchip underneath the surface of his skin. The caption reads: “Cybernetics pioneer Kevin Warwick is upgrading the human body – starting with himself.” While the bulk of the text details

Warwick’s personal cyborg experiences using technological implants to manipulate environments and communicate with others, Warwick also offers several reasons for believing that humans should take active steps to collectively evolve into a cyborg culture.

According to Warwick, we currently live in a unique historical period. Unlike the past, the present is alleged to be a time in which humans can “choose” to exert a profound influence over their future. While Warwick concedes that human evolution has involved interconnections between natural and cultural forces, he insists that *Homo Sapiens* have been too encumbered by natural limitations – limitations that have severely restricted our possibilities for action, perception, and cognition. According to Warwick, by developing powerful and small computational technologies that can be implanted under the skin and connected to our nervous systems and brains, humans can embrace cyborg identities and become beneficiaries of the following advantages:

- 1A. As cyborgs, we can transcend the physical limits of our natural embodiment. For example, we can create prosthetics to replace damaged body parts – not just limbs, but also perceptual channels, such as ears and eyes.
- 1B. The underlying idea, here, seems to be that since the body is essentially a machine, one should not be concerned about immersing it into and penetrating it with other machines that will enhance its physical capacities.
- 2A. As cyborgs, we can transcend the perceptual limits of our natural embodiment. Rather than accessing the world through the naturally restricted capacities of our five senses, we can use implants in order effortlessly to see things more accurately. Ultraviolet, infra-red, and X-ray spectra, as well as current images of multi-dimensional data, are only the beginning of what is perceptually possible through cyborg innovation. Ostensibly, we “will even be able to relive memories that we did not have in the first place” (p. 4).
- 2B. The underlying idea, here, seems to be that since human perception is a computational process, one should not be concerned about enhancing or transforming perception via other computational devices.
- 3A. As cyborgs, we can transcend the traditional processes that have been required for developing our cognitive competencies. By having our “brains

- linked to technology,” we can bypass the stage of learning basic material. For example, future cyborgs will “not need to learn basic mathematics” (p. 4).
- 3B. The underlying idea, here, seems to be that since human cognition is essentially a computational process, one should not be concerned about mediating or altering such processes through the use of other computational devices.
 - 4A. As cyborgs, we can transcend the limits of human speech. By having our brains plugged into machines that other people’s brains are also connected to, we can overcome the “serial, error prone and incredibly slow way of communicating with others,” ultimately communicating with other humans at “zero” error rate “merely by thinking to each other” (pp. 2–3).
 - 4B. The underlying idea, here, seems to be that since humans are computational beings, we should aim to achieve the more sophisticated level of communication that other computational devices exhibit.
 - 5A. As cyborgs, we can transcend the cognitive limits of our biological brains. As the processes for perceiving and acting upon the world are altered, we will enliven our capacity for thinking and understanding. This, in turn, will lead to the formation of new and more “enlightened” beliefs concerning what is and is not possible.
 - 5B. The underlying idea, here, seems to be that since human cognition is essentially a computational process, one should not be concerned about the values that ride on the shirrtails of the devices and the contexts of use favored by such devices.
 - 6A. As cyborgs, we can overcome our current vulnerability to autonomous technology. Ostensibly, we have created some technologies that – at least in some respects – are more intelligent than we are. Consequently, our best chance of avoiding the fate of ultimately becoming enslaved by them is to inhabit an immersive technological reality – one that enhances our bodily, cognitive, and perceptual capacities (pp. 1–5), and which also allows us to control our enhancement devices.
 - 6B. The underlying idea, here, seems to be that commercial culture is itself emancipatory, and that personalized technological consumption is the antidote to political fears of a technologically corporatized, centralized and surveilled society.

If Warwick’s cyborg agenda appears compelling, it is because he insists that immersive relations with technology

will enhance several domains of experience, while diminishing none of them. By denying tradeoffs and characterizing human volition as the autonomous center of cyborg activity, Warwick’s conceptual framework turns critics of technology into nostalgic obstructionists. After all, who would want to stand in the way of medical progress, particularly when it comes to giving hope to the severely disabled? Who would be against humans acquiring more options for thinking, acting, and connecting? Who would be against humans gaining more control over their environments? The rhetorical questions answer themselves and, so, suggest that there are not any serious questions to be asked.

Warwick even dismisses anxiety about the loss of privacy in a surveillance society as an outmoded complaint, one rooted in an unrealistic, Orwellian conception of technology – a conception that, he claims, fails to make crucial distinctions between abuses of state-controlled political power and the freedoms provided by the marketplace of cyborg goods. To this end, Warwick offers the following reflections upon his own cyborg experiences of using implanted technology that tracked his activities:

I wasn’t in the slightest worried or even upset about the computer monitoring my movements. After all it was opening doors for me, switching on lights, and even greeting me. These were all nice and positive things. . . . I was gaining rather than losing something. The computer was *only giving me extras* and this was something that I was happy with If this is correct, in general it would mean that George Orwell’s negative view of a human dictatorial Big Brother is not really the sort of thing we are likely to see in the future. Rather, we are looking at a computer network to which humans are linked *because it gives us benefit*. Essentially, we are happy to allow such a system to spy on us and monitor us because of the positives it brings. Big Brother therefore becomes a positive force that we choose and that we want, rather than a negative and something we want to get rid of. Orwell’s Big Brother was also a political entity, whereas in reality we are heading towards a commercial, Big Company Big Brother” (p. 85; emphasis added).

Warwick sees no reason to worry. His cyborg-ontology is already market ideology in drag, and his ontological individualism replicates standard *laissez-faire* market constructions of autonomy and agency. Specifically, Warwick presupposes that:

- (1) Technological markets arise as a consequence of individual demand, rather than emerging through

forces that shape individuals and their desires of consumption in the first place.

- (2) The uses to which technologies (and persons in relation to them) get put are simply consequences of the independent choices of individuals, rather than the accumulated and contextually established uses already in place and culturally sanctioned when opportunities for choice are offered. This view suggests that when one chooses a Chevy over a Ford, the entire history of political economy behind privileging automobiles in the first place – rather than, say, trains – can be treated as entirely incidental to the desires individuals acquire and the subsequent choices they make.

Naturalizing Cyborg Conceptions of Mind

In Andy Clark's (2003) *Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence*, an account of human nature is given that radicalizes yet further the combined naturalism of CTM and Warwick's view that using the tools made available by the digital marketplace will allow us to "upgrade" ourselves with "extras" and "benefits." As an update to the earlier "extended, mind" thesis that he developed with David Chalmers, Clark defines human beings as "cyborgs."³ What this means, according to Clark, is that humans have always been "reasoning systems whose minds and selves are spread across biological brain and nonbiological circuitry." As "cognitive opportunists" with computational minds, we have long experienced collaborative and literal mergers with external, nonbiological tools that have enabled us to extend our problem-solving capacities beyond the biological "skinbag" – a threshold that includes the inherited architecture of the human mind. Framed in this way, Clark depicts bio-technological mergers with contemporary digital technologies as merely following from and extending "natural" stages of human development. According to Clark, when we use these technologies (as well as their historical predecessors), we naturally "enhance" and "upgrade" our cognitive capacities, and, thereby, our very being.

In short, Clark endorses the view that humans are "tools all the way down," and he follows in the CTM trend of using technological metaphors to describe how

cognition itself is transformed once it is interwoven with and seen as inseparable from technology. However, unlike the brain-chip scenario discussed by Pinker, or the implantation schemes with which Warwick experiments, Clark contends that non-invasive technologies, including an artifact as basic as writing, can transform someone into a cyborg. The technology of writing, Clark says, allows us to extend our minds into a variety of media, now notably paper and computer screens. In effect, what starts out as an effort to naturalize our relations with artifacts turns out, in this case too, to be an implicit advocacy for a commercialized context of device consumption. Thus, Clark shifts his own context from the natural to the social to the presumed – evolutionarily naturalized – social benefits of merging with what the marketplace makes available. It comes as no surprise, therefore, that Clark's view of cyborg cognition would lend itself rather congenially and uncritically to "post-human cyborg consumption" – in effect, to marketing and advertising theorists keen to take further advantage of our new device-driven "nature."

Cyborgs Commercialized

A clear articulation and extension of the logic underlying this aspect of Clark's philosophy is espoused by Markus Giesler, a "consumer anthropologist" who coined the phrase, "posthuman cyborg consumers." According to Giesler, consumers have come to embrace the idea that when they use portable digital devices, they can experience intimate connections with their artifacts. These connections affect their users so profoundly that two powerful experiences – both of which Clark discusses – are often the result of casual and repetitive engagement:

- (1) Users experience a collapse in the boundaries that once appeared to separate "humans" from "machines."
- (2) Users experience the remnants of their biologically based views of selfhood as dissipating.

Indeed, far from merely archiving sounds and images, Giesler, like Clark, sees devices such as iPods as actually providing their users with opportunities to partake in "posthuman" sensibilities. By making "user-friendly" processes of recombining, augmenting, and disseminating information available, iPods facilitate new ways for

their users to think, perceive, and act. The issue here, therefore, is not one that primarily concerns the use of technology to acquire new abilities. Rather, what Giesler is interested in is how consumer norms are altered when people become attached to their digital devices and come to develop new identities and experiences of perception and action.

In both Clark's and Giesler's analyses, the experience of using immersive and computationally powerful digital devices is constitutive. These devices facilitate the formation of human-machine "cybernetic units" – that is, hybrid matrixes that offer the promise of "technotranscendence." Just as blind people can merge with walking sticks and experience these prosthetic artifacts as directly extending the reach of their perceptual systems, so too can iPod users experience their transparent yet inorganic devices as constant, reliable, and personalized extensions of identity. This permits: (1) the physically limited here-now body to be reconfigured, and, ultimately, transcended; and (2) the emergence of new ways to relate to other people. The iPod's hard drive, in other words, does not need to be experienced as an external storage device. Rather, it can come to feel as if it were a direct extension of the user's memory – an extension that, through displays of sight and sound, can readily become a collective and shared experience.

While this characterization of the underlying logic of iPod advertisements might seem obvious to philosophers such as Clark, it is a mode of thought that is apparently less transparent and self-conscious to traditional market researchers. To be sure, even casual television watchers can recall that iPod commercials express cyborgian desire. In one popular series, they feature animated dancing cybernetic beings – beings whose digitally enhanced gestures indicate a level of heightened aesthetic bliss that appeal's achievable only when human-plus-iPod entities are formed. In "Reframing the Embodied Consumer as a Cyborg: A Posthumanist Epistemology of Consumption" – an article that was, interestingly enough, published in *Advances in Consumer Research* – Giesler and Alladi Venkatesh (2005) claim that today's market researchers have much to learn from the study of "post-humanist epistemology." Accordingly, they write: "The two-fold purpose of this research is to introduce a post-humanist epistemology of technology consumption and to illustrate the usefulness of this epistemology in the study of consumption as a whole" (p. 1). In service of their thesis, the authors provide summaries of key theoretical paradigms and motifs found in the philosophy

of technology (e.g., Martin Heidegger, Jean-François Lyotard, and Don Ihde), science and technology studies (e.g., Donna Haraway, Bruno Latour, and Sherry Turkle), cognitive science (e.g., Huberto Maturana and Francisco Varela), and systems theory (including Niklas Luhmann).

Their purpose is not to contribute to these academic debates but, rather, to shape them as a collective demonstration that the "Cartesian" assumptions of contemporary market researchers should be revised. Their seamless transition between thoughts about epistemology and ontology and the domain of commercial transactions is in service of the following conviction. In so far as Western market researchers are, like all Westerners, inheritors of a distinctly Western intellectual tradition, it is not surprising that they are guilty of subscribing, albeit unwittingly, to a full-blown but now outdated philosophical anthropology. Thus, updating one's philosophical anthropology requires making it consistent with cyborg conceptions of consumption.

Giesler and Venkatesh insist that under the constraints of "Cartesian epistemology" and "representational thinking," marketers have failed to fully understand the "meaning and experiences of technological consumption" (p. 6). In effect, they make two sweeping allegations – allegations that closely resemble Clark's philosophical criticisms of philosophers and scientists who do not endorse the extended mind thesis:

- (1) Marketers routinely view technological devices through outdated conceptual schemes that tend to prioritize the "Human Mind" and leave "the technological product to the material world of bodies and objects" (p. 1).
- (2) As a consequence of accepting the "external tool" account of commodities, marketers limit their ability to connect fully with their intended audiences (p. 1).

In short, because "Cartesian marketers" do not appreciate the "posthuman cyborg" view that the boundaries between human and machine are flexible and subject to pleasurable re-negotiation, Giesler and Venkatesh contend that marketers fail to appreciate the complexity of today's "hybrid marketplace matrix." Such a marketplace, they argue, is one dominated by users who no longer care to distinguish "between humans and technologies and instead embed [themselves in] a plethora of nature-cultures and body-minds" (p. 1). In this context, even "consumer researchers" are themselves "cyborg consumers," and

thus the notions of identity and well-being they employ should be viewed in thoroughly cyborgian terms (p. 4).

Cyborg-Talk: From Ontological Description to Political Economy

What can be learned from considering the reciprocal migration of ideas that have thus far been discussed – a trend that moves from CTM, to academic cyborg theories, to marketplace accounts of cyborg identities and desires, and back? While a variety of moral and political criticisms have been proffered against cyborg philosophies, most of them are incomplete. For example, Horgan notes:

- President Bush's Council on Bioethics has suggested that the work ethic of students could be compromised if they could download textbooks directly into their brains.
- Given the range of technological programs sponsored by organizations like the Defense Advanced Research Projects Agency, concern has been raised over the possibility that remote-controlled cyborg soldiers, such as the kind imagined in the film *The Manchurian Candidate*, will be created. Beyond military concerns, there is a general worry, articulated by William Safire, that a range of possible "controlling organizations" could monitor and actively manipulate our minds and, therefore, our social participation.
- Neurobionics might deepen gaps in power by furthering the digital-divide.

Beyond these considerations, Horgan dismisses the cyborg idea as the preoccupation of extreme technological enthusiasts who confuse science and science fiction and risk diverting attention away from genuine social issues. He concludes:

Indeed, now and for the foreseeable future, cyber-evangelism is best understood as an escapist, quasi-religious fantasy, which reflects an oddly dated, Jetsonsque faith in scientific progress and its potential to cure all that ails us. Even those cyber-evangelical books published well after September 11, 2001, and the end of the dot-com boom echo the hysterical techno-optimism of the late 1990s. At their best, they raise some diverting questions ... But ... I reminded myself of the issues that preoccupy most mature adults these days: terrorism, overpopulation, poverty, environmental degradation, AIDS and other diseases, and all the pitfalls of ordinary life.

But other concerns remain. Cyborg philosophies of the sort that Clark advocates exemplify a general problem that philosophers of mind and cognitive scientists should consider. Clark tends to treat some of the dominant buzz-words found in today's digital marketplace as appropriate philosophical terminology for his "naturalist" ontology, one that is said to underlie both our previous and contemporary experiences of technology and that traditional philosophical theories have not adequately grasped. In projecting backwards, however, from the cyborgian to the natural, Clark ignores some of the most questionable effects of marketing feedback loops on our concepts, metaphors, and models of identity:

- The more inclined we are to see our choices of ontological vocabulary as "natural" and neutral rather than as socially invested projects, as "accurate representations" rather than constructed and purposeful instruments, the more likely we are to fail to engage with the specific cultural and political projects these vocabularies inevitably propel.
- In particular, the more inclined we are to see our personal and collective desires through the images and vocabularies that marketers promote, such as "upgrades," "enhancements," and "opportunism," the less inclined we may be to question the adequacy of those very images and vocabularies as signifiers of human potential, human solidarity, and human flourishing, let alone as an adequate representation of "human nature."
- The more inclined we are to equate technological advances in information management with improved social relations, the less inclined we may be to confront the political and economic forces that are most responsible for shaping our social relations, or to consider the political implications that follow when information technologies are unequally distributed and when they compound, therefore, already established social inequalities.
- The more inclined we are to treat commercially induced, individually expressed "choices" of technological consumption as synonymous with social progress and democratic participation, the less inclined we may be to question whether we want our conception of the social and public realms themselves to be merely the accumulated consequence of commercial activity.

As John Dewey noted some time ago, we are the kind of beings who invent vocabularies to help us achieve certain goals – to cope with and/or transform nature, for

example – and we then undergo the accumulated force these vocabularies acquire in social life. Computational vocabularies of mind and naturalized forms of cyborg-talk are examples of such inventions. In this sense, CTM is both false and functional. It is false (that is, misleading in the meta-epistemological sense), if we treat it (or any vocabulary) as an accurate representation, as an assertion of ontological equivalence to the way things are in the absence of our vocabulary for describing and managing them. It is also perfectly functional if we treat the vocabulary as a motivated instrument for managing, with the help of computational technique, otherwise less manageable affairs. In other words, CTM is a good vocabulary for certain purposes and lousy for others. Treating the mind informationally is useful if we want the best possible help we can get from computers. It is not useful, however, if over-generalized. It will not be a particularly helpful vocabulary or representation of “mind,” for example, when engaging in moral reflection, or writing love-letters, or when questioning our political leaders and imagining a less technocratically determined future. The issue is not the truth or falsity of CTM-based cyborg-talk by reference to “the way things really are,” but whether such talk captures with sufficient critical, normative, and ontological reflexivity and hope the kinds of beings we wish to become. Do we wish to become adjuncts of the latest trends in market-based technological promotion, or critics of the limitations and prescriptive overdetermination such trends and their over-generalized vocabularies promote?

Conclusion: Tools of Inquiry and Metaphors of Identity

Our concern is that CTM is an effort to convert something we do not know and cannot manipulate terribly successfully – individual minds and consciousness – into something we do and can manipulate pretty well: numbers, codes, interactive algorithms, etc. Computation can be a useful tool of inquiry and, if over-generalized, a dubious metaphor or model of identity. “Computation” has become, however, an effort to forge an identity, an equivalence, between minds and numbers, through a medium – numbers – that minds amongst themselves do not trade in. Indeed, as an ontological argument for equivalence, it’s a fallacy; as a pragmatic push to get numbers to say more about minds than other instruments or technologically endorsed metaphors might be able to

say, it might have value. As an effort to provide better diagnostic models and more successful interventions, it might work better than some alternatives. But this kind of success is the result of producing repeatable correlations, not discovering identities and correspondences. If we begin by assuming a form of identity – mind = computational apparatus – we risk begging a significant question and doing so without either benefiting (or diminishing) the pragmatic success we seek.

The fallacy entails assuming, and thinking we need to assume, a kind of ontological transitivity: if mind = numbers, and numbers = the essence of digital technologies, then mind = these technologies; mind-talk must be coterminous with cyborg-talk. To make this transitivity work, however, we need to assume an ontological equivalence, pretend that we did not invent it, and cram all the properties we associate with vocabularies of mind into a reductively transitive equation. For some empirical or representational purpose or other, this might work well. If we want generalizable, manipulable, and repeatable processes for modeling and predicting the causal pathways of brain states, this is probably helpful. If our interest, however, is in discussing the social forces of political economy already concentrated in the technological sphere, and already at work in shaping our sense of identity and purpose, we might rightly seek out a different vocabulary, one that is less computational and more, say, historical or political. In effect, to say that the mind is only or essentially computation is like saying that the Bill of Rights is only or essentially words. While the reduction is perhaps, “true” in some sense, this is beside the point. The reduction, in its abstraction, misses entirely what matters most. Concepts of mind, like Bills of Rights, are social constructions, the result of ethically and reflexively oriented vocabularies whose purposes-as-vocabularies are obscured by the reduction.

Given our concerns about the adverse consequences of taking metaphor too far, we invite consideration of *a moratorium on cyborg discourse*. By having pushed some computational techniques and technological devices into ontological definitions of identify, cyborg-talk has extended the interests of a commercial economy into an evolutionary and naturalized over-reach, without acknowledging the forces, interests, and background conditions that give these tools their force and prestige – their capacity for over-reach – in the first place. Naturalized cyborg-talk is political economy through the back door. By shifting our analytical focus from the *biological feedback loops* discussed by CTM proponents to

the *social feedback loops* that have come to link academic theorizing on cyborgs with marketing research and advertising practices, we hope to add an important dimension to the philosophy of mind that is seldom explored or made explicit – a social, political, and ethical dimension. Our concern is to scrutinize the migration of ideas – the movement of thought that extends from CTM to cyborgs to “posthuman consumerism” – and

the social and political consequences (and evasions) that can follow when this discursive constellation is understood in thinly and reductively descriptive and representational terms. That is, cyborg- and CTM-talk is not simply the result of or being applied only to scientific research. It is a worldview, one that attempts to tell us not just who or what we are, but one that is recommending who and what we should want to become.

Notes

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- 1 We accept the view that the concepts one chooses are already part of the process by which evaluation is facilitated; that acts of description are already – as Rorty continually argues – ways of taking a position on matters of cultural concern. Likewise, our analysis here presumes that cyborg-talk is not culturally neutral concerning ontology. Rather, it is already aligned with a context, with a program that slants ontological description in specific ways (see Rorty 2007).
- 2 To minimize potential confusion, it should be noted that by foregrounding “metaphor” in this way we are not treating CTM as a false (or true) theory that is to be judged by reference to an independent set of “empirically accurate” (or inaccurate) referents. Rather, we are making the meta-epistemological point that it does nothing extra to compliment a descriptive and explanatory vocabulary in terms of “accuracy” in the first place. In a Kuhnian sense, CTM is a normal vocabulary that makes representational claims, but such claims are always bounded by the operative vocabulary itself; as with all human constructed theoretical frameworks,

the possibility of capturing the “mental phenomena themselves” is foreclosed from the start. Thus, when we say that an epistemic alliance “is made in metaphor,” we are not directly contributing to the existing literatures that question the empirical “evidence” for CTM. Rather, our claim is that the vocabularies by which empirical work is facilitated are sustained (or abandoned) only in relation to their perceived superiority to rival vocabularies. Thus, if we appear to be taking a substantive stand by appealing to “metaphor,” it is because we are affirming pluralism: CTM may be quite useful for accomplishing some purposes – for mapping, modeling, predicting, controlling, for aligning digital technologies as tools with diagnostic or therapeutic procedures of a certain type, say – and not for accomplishing others. The critical point, then, is that vocabularies are purposeful, and that the metaphorical alliances between vocabularies are ways in which some of these purposes become shared and mutually reinforcing. The metaphorical alliance we have in mind suggests a larger constellation of forces – a worldview, if you will – is at play, one that is ultimately interpretative in nature, and not reducible to a specific empirical claim.

- 3 We concentrate more extensively on Clark's work in Selinger and Engström 2007.

References

- Clark, A. (2003). *Natural-born cyborgs: Minds, technologies and the future of human intelligence*. New York: Oxford University Press.
- Davis-Floyd, R., & Dumit, J. (Eds.). (1998). *Cyborg babies*. New York: Routledge.
- Friedman, T. (2006). *The world is flat*. New York: Factor, Straus, and Giroux.
- Giesler, M., & Venkatesh, A. (2005). Reframing the embodied consumer as a cyborg: A posthumanist epistemology of consumption. *Advances in Consumer Research*, 32, 1–9.
- Gray, C. (Ed.). (1995). *The cyborg handbook*. New York: Routledge.
- Haraway, D. (1991). A cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century. In D. Haraway (Ed.), *Simians, cyborgs and women: The reinvention of nature* (pp. 149–181). New York: Routledge.
- Horgan, J. (2005). Brain chips and other dreams of the cyber-evangelists. *Chronicle of Higher Education*, June 3.
- Pinker, S. (1997). *How the mind works*. New York: Norton.
- Rorty, R. (2007). *Philosophy as cultural politics*. Cambridge: Cambridge University Press.
- Selinger, E., & Engström, T. (2007). On naturally embodied cyborgs: Identities, metaphors, and models. *Janus Head*, 9(2), 353–584.
- Warwick, K. (2004). *I, Cyborg*. Chicago: University of Illinois Press.

Anonymity versus Commitment: The Dangers of Education on the Internet

Hubert L. Dreyfus

Introduction

For two decades computers have been touted as a new technology that will revitalize education. In the eighties they were proposed as tutors, tutees, and drill masters, but none of those ideas seem to have taken hold. Now the latest proposal is that somehow the power of the World Wide Web will make possible a new approach to education for the twenty-first century.

In *School's Out*, Lewis J. Perelman, considering the future of high schools, announces with assurance:

With knowledge doubling every year or so, “expertise” now has a shelf life measured in days; everyone must be both learner and teacher; and the sheer challenge of learning can be managed only through a globe-girdling network that links all minds and all knowledge.¹

He continues:

I call this new wave of technology *hyperlearning* ... The *hyper* in hyperlearning refers not merely to the extraordinary speed and scope of new information technology, but to an unprecedented degree of connectedness of knowledge, experience, media, and brains – both human and non-human ... We have the technology today to enable virtually anyone who is not severely handicapped to learn anything, at a “grade A” level, anywhere, anytime.²

Speaking of higher education in *Transforming Education*, Michael Dolence and Donald Norris make the same point:

Under the emerging vision for learning in the 21st century, information technology is a primary instrument of transformation. It is the key ingredient making feasible a network learning, distance-free, knowledge navigation-based vision for the Information Age learner.³

I propose to translate Kierkegaard’s account of the dangers and opportunities of what he called “The Press” into a critique of “The Internet” so as to raise the question: what contribution – for good or ill – can the World Wide Web, with its capacity to deliver vast amounts of information to users all over the world, make to educators trying to pass on knowledge and to develop skills in their students? I will then use Kierkegaard’s three-stage answer to the problem of anonymity and lack of involvement posed by the press – his claim that to have a meaningful life the learner must pass through the aesthetic, the ethical and the religious spheres of existence – to suggest that only the first two stages – the aesthetic and the ethical – can be implemented with Information Technology, while the religious stage, which alone makes meaningful learning possible, is undermined rather than supported by the tendencies of the Net.

Hubert L. Dreyfus, “Anonymity versus Commitment: The Dangers of Education on the Internet,” from *Ethics and Information Technology*, 1/1 (1999), pp. 15–21. Reprinted by permission of Springer.

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How the Press and the Internet Undermine Commitment and Meaning

In his essay, *The Present Age*,⁴ Kierkegaard claimed that his age was characterized by reflection and curiosity. People took an interest in everything but were not committed to anything. He attributed this growing cultivation of curiosity and the consequent failure to distinguish the important from the trivial to the press. Its new massive distribution of desituated information, he held, was making every sort of information immediately available to anyone thereby producing an anonymous, detached spectator. He wrote in his journal: "... here ... are the two most dreadful calamities which really are the principle powers of impersonality – the press and anonymity."⁵ Kierkegaard thought that, thanks to these powers, the press would complete the leveling of qualitative distinctions, distinctions of worthiness, a leveling that had been going on in the West since the Enlightenment.

What Kierkegaard envisaged as a consequence of the press's indiscriminate coverage and dissemination is now being realized on the World Wide Web. All qualitative distinctions are, indeed, being leveled. Relevance and significance have disappeared. And this is an important part of the attraction of the Web. Nothing is too trivial to be included. Nothing is so important that it demands a special place. In his religious writing, Kierkegaard criticized the implicit nihilism in the idea that God is equally concerned with the salvation of a sinner and the fall of a sparrow. On the Web, the attraction and the danger is that everyone can take this godlike point of view. One can view a coffee pot in Cambridge, the latest supernova, read the latest news in Chile, look up references in a library in Alexandria, or direct a robot to plant and water a seed in Austria, not to mention plow through thousands of ads, all with equal ease and equal lack of any sense of what is important.⁶

When Kierkegaard attacks the Press, he attacks it for creating what he calls *the Public*. As Kierkegaard puts it, "In order that everything should be reduced to the same level, it is first of all necessary to procure a phantom, its spirit, a monstrous abstraction, and all-embracing something which is nothing, a mirage – and that phantom is the public."⁷ According to Kierkegaard, the Press speaks for the Public but no one stands behind the views the public holds. Because of this absence of responsibility, Kierkegaard suggested as a motto for the Press: "Here

men are demoralized in the shortest possible time on the largest possible scale, at the cheapest possible price."⁸

Kierkegaard would no doubt have been happy to transfer this same motto to the Internet, for, just as no individual assumes responsibility for the consequences of the information in "the Press", no one assumes responsibility for the accuracy of the information on the Web. The information has become so anonymous that no one knows or cares where it came from. Of course, in so far as one does not take action on the information, no one really cares if it is reliable. All that matters is that everyone passes the word along by forwarding it to other users. Moreover, in the name of protecting privacy, ID codes are being developed that will assure that even the sender's address can be kept secret. The Net is thus a perfect medium for slander and innuendo. Kierkegaard could have been speaking of the Internet when he said of the Press: "It is frightful that someone who is no one ... can set any error into circulation with no thought of responsibility and with the aid of this dreadful disproportioned means of communication."⁹

Kierkegaard would surely see in the Net with its interest groups, which anyone in the world can join and where one can discuss any topic endlessly without consequences, the height of irresponsibility. Without rootedness in a particular problem, all that remains for the interest group commentator is endless gossip. In such groups anyone can have an opinion on anything and all are only too eager to respond to the equally deracinated opinions of other anonymous amateurs who post their views from nowhere. Such commentators do not take a stand on the issues they speak about. Indeed, the very ubiquity of the Net makes any such local stand seem irrelevant. As Kierkegaard puts it: "A public is neither a nation, nor a generation, nor a community, nor a society, nor these particular men, for all these are only what they are through the concrete; no single person who belongs to the public makes a real commitment."¹⁰

The only alternative Kierkegaard saw to this anonymity and lack of commitment was to plunge into some kind of activity – any activity – as long as one threw oneself into it with passionate involvement. Towards the end of *The Present Age* he exhorts his contemporaries to make such a leap:

There is no more action or decision in our day than there is perilous delight in swimming in shallow waters. But just as a grown-up, struggling delightedly in the waves, calls to those younger than himself: "Come on, jump in quickly" – the

decision in existence...calls out...Come on, leap cheerfully, even if it means a lighthearted leap, so long as it is decisive. If you are capable of being a man, then danger and the harsh judgment of existence on your thoughtlessness will help you become one.¹¹

The Aesthetic Sphere: Commitment to the Enjoyment of Sheer Information

Such a lighthearted leap into the deeper water is typified by the Net-surfer for whom information gathering has become a way of life. Such a surfer is curious about everything and ready to spend every free moment visiting the latest hot spots on the Web. He or she enjoys the sheer range of possibilities. Something interesting is only a click away.

Commitment to information as a boundless source of enjoyment puts one in what Kierkegaard calls *the aesthetic sphere of existence* – his anticipation of postmodernity. For such a person just visiting as many sites as possible and keeping up on the cool ones is an end in itself. The only qualitative distinction is between those sites that are interesting and those that are boring. Life consists in fighting off boredom by being a spectator at everything interesting in the universe and in communicating with everyone else so inclined. Such a life produces a self that has no defining content or continuity but is open to all possibilities and to constantly being drawn into new games.

But we have still to explain what makes this use of the Web attractive. Why is there a thrill in being able to find out about everything no matter how trivial? What motivates a commitment to curiosity? Kierkegaard thought that in the final analysis people were attracted to the Press, and we can now add the Web, because the anonymous spectator *takes no risks*. The person in the aesthetic sphere keeps open all possibilities and has no fixed identity that could be threatened by disappointment, humiliation or loss. Surfing the Web is ideally suited to such a life. On the Internet commitments are at best virtual commitments and losses only virtual losses.

But when he is speaking from the point of view of the next higher sphere of existence, Kierkegaard tells us that the self requires not “variableness and brilliancy” but “firmness, balance and steadiness.”¹² So, according to Kierkegaard: “As a result of knowing and being everything possible, one is in contradiction with oneself.”¹³

We would therefore expect the aesthetic sphere to reveal that it was ultimately unlivable, and, indeed, Kierkegaard held that if one threw oneself into the aesthetic sphere with total commitment it was bound to break down under the sheer glut of information and possibilities. Without some way of telling the relevant from the irrelevant and the significant from the insignificant, everything becomes equally interesting and equally boring. Writing under a pseudonym from the perspective of someone experiencing the melancholy that signals the breakdown of the aesthetic sphere he laments: “My reflection on life altogether lacks meaning. I take it some evil spirit has put a pair of spectacles on my nose, one glass of which magnifies to an enormous degree, while the other reduces to the same degree.”¹⁴

This inability to distinguish the trivial from the important eventually stops being exciting and leads to the very boredom the aesthete and Net-surfer dedicate their lives to avoiding. Thus, Kierkegaard concludes: “every aesthetic view of life is despair, and everyone who lives aesthetically is in despair whether he knows it or not. But when one knows it ... a higher form of existence is an imperative requirement.”¹⁵

The Ethical Sphere: Turning Information into Knowledge

That higher form of life Kierkegaard calls *the ethical sphere*. In it one has a stable identity and one is committed to involved action. Information is not denigrated but is sought for serious purposes. Only if one makes a commitment to some perspective – chooses some interest or subject to learn about – can one have a sense of relevance and thus turn information into knowledge. To cite again *Transforming Higher Education*:

Until recently, educators found it sufficient to distinguish between “data” and “information” – interpreted data that has a directed use. Today, a further value must be stipulated – knowledge, which is the perspective and insights that derive from the synthesis of information. Learners need to develop the capacity to search, select, and synthesize vast amounts of information to create knowledge.¹⁶

But if all one has is information, how is the student supposed to arrive at a perspective in terms of which to turn the information into knowledge? This is especially important since it turns out that for a beginner in any

domain to become competent in that domain the beginner must take up a perspective from which to distinguish what is relevant from what is irrelevant.

Taking up such a perspective requires taking risks which involves the learner more and more in his or her tasks. While it might seem that this involvement would interfere with detached rule-testing and so would inhibit further skill development, in fact just the opposite seems to be the case. Only if the detached rule-following stance of the novice is replaced by involvement, can there be further advancement, while resistance to the frightening acceptance of risk and responsibility can lead to stagnation.

Patricia Benner has observed this phenomenon in the education of nurses. Nurses who protect themselves from becoming involved in their work of helping people get well or at least to have dignified deaths, and who therefore do not allow themselves to take up a perspective and then feel elation at their successes and sorrow at their failures, never get past this competence stage and burn out because there are too many facts and rules to keep track of.¹⁷

Thus studies of skill acquisition have shown that, unless the outcome matters and unless the person developing the skill is willing to accept the pain that comes from failure and the elation that comes with success, the learner will be stuck at the level of competence and never achieve mastery. Only those willing to take risks go on to become experts.

It follows that, since expertise can only be acquired through involved engagement with actual situations, the possibility of acquiring expertise is lost in the disengaged discussions and deracinated knowledge acquisition characteristic of the Net. Not only is the detached learner unable to acquire specific disciplinary skills, but, for the same reason, such a learner could not acquire the general skills for getting around in the world and getting on with others that Aristotle calls *phronesis* or *practical wisdom*.

The Net-enthusiast will presumably answer that all the learner has to do to turn information into knowledge, and rule-following into skilled behavior, is to choose a perspective – something that matters – and care about the outcome. But Kierkegaard would argue that the very ease of making choices on the Internet would ultimately lead to the inevitable breakdown of serious choice and so of the ethical sphere. Commitments that are freely chosen can and should be revised from minute to minute as new information comes along. But where there is no risk and every commitment can be

revoked without consequences, choice becomes arbitrary and meaningless. Nothing really matters.¹⁸

To avoid the constant choice of new perspectives, one might, like Judge William, Kierkegaard's pseudonymous author of the description of the ethical sphere in *Either/Or*, turn to one's talents and one's social roles to limit one's choices. Thus, Judge William says that his range of possible relevant actions is constrained by his social roles as judge and husband. But Judge William admits, indeed he is proud of the fact that, as an autonomous person, he is free to give whatever meaning he decides to his talents and his roles. He thus can choose which talents and therefore which commitments are the most important ones. This choice is based on a more fundamental choice of what is worthy and not worthy, what good and what evil. As Judge William puts it:

The good *is* for the fact that I will it, and apart from my willing, it has no existence. This is the expression for freedom By this the distinctive notes of good and evil are by no means belittled or disparaged as merely subjective distinctions. On the contrary, the absolute validity of these distinctions is affirmed.¹⁹

But, Kierkegaard argues, if everything is up for choice, including the standards on the basis of which one chooses, there is no reason to choose one set of standards rather than another. Choosing the guidelines for one's life never makes any serious difference since one can always choose to rescind one's previous choice.

The ethical breaks down because the power to make commitments and so to choose what information to seek out undermines itself. Any choice I make does not get a grip on me so it can always be revoked. It must be constantly reconfirmed by a new choice to take the previous one seriously. As Kierkegaard puts it:

If the despairing self is *active*, ... it is constantly relating to itself only experimentally, no matter what it undertakes, however great, however amazing and with whatever perseverance. It recognizes no power over itself; therefore in the final instance it lacks seriousness The despairing self is content with taking notice of itself which is meant to bestow infinite interest and significance on its enterprises, and which is exactly what makes them experiments The self can, at any moment, start quite arbitrarily all over again and, however far an idea is pursued in practice, the entire action is contained within an hypothesis.²⁰

Thus the *choice* of perspective that was supposed to turn the glut of information into knowledge and provide the

involvement necessary for skill acquisition only adds to the pool of possibilities, and one ends up in what Kierkegaard calls the despair of the ethical. Kierkegaard concludes that one cannot stop the proliferating of information and turn it into relevant knowledge by *deciding* what is worth knowing; one can only turn information into relevant and meaningful knowledge, and one can only care about one's performance and so develop skills, if one has a strong identity based on a serious, long-lasting commitment.

The Religious Sphere: Making One Unconditional Commitment

The view of commitments as choices open to being revoked does not seem to hold for those commitments that are most important. These special commitments are neither the ones that I arbitrarily choose nor the ones that I am obliged to keep because of my social role. Rather, these special commitments are experienced as grabbing my whole being. When I respond to such a summons by making an *unconditional* commitment, this commitment determines who I am and what will be the significant issue for me for the rest of my life. Political and religious movements can grab us in this way as love relationships and, for certain people, such vocations as the law or music.

These unconditional commitments are different from the normal sorts of commitments. They define the world in which our everyday commitments are made. They thus determine which commitments really matter and why they do. Identities based on unconditional commitments, then, stop the proliferation of choices. They block nihilism by establishing qualitative distinctions between what, for the individual, is important and trivial, relevant and irrelevant, serious and playful.

But, of course, such a commitment is risky. One's cause may fail. One's lover may leave. And, since one has defined oneself in terms of them, one cannot just walk away. On the contrary, one's identity and world will collapse and one will experience grief. The detachment of the "Present Age", the flexibility of the aesthetic sphere, and the unbounded freedom of the ethical sphere are all ways of avoiding this risk. But it turns out, Kierkegaard claims, that for that very reason they level all qualitative distinctions and end in the despair of meaninglessness. There is no way to have a meaningful life and to develop

particular skills and the skill of being a good human being without taking risks.

This leads to the perplexing question: What role can Information Technology play in encouraging and supporting such unconditional commitments? A first suggestion might be that the movement from the aesthetic stage to the religious stage will be facilitated by the Web just as flight simulators help one learn to fly. One would be solicited to throw oneself into Net-surfing and find that boring; then into making free choices and revocable commitments until they proliferated absurdly; and so finally be driven to let oneself be drawn into a risky irrevocable commitment as the only way out of despair. Indeed, at any stage from looking for all sorts of interesting web sites as one surfs the Net, to striking up a conversation in a chat room, to making commitments to interest groups, one might just get hooked by one of the ways of life opened up and find oneself drawn into a world-defining lifetime commitment. No doubt this might happen – people do meet in chat rooms and fall in love – but it is certainly infrequent.

Kierkegaard would surely argue that, while the Internet *allows* unconditional commitments, it does not *support* them. Like a simulator, it manages to capture everything but the risk. Our imaginations can be drawn in, as they are in playing games and watching movies. And no doubt game simulations sharpen our responses for non-game situations. But so far as games work by capturing our imaginations, they will fail to give us serious commitments. We teach or work in the laboratory day after day because these activities matter greatly to us. But we are unlikely to stay with either for long if we have only an imaginary ultimate commitment. The temptation is to live in a world of stimulating images and simulated commitments and thus to lead a simulated life. Far from encouraging unconditional commitments, the Net tends to turn all of life into a risk-free game. So, in the end, although Information Technology does not *prohibit* unconditional commitments, it does *inhibit* them.

The test as to whether one had acquired an unconditional commitment would come if one had the incentive and courage to transfer what one had learned to the concrete situation in the real world. There one would confront what Kierkegaard called "the danger and the harsh judgement of existence." And, precisely the attraction of the Net would inhibit that final plunge. Anyone using the Net that was led to risk his or her real identity in the real world would thus have to act against the grain of what attracted them to the Net in the first place.

If Kierkegaard is right, for the cyber-world to avoid despair, it would have to find a way of canceling its risk-free attraction by somehow supporting and encouraging unconditional commitments and strong identities in the real world where risk of failure and disappointment is inevitable.

Conclusion

If educators who teach in the world of hyper-information and hyper-connectivity want to impart knowledge and skills they will not only have to encourage their students to plunge in and swim in deep and dangerous waters, as Kierkegaard proposed, they will also have to encourage them to swim upstream. That is, they will have to foster the sort of unconditioned commitments and strong identities necessary for turning information into meaningful knowledge and the involvement necessary for developing the skills to use it. Only then can they develop in their students knowledge, skills and what Aristotle called practical wisdom.

But what will give these students the strength to resist the nihilistic pull of the new network culture? Their teachers will have to foster those social practices that support strong identities. Fortunately, there are still in our culture the narratives left from the Judeo-Christian tradition that Kierkegaard was drawing on

and trying to preserve. We will have to go on preserving them. We also still have culture heroes like Martin Luther King, Jr. who show that it makes sense to die for one's commitments.

This shows us the basic problem with the Internet and explains why, despite wild promises, attempts to use it in education have so far failed. Since skills cannot be captured and transmitted in rules and the attraction of a life of risk and commitment cannot be fully portrayed by narratives, education at its best must be based on apprenticeship. Even science which starts out teaching rules and techniques ends up with the student as an apprentice in a successful scientist's laboratory. Computer games can teach hand-eye co-ordination, but where worldly expertise is concerned, one can only learn by imitation of the style and day-by-day responses to specific local situations of someone who already has the relevant mastery.

Only by working closely with students in a shared situation in the real world can teachers with strong identities ready to take risks to preserve their commitments pass on their passion and skill so their students can turn information into knowledge and practical wisdom. In so far as we want to teach skill in particular domains and practical wisdom in life, which we certainly do, we thus finally run up against the limits of the World Wide Web. As far as I can see, learning by apprenticeship can work only in the nearness of the classroom and laboratory; never in cyberspace.

Notes

- 1 Lewis J. Perelman, *School's Out*, New York: Avon/ Education, p. 22, 1993.
- 2 Ibid. p. 23.
- 3 Michael G. Dolence and Donald M. Norris, *Transforming Higher Education*, Ann Arbor: Society for College and University Planning, p. 36, 1995.
- 4 Translated separately by Alexander Dru as *The Present Age*, New York: Harper and Row, 1962.
- 5 *Pap. IX A 378*, 1848. The translations are from *Søren Kierkegaard's Journals and Papers*, tr. by Howard V. Hong and Edna H. Hong, Bloomington: Indiana University Press, vol. 2, p. 480, 1970 (indicated as *Journals and Papers*).
- 6 This leveling of differences is reflected in the way information is organized on the Web. When information is organized in a traditional hierarchical database, the user is forced to commit to a certain class of information before he can view more specific data that fall under that class. For example, I have to commit to an interest in animals before I can find out what I want to know about tortoises: and once having made that

commitment to the animal line in the database, I can't then examine the data on problems of infinity without backtracking through my previous commitments. When information is organized in hypertext, as it is on the Web, however, instead of the privileged relations between a class and its members, the organizing principle is the interconnectedness of all knowledge. The goal of hypertext is to allow the user easily to get from one data entry to any other, as long as they are related in at least some tenuous fashion. So, for instance, in examining the entry on tortoises, I might click on the bold text that reads "Tortoises – compared to hares," and be transported instantly to an entry on Zeno's paradox. In this way the user is encouraged to traverse a vast network of knowledge and information, all of which is equally accessible and none of which is privileged. Everything is linked to everything else on a single level. Moreover, the links are not based on a developing sense of relevance but on the canned, context-free relevance of key words. *Quantity* of connections has replaced any judgement as to the *quality* of those connections. [Ed.]

- 7 *The Present Age*, p. 59.
 8 *Journals and Papers*, p. 489.
 9 *Ibid.* p. 481.
 10 *The Present Age*, p. 63.
 11 *Ibid.* pp. 36–37.
 12 *Either/Or*. tr. by Alastair Hannay, Harmondsworth: Penguin Books, p. 391, 1992.
 13 *The Present Age*, p. 68.
 14 *Either/Or* p. 46.
 15 *Ibid.* p. 502.
 16 *Transforming Higher Education*, p. 26.
 17 Patricia Benner, *From Novice to Expert, Excellence and Power in Clinical Nursing Practice*, Reading: Addison-Wesley, 1984.
 18 Enthusiasts try to make an advantage of this rapid turnover of ideas and commitments and use it as an excuse to throw out old-fashioned critical reflection and discussion. In *Transforming Higher Education* we read:

Network scholarship increases the “bandwidth” of information that can be synthesized by an individual and shortens the timeframe [But] some [faculties].. are stuck in yesterday’s model of scholarship: print media and leisurely timeframes for debate and discussion. (p. 25)

But this call for keeping up with the accelerating rate of change is followed by the admission that this new form of constant adaptation is not working.

The tools of network scholarship are revolutionizing discovery research and the synthesis of information in particular academic disciplines. They have not been applied as successfully ... to other forms of ... teaching/learning. (*Ibid.*)

[Ed.]

- 19 *Either/ Or*, p. 524.
 20 *The Sickness unto Death*, tr. by Alastair Hannay, Harmondsworth: Penguin Books, p. 100, 1989.

References

- Patricia Benner. *From Novice to Expert, Excellence and Power in Clinical Nursing Practice*. Reading, Addison-Wesley, 1984.
 Michael G. Dolence and Donald M. Norris. *Transforming Higher Education*. Ann Arbor, Society for College and University Planning, 1995.
 S. Kierkegaard. *The Present Age*. Translated separately by Alexander Dru, New York, Harper and Row, 1962.
 S. Kierkegaard. *Journals and papers*. Paper IX A 378, 1848. Translated by Howard V. Hong and Edna H. Hong. Bloomington, Indiana University Press, 1970.
 S. Kierkegaard. *The Sickness unto Death*. Translated by Alastair Hannay. Harmondsworth, Penguin Books, 1989.
 S. Kierkegaard. *Either/Or*. Translated by Alastair Hannay. Harmondsworth, Penguin Books, 1992.
 Lewis J. Perelman. *School’s Out*. New York: Avon/Education, 1993.

Technology, Knowledge, and Power

Introduction

This final section focuses on several approaches to the question of the relationship between (especially scientific) knowledge and (especially technological) power, the problem of their joint social impact, and the possibility of re-orienting or transforming technology.

Especially among critical social theorists and other continental philosophers, there is widespread agreement that if we simply begin by describing and analyzing the roles of science and technology in everyday existence, we risk uncritically evaluating them entirely in their own terms. For example, it is through technology that science makes its most powerful impact on our lives, but there is some danger that we will too hastily follow those like Latour, Ihde, and Verbeek who mostly conceive science and technology together as the single phenomenon, “technoscience,” and thus tend to take for granted that the influence of science and technology on our lives is best evaluated from the point at which “it” is experienced in everyday technological mediations. The problem is that this kind of philosophical approach often sidesteps the question of how science and technology are themselves already shaped by the (often undemocratic) political and economic interests that inform their combined operation in everyday affairs. For many critics (Feenberg, in this section, among them), failure to ask this prior question deprives us of an effective way to consider the kind of social planning (for which technological knowledge alone is

insufficient) that would ensure a genuinely democratic implementation of technology.

To put the matter a different way, the argument is that the facts and theories of science cannot be adequately understood if one depends primarily on the familiar ideas and imagery of the contemporary lifeworld. At any given moment, technological knowledge simply empowers us to control our natural and human surroundings in whatever ways are now available to us, given the science that has been employed to make this possible. The only hope we have of determining a more “enlightened” (or, for Feenberg, “democratic”) course of action, lies in enlisting the capacity of scientific theorizing to gain some degree of reflective independence from our usual understanding of these surroundings. It is this sort of independence we need if we are to question and re-evaluate the courses of action our technologies currently induce us to pursue. In the meantime, we cannot rationally discuss the question of the optimal relations between technical progress and the social lifeworld when the whole issue remains structured by the ideologies and myths associated with the social life of our time. As all the authors in this section acknowledge in various ways (even Mesthene, who is certainly the least concerned about it), the familiar Enlightenment assumption that we can automatically associate instrumental control of technical problems with democratic freedom – an assumption that persuaded social theorists as diverse as Comte and Marx that it would just be a matter of time before the technical control of productive forces would be

overseen by a democratic decision-making process – is simply mistaken.

Michel Foucault, one of the most influential social philosophers of the last several decades, maintained a lifelong concern for the rise and growing cultural dominance of scientific knowledge in all its forms; but he is known above all for his analyses of the hidden as well as overt relations of power embedded in our “discourses of knowledge” and in the political implications of these relations in human affairs. Thoroughly interdisciplinary in his procedures and choice of topics, Foucault is usually said to have gone through two (possibly three) main intellectual stages. In earlier work, he undertakes an “archeological” and historical investigation of the emergence of the modern “*episteme*” (i.e., general conception of rationality), and he analyzes its function as a paradigm for the sciences of both nature and human life, as well as for the more “dubious disciplines” of applied social science such as criminology, psychoanalysis and psychiatry, and education. In perhaps his most famous work of this period, *The Order of Things* (1966), Foucault characterizes the discontinuous history of the sciences in which *epistemes* succeed one another in a way that bears some resemblance to the works of Kuhn, Toulmin, and other postpositivist philosophers of science in the Anglo-American tradition.

In later works, Foucault employs what he calls a “genealogical” rather than archeological method. There, he more explicitly focuses on sociopolitical issues, and his central concern is with the largely unrecognized ways in which knowledge not only “is” power, as Bacon remarked, but also involves relationships of power that privilege some and dehumanize others. In *Discipline and Punish* (1975), Foucault employs his general theory of knowledge and power in the production of “technologies of the self” to show how the scientific conceptions of rationality and irrationality get utilized to classify, mold, isolate, and discipline “deviant” individuals. Foucault admits, of course, that part of the technology here is physical – for example, as it is found in the architecture of prisons and schools, including Bentham’s famous panopticon (see below). Yet he argues that to judge technology by its tools and productions is to miss its point. One gets closer to the truth by recognizing that aspect of technology which involves behavioral techniques – for example, the confession and the examination, whether in a clinical, academic, or juridical setting. Foucault’s characterization of behavioral techniques bears a striking resemblance to the descriptions of

Skinnerian behavioral technology in the United States. What is equally striking, however, is the contrast between the adulation heaped upon such techniques by its academic and therapeutic advocates and Foucault’s deeply critical stance toward these same techniques. For him, too little concern has been shown for the fact that behavioral technologies need no tools and yet work powerfully on and often against people. In this emphasis on tool-free technology, Foucault clearly shares ground with Mumford, whose “megamachine” is a technological apparatus consisting in human beings, and with Ellul, who also refuses to tie “technique” to the involvement of any hardware but conceives it instead as involving the rationalization of all aspects of life for the purpose of maximizing efficiency. Some readers claim to find evidence of a third stage in Foucault’s late essays and seminars, where his focus seems to shift noticeably away from the sort of critical stance toward our present situation that he otherwise shares with people like Mumford and Ellul (and Heidegger?), and where he seems to look instead toward the question of how to respond to it – that is, how we might yet otherwise “be” in a technoscientific world. In such places, Foucault seems to provide some basis for a postmodern ethics, in which non-traditional technologies of the self might transform our understanding of critical reflection and autonomy in ways that would enable us to mitigate the persistent presence of the effects of techniques of domination.

With his critical conception of techniques as instruments of power in the background, Foucault argues in the present excerpt from *Discipline and Punish* that those like Guy Debord, who characterize modern society with its professional sports and mass media as a “society of the spectacle,” are quite wrong. On the contrary, Foucault asserts, ours is a society involving mutual surveillance. For example, in ancient times architecture was arranged so that a maximum number of spectators could observe a single thing or person. In the modern carceral world, architecture is arranged (and not just in prisons!) so that the ideal is a single observer observing as many people as possible. Foucault shows how the apparently more “humane” treatment of criminals and the insane is really a more insidious form of control based on more insidious conceptions of “informed” observation and visibility. Under the old regimes of torture and inquisition, punishment was overt, physical, and administered by visible representatives of a state or royal power. Modern modes of punishment are at once less visible and more complete. By making criminals, the socially undesirable, and

the insane objects of technoscientific “knowledge,” they are more effectively and totally “understood,” classified, and brought under control – not just by physical force but by hidden forms of coercion – for example, the modern juridical form of examination. One can also see this transition from ancient to modern practices of control reflected in changes in characterizations of the scientific method. For Bacon, scientific experiment verges (*only* metaphorically?) on a sort of torture of nature. According to Kant’s *First Critique*, scientific inquiry is like a judicial examination, where the scientist is a judge, putting the question to nature. Foucault was himself active in the prison liberation movement but denied that courses of action could be grounded “ethically,” in any traditional sense. His archeological and genealogical descriptions, like those of Marx in his more scientific moods, were supposedly value-free.

In his famous “Do Artifacts Have Politics?” (he answers, Yes), Langdon Winner begins by distinguishing his view of the relations between technology and society from those who conceive the relation according to the standard social science model. It is too easy, he argues, to explain present technologies in terms of antecedent conditions “on” them. Of course, social conditions obviously affect everything, but if we take (what he conceives as) Husserl’s advice and go to the technological “things themselves,” we can see that this approach distorts the character of technology in two ways. First, it encourages the familiar but mistaken assumption that technologies themselves are mere neutral things, available for use but otherwise just instruments, and thus, second, it encourages us to look in the wrong places to discover why we have and use the technologies we do. In fact, he argues, we need to see the “inherently political” character of technologies themselves. Only then will we be able to understand the often troubling patterns of development in the modern world.

It is worth noting that Winner’s line of reasoning shows clear affinities here with postphenomenologists like Verbeek, who actually cites Winner in his discussion of the “political intentionality” of technologies (see Chapter 47) and identifies his own recent coinage, the “morality of things,” as “analogous” to Winner’s idea that artifacts have politics (*Moralizing Technology*, 2011). There are some affinities, too, with critical social theorists like Feenberg, who agrees with Winner’s idea of technologies as socially and politically “coded” and often so in undemocratic ways (*Between Reason and Experience*, 2011) – although he argues at the same time that we need much

more detailed analyses than Winner’s, both of the socio-culturally rich “technical codes” that artifacts actually do have and also of how it might be possible to “democratize” them (see below). Although Winner does not say so, one might also think of his criticisms of the social determination of artifacts as what phenomenologists call an “ontological” critique – that is, an argument that to “be” an artifact is to be something both more and different than socially determined and merely instrumental.

One of Winner’s examples has become famous. Drawing on Robert A. Caro’s Pulitzer Prize-winning study of New York’s influential urban planner, *The Power Broker: Robert Moses and the Fall of New York* (1974), Winner reports that there were apparently elitist and even racist reasons why Moses designed low-clearance bridges – accessible to cars but not to buses – for the Long Island Expressway. In a word: no buses, no inner-city undesirables to bother upper-class life at Jones Beach. Obviously, then, Moses’ bridges “are” political. Here is one of countless cases in which the sheer presence of certain technologies, whatever they are, can coerce human behavior (as here: “Those people” will have to find somewhere else to swim). Some commentators have complained that the mere construction of the low bridges is insufficient “proof” of Winner’s accusation, especially since other explanations seem possible (e.g., low bridges simply favor the automobile, or protect nature from commercialization and industrialization, or extend progressivist cultural sympathy for the popular national park code that our architecture should honor nature). Besides, the idea that any one person, no matter how powerful, could actually be responsible for the whole affair relies on a questionable conception of social causation (the so-called – and revealingly gendered – “great man theory of history”). However, these objections obscure Winner’s main point. Whatever Moses’ actual motive and whatever one thinks of the design of his bridges, their sheer presence *as built* is inextricably bound up with specific social consequences and political organization. And the fact is, many technologies obviously do express political attitudes (e.g., Cyrus McCormick’s pneumatic molding machines may have “modernized” his factory, but the point was to get rid of skilled workers who had the gall to unionize). Moreover, even when no particular political motive seems involved, the way technologies are designed, built, and organized will “produce a set of consequences logically and temporally *prior* to any of [their] professed uses.”

Winner's worry, of course, is that more often than not these consequences are anti-progressive and undemocratic. (Compare McDermott's argument below against Mesthene, whom he accuses of encouraging right-wing politics by defending an unrelievedly technocratic society, in which education, social privilege, and political power all naturally tend to be undemocratically concentrated in the hands of "experts.") However, Winner refuses to accept the gloomy conclusion of technological pessimists. The fact that virtually all technologies, just by being the technologies they are, affect our ways of ordering human life does not mean that the sociopolitical determination of artifacts is "deterministic" in the hopelessly full sense. Sometimes, he notes, a configuration may seem "required," but often it is only "strongly compatible with" one specific sociopolitical arrangement. Indeed, even when it does seem more or less required, the overall sociopolitical arrangement is typically set up not just automatically or with one choice (e.g., to build a large transmission line for electric power), but by means of numerous further decisions through which the course of its development is facilitated or could be altered (e.g., the line's route, location of generators, height and appearance of the towers). Citing Engels' "On Authority" (see Chapter 8), Winner points out that it also matters how carefully an arrangement – especially an arrangement with a "distinctive political cast" – is considered at the beginning, before its sheer presence takes on a life of its own, and thus at a time when the traditional temptations to, say, centralize authority for efficiency's sake might be most effectively – and democratically – dealt with. In short, Winner's discussion is rich with examples and distinctions of what should be considered in the choosing of our technologies – so much so that some readers have protested that it is no longer clear what Winner would have us do, or even how far he thinks we are free to do it. Nevertheless, he does succeed in fleshing out his central point. Our technologies may leave us with a wider or a narrower effective range of choice, but in making the choices that we have, it is important to consider not only their social and political contexts but the technologies themselves – if, that is, we are to successfully "salvage the autonomy of politics from the bind of practical [i.e., technological] necessity."

Emmanuel Mesthene's upbeat account of the social impact of technological change and John McDermott's acerbic response to him have come to constitute a classical exchange in the evaluation of modern technology. In "Technology and Wisdom" Mesthene, the director of

the early and short-lived Harvard University Program on Technology and Society, presents with admirable openness and clarity the attitude that often lies less candidly acknowledged behind pro-technological writing. There are, says Mesthene, no longer any real limits to what we can do with nature or ourselves. The notion of physical impossibility – the "sheer rock-bottomness of nature" – has been overcome. Previous societies always labored under some notion of cosmic or divine impediment – for instance, a surd universe of matter, a chaotic cosmic substratum (e.g., Plato's receptacle), arbitrary but unavoidable fate as in Greek tragedy, or original sin as in Christian theology. Modern science, however, makes everything transparent and understandable (recall the logical empiricists' "Scientific Conception of the World" in Chapter 9: "There are no depths ... Everything is accessible"). Nothing, as Mesthene sees it, is incomprehensible or uncontrollable. (One might note in passing that quantum mechanics, chaos theory, and anti-reductionistic claims concerning biology may all raise doubts about Mesthene's thesis, but the point to stress is that his attitude, accurate or not, prereflectively guides the great majority of advocates of technological progress and technocracy.) In the end, then, given the conceptual power of scientific understanding, there is nothing to stop unlimited technological development. In fact, says Mesthene, we have not and will not stop technological development because it is an expression of our humanity. Hence, those who urge technological caution are guilty of the same sort of "failure of nerve" that beset the Hellenistic world.

In his symposium contribution to the Fourth Annual Report of his Harvard program (from which the second part of our selection comes), Mesthene positions himself between optimistic technological utopians and pessimistic technological dystopians, but also argues against traditionalists who claim that modern technologies raise no new issues concerning the human condition. The simple fact is, he asserts, that new technologies open new possibilities and put within reach other possibilities that were previously too costly and difficult to realize. Thus, inevitably, technology changes the range and weightings of our possibilities, and the only proper response to this fact is to cease clinging to some given set of supposedly permanent values and embrace instead the process of "valuation" called for by each new circumstance. (To what extent, we might ask, does Mesthene's position resemble Dewey's instrumentalism? See Chapter 34.) As for the political consequences of this state of affairs,

Mesthene claims that, in some ways, it fosters democracy (for example, with the promise of instant voting, or, more importantly, by making closer and more organized forms of cooperation necessary). At the same time, he holds that our understanding of what democracy is will necessarily have to undergo development. For example, democracy can no longer be as “direct” as traditional theory depicts it. Technological change encourages us to produce an ever-better-educated public, but nothing can stop the inevitably widening gap between technological experts who guide policy and citizens who are supposed to set it. “No amount of participation [in government] in the populist sense,” says Mesthene, “can substitute for the expertise and decision-making technologies that modern government must use.” Nevertheless, he adds, the presentation of facts by experts in, say, economics and international affairs will tend to increase consensus by removing issues from controversy.

It is Mesthene’s view of the political consequences of technological development upon which McDermott seizes. In “Technocracy: The Opiate of the Intellectuals” (which started life as a review of Mesthene’s 1970 book, *Technological Change: Its Impact on Man and Society*), he calls Mesthene’s arguments – for all their soothing rhetoric about a “new democratic ethos” – the straightforward defense of a politically right-wing, technocratically elitist position. As Mesthene himself seems at times to realize, the society he envisions is fundamentally dependent on expert social scientific and business management opinion and is therefore increasingly without need of popular support or participation. McDermott coins the phrase, *laissez innover*, to describe Mesthene’s kind of ideology of technocracy. Just as *laissez faire* was never a genuine description of real economies with their monopolies and government favors but rather an ideology to support entrepreneurs against employees, so the doctrine of *laissez innover* is designed, not to liberate technological creativity from old-fashioned doubts but to free technocrats and their economic masters from popular restraint or regulation. In order to illustrate the increasingly undemocratic and expert-dependent character of the world Mesthene embraces, McDermott contrasts the ultra-rationality of strategic bombing during the Vietnam War with the myths created by uninformed and dismayed ground troops who could not understand why they were being beaten by a technologically inferior indigenous force. In a striking exemplification of the general argument of Habermas, Marcuse, and the critical social theorists, McDermott shows how, contrary to Mesthene’s

rosy picture of an ever-better-educated population, technological “rationality” at the top breeds “irrationality” and fear among the populace. In his brief retrospective, McDermott reaffirms his conviction that technology is still as central to our world and as problematically related to democratic interests as it was when he wrote “Technology.” If anything, the separation of a technocratic class from the “masses” is even greater today, and *laissez innover*, instead of constituting an ideological replacement for *laissez faire*, has simply merged with it in a new, more technologized understanding of “the Market” and its “requirements.” (Might we also compare McDermott’s account of Vietnam-era computerized bombing runs and today’s worldwide drone attacks?)

Andrew Feenberg’s “Democratic Rationalization” combines criticism of technological determinism with a call for the democratization of technology and concludes with a summary of the criticisms of Heidegger’s account of technology that he elaborates in his selection in Part IV (Chapter 31). Feenberg touches upon many of the themes in previous selections. He rejects the deterministic, “unilinear” picture of the course of technology (e.g., Heilbroner, Chapter 37). He also rejects Max Weber’s view that technological rationalization makes industrial democracy impossible – a view which he claims to find in both Heidegger and Ellul and which is sketched in simple terms in Engels’ “On Authority” (see Chapter 8). Feenberg appeals to the social constructivism of Pinch and Bijker (see Chapter 24), arguing that it is only “decontextualized” conceptions of technology that can make it appear to be the self-generating foundation of modern society. A closer, more ground-level look at technology in its actual social and cultural setting reveals that its development is in fact multi-directional, not unilinear, and its course is “overdetermined” by and variously adaptive to both technical and societal demands.

Feenberg argues that his non-deterministic position cannot help being political, since if there are no predetermined “technological imperatives,” then technology needs to be interpreted, and the choices it embodies and makes possible need to be made explicit and evaluated. Here, Feenberg gives the social constructivists’ method of interpretive flexibility a hermeneutic twist. It is not how technology *functions* but what its objects are taken to *be* that requires illumination. In his language, to focus exclusively on the “design” of technological devices ignores the way every design incorporates a “technical code” that reflects, often in undemocratic ways, what is supposed to be valued and privileged (but thus could be

recoded to reflect other, more democratic concerns). Feenberg identifies “social meaning” and “cultural horizon” as the two hermeneutical dimensions of technical artifacts. Computer hackers obviously exemplify one way that users of technical objects reinterpret and modify their social meaning. (One might also think of how cell phones have recently become revolutionary devices in the Middle East.) Similarly, the AIDS patients’ movement transformed the way medical drug treatment and experimentation are understood. As regards the cultural horizon, Feenberg points out that in Foucault’s theory

of “power/knowledge,” modern forms of oppression are shown to depend on alleged “truths” of a technical frame of understanding the maintains its dominance precisely by not being recognized as the contingent, chosen cultural image of technical control that it is. Feenberg closes by complaining that, from the level of abstraction maintained by people like Heidegger, the specific character of today’s technology cannot appear – with the result that it can then seem to be a “metaphysical condition,” instead of the result of a particular social hegemony that it really is.

Panopticism

Michel Foucault

The following, according to an order published at the end of the seventeenth century, were the measures to be taken when the plague appeared in a town.¹

First, a strict spatial partitioning: the closing of the town and its outlying districts, a prohibition to leave the town on pain of death, the killing of all stray animals; the division of the town into distinct quarters, each governed by an intendant. Each street is placed under the authority of a syndic, who keeps it under surveillance; if he leaves the street, he will be condemned to death. On the appointed day, everyone is ordered to stay indoors: it is forbidden to leave on pain of death. The syndic himself comes to lock the door of each house from the outside; he takes the key with him and hands it over to the intendant of the quarter; the intendant keeps it until the end of the quarantine. Each family will have made its own provisions; but, for bread and wine, small wooden canals are set up between the street and the interior of the houses, thus allowing each person to receive his ration without communicating with the suppliers and other residents; meat, fish and herbs will be hoisted up into the houses with pulleys and baskets. If it is absolutely necessary to leave the house, it will be done in turn, avoiding any meeting. Only the intendants, syndics and guards will move about the streets and also, between the infected houses, from one corpse to another, the “crows”, who can be left to die: these are “people of little substance

who carry the sick, bury the dead, clean and do many vile and abject offices”. It is a segmented, immobile, frozen space. Each individual is fixed in his place. And, if he moves, he does so at the risk of his life, contagion or punishment.

Inspection functions ceaselessly. The gaze is alert everywhere: “A considerable body of militia, commanded by good officers and men of substance”, guards at the gates, at the town hall and in every quarter to ensure the prompt obedience of the people and the most absolute authority of the magistrates, “as also to observe all disorder, theft and extortion”. At each of the town gates there will be an observation post; at the end of each street sentinels. Every day, the intendant visits the quarter in his charge, inquires whether the syndics have carried out their tasks, whether the inhabitants have anything to complain of; they “observe their actions”. Every day, too, the syndic goes into the street for which he is responsible; stops before each house: gets all the inhabitants to appear at the windows (those who live overlooking the courtyard will be allocated a window looking onto the street at which no one but they may show themselves); he calls each of them by name, informs himself as to the state of each and every one of them – “in which respect the inhabitants will be compelled to speak the truth under pain of death”; if someone does not appear at the window, the syndic must ask why: “In this way he will find out easily enough

Michel Foucault, “Panopticism,” from *Discipline and Punish*, trans. Alan Sheridan (Pantheon, 1978), pp. 195–209, 216–228, 316–317, 326–333, abridged. Reprinted by permission of Georges Borchardt and Penguin Books UK.

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whether dead or sick are being concealed.” Everyone locked up in his cage, everyone at his window, answering to his name and showing himself when asked – it is the great review of the living and the dead.

This surveillance is based on a system of permanent registration: reports from the syndics to the intendants, from the intendants to the magistrates or mayor. At the beginning of the “lock up”, the role of each of the inhabitants present in the town is laid down, one by one; this document bears “the name, age, sex of everyone, notwithstanding his condition”: a copy is sent to the intendant of the quarter, another to the office of the town hall, another to enable the syndic to make his daily roll call. Everything that may be observed during the course of the visits – deaths, illnesses, complaints, irregularities – is noted down and transmitted to the intendants and magistrates. The magistrates have complete control over medical treatment; they have appointed a physician in charge; no other practitioner may treat, no apothecary prepare medicine, no confessor visit a sick person without having received from him a written note “to prevent anyone from concealing and dealing with those sick of the contagion, unknown to the magistrates”. The registration of the pathological must be constantly centralized. The relation of each individual to his disease and to his death passes through the representatives of power, the registration they make of it, the decisions they take on it.

Five or six days after the beginning of the quarantine, the process of purifying the houses one by one is begun. All the inhabitants are made to leave; in each room “the furniture and goods” are raised from the ground or suspended from the air; perfume is poured around the room; after carefully sealing the windows, doors and even the keyholes with wax, the perfume is set alight. Finally, the entire house is closed while the perfume is consumed; those who have carried out the work are searched, as they were on entry, “in the presence of the residents of the house, to see that they did not have something on their persons as they left that they did not have on entering”. Four hours later, the residents are allowed to re-enter their homes.

This enclosed, segmented space, observed at every point, in which the individuals are inserted in a fixed place, in which the slightest movements are supervised, in which all events are recorded, in which an uninterrupted work of writing links the centre and periphery, in which power is exercised without division, according to a continuous hierarchical figure, in which each individual is constantly located, examined and distributed

among the living beings, the sick and the dead – all this constitutes a compact model of the disciplinary mechanism. The plague is met by order; its function is to sort out every possible confusion: that of the disease, which is transmitted when bodies are mixed together; that of the evil, which is increased when fear and death overcome prohibitions. It lays down for each individual his place, his body, his disease and his death, his well-being, by means of an omnipresent and omniscient power that subdivides itself in a regular, uninterrupted way even to the ultimate determination of the individual, of what characterizes him, of what belongs to him, of what happens to him. Against the plague, which is a mixture, discipline brings into play its power, which is one of analysis. A whole literary fiction of the festival grew up around the plague: suspended laws, lifted prohibitions, the frenzy of passing time, bodies mingling together without respect, individuals unmasked, abandoning their statutory identity and the figure under which they had been recognized, allowing a quite different truth to appear. But there was also a political dream of the plague, which was exactly its reverse: not the collective festival, but strict divisions; not laws transgressed, but the penetration of regulation into even the smallest details of everyday life through the mediation of the complete hierarchy that assured the capillary functioning of power; not masks that were put on and taken off, but the assignment to each individual of his “true” name, his “true” place, his “true” body, his “true” disease. The plague as a form, at once real and imaginary, of disorder had as its medical and political correlative discipline. Behind the disciplinary mechanisms can be read the haunting memory of “contagions”, of the plague, of rebellions, crimes, vagabondage, desertions, people who appear and disappear, live and die in disorder.

If it is true that the leper gave rise to rituals of exclusion, which to a certain extent provided the model for and general form of the great Confinement, then the plague gave rise to disciplinary projects. Rather than the massive, binary division between one set of people and another, it called for multiple separations, individualizing distributions, an organization in depth of surveillance and control, an intensification and a ramification of power. The leper was caught up in a practice of rejection, of exile-enclosure; he was left to his doom in a mass among which it was useless to differentiate; those sick of the plague were caught up in a meticulous tactical partitioning in which individual differentiations were the constricting effects of a power that multiplied, articulated

and subdivided itself; the great confinement on the one hand; the correct training on the other. The leper and his separation; the plague and its segmentations. The first is marked; the second analysed and distributed. The exile of the leper and the arrest of the plague do not bring with them the same political dream. The first is that of a pure community, the second that of a disciplined society. Two ways of exercising power over men, of controlling their relations, of separating out their dangerous mixtures. The plague-stricken town, traversed throughout with hierarchy, surveillance, observation, writing; the town immobilized by the functioning of an extensive power that bears in a distinct way over all individual bodies – this is the Utopia of the perfectly governed city. The plague (envisaged as a possibility at least) is the trial in the course of which one may define ideally the exercise of disciplinary power. In order to make rights and laws function according to pure theory, the jurists place themselves in imagination in the state of nature; in order to see perfect disciplines functioning, rulers dreamt of the state of plague. Underlying disciplinary projects the image of the plague stands for all forms of confusion and disorder; just as the image of the leper, cut off from all human contact, underlies projects of exclusion.

They are different projects, then, but not incompatible ones. We see them coming slowly together, and it is the peculiarity of the nineteenth century that it applied to the space of exclusion of which the leper was the symbolic inhabitant (beggars, vagabonds, madmen and the disorderly formed the real population) the technique of power proper to disciplinary partitioning. Treat “lepers” as “plague victims”, project the subtle segmentations of discipline onto the confused space of internment, combine it with the methods of analytical distribution proper to power, individualize the excluded, but use procedures of individualization to mark exclusion – this is what was operated regularly by disciplinary power from the beginning of the nineteenth century in the psychiatric asylum, the penitentiary, the reformatory, the approved school and, to some extent, the hospital. Generally speaking, all the authorities exercising individual control function according to a double mode; that of binary division and branding (mad/sane; dangerous/harmless; normal/abnormal); and that of coercive assignment, of differential distribution (who he is; where he must be; how he is to be characterized; how he is to be recognized; how a constant surveillance is to be exercised over him in an individual way, etc.). On the one hand, the lepers are treated as plague victims; the tactics of individualizing

disciplines are imposed on the excluded; and, on the other hand, the universality of disciplinary controls makes it possible to brand the “leper” and to bring into play against him the dualistic mechanisms of exclusion. The constant division between the normal and the abnormal, to which every individual is subjected, brings us back to our own time, by applying the binary branding and exile of the leper to quite different objects; the existence of a whole set of techniques and institutions for measuring, supervising and correcting the abnormal brings into play the disciplinary mechanisms to which the fear of the plague gave rise. All the mechanisms of power which, even today, are disposed around the abnormal individual, to brand him and to alter him, are composed of those two forms from which they distantly derive.

Bentham’s *Panopticon* is the architectural figure of this composition. We know the principle on which it was based: at the periphery, an annular building; at the centre, a tower; this tower is pierced with wide windows that open onto the inner side of the ring; the peripheral building is divided into cells, each of which extends the whole width of the building; they have two windows, one on the inside, corresponding to the windows of the tower; the other, on the outside, allows the light to cross the cell from one end to the other. All that is needed, then, is to place a supervisor in a central tower and to shut up in each cell a madman, a patient, a condemned man, a worker or a schoolboy. By the effect of backlighting, one can observe from the tower, standing out precisely against the light, the small captive shadows in the cells of the periphery. They are like so many cages, so many small theatres, in which each actor is alone, perfectly individualized and constantly visible. The panoptic mechanism arranges spatial unities that make it possible to see constantly and to recognize immediately. In short, it reverses the principle of the dungeon; or rather of its three functions – to enclose, to deprive of light and to hide – it preserves only the first and eliminates the other two. Full lighting and the eye of a supervisor capture better than darkness, which ultimately protected. Visibility is a trap.

To begin with, this made it possible – as a negative effect – to avoid those compact, swarming, howling masses that were to be found in places of confinement, those painted by Goya or described by Howard. Each individual, in his place, is securely confined to a cell from which he is seen from the front by the supervisor; but the side walls prevent him from coming into contact with his companions. He is seen, but he does not see;

he is the object of information, never a subject in communication. The arrangement of his room, opposite the central tower, imposes on him an axial visibility; but the divisions of the ring, those separated cells, imply a lateral invisibility. And this invisibility is a guarantee of order. If the inmates are convicts, there is no danger of a plot, an attempt at collective escape, the planning of new crimes for the future, bad reciprocal influences; if they are patients, there is no danger of contagion; if they are madmen there is no risk of their committing violence upon one another; if they are schoolchildren, there is no copying, no noise, no chatter, no waste of time; if they are workers, there are no disorders, no theft, no coalitions, none of those distractions that slow down the rate of work, make it less perfect or cause accidents. The crowd, a compact mass, a locus of multiple exchanges, individualities merging together, a collective effect, is abolished and replaced by a collection of separated individualities. From the point of view of the guardian, it is replaced by a multiplicity that can be numbered and supervised; from the point of view of the inmates, by a sequestered and observed solitude (Bentham, 60–64).

Hence the major effect of the Panopticon: to induce in the inmate a state of conscious and permanent visibility that assures the automatic functioning of power. So to arrange things that the surveillance is permanent in its effects, even if it is discontinuous in its action; that the perfection of power should tend to render its actual exercise unnecessary; that this architectural apparatus should be a machine for creating and sustaining a power relation independent of the person who exercises it; in short, that the inmates should be caught up in a power situation of which they are themselves the bearers. To achieve this, it is at once too much and too little that the prisoner should be constantly observed by an inspector: too little, for what matters is that he knows himself to be observed; too much, because he has no need in fact of being so. In view of this, Bentham laid down the principle that power should be visible and unverifiable. Visible: the inmate will constantly have before his eyes the tall outline of the central tower from which he is spied upon. Unverifiable: the inmate must never know whether he is being looked at at any one moment; but he must be sure that he may always be so. In order to make the presence or absence of the inspector unverifiable, so that the prisoners, in their cells, cannot even see a shadow, Bentham envisaged not only Venetian blinds on the windows of the central observation hall, but, on the inside, partitions that intersected the hall at right

angles and, in order to pass from one quarter to the other, not doors but zig-zag openings; for the slightest noise, a gleam of light, a brightness in a half-opened door would betray the presence of the guardian.² The Panopticon is a machine for dissociating the see/being seen dyad: in the peripheric ring, one is totally seen, without ever seeing; in the central tower, one sees everything without ever being seen.³

It is an important mechanism, for it automatizes and disindividualizes power. Power has its principle not so much in a person as in a certain concerted distribution of bodies, surfaces, lights, gazes; in an arrangement whose internal mechanisms produce the relation in which individuals are caught up. The ceremonies, the rituals, the marks by which the sovereign's surplus power was manifested are useless. There is a machinery that assures dissymmetry, disequilibrium, difference. Consequently, it does not matter who exercises power. Any individual, taken almost at random, can operate the machine: in the absence of the director, his family, his friends, his visitors, even his servants (Bentham, 45). Similarly, it does not matter what motive animates him: the curiosity of the indiscreet, the malice of a child, the thirst for knowledge of a philosopher who wishes to visit this museum of human nature, or the perversity of those who take pleasure in spying and punishing. The more numerous those anonymous and temporary observers are, the greater the risk for the inmate of being surprised and the greater his anxious awareness of being observed. The Panopticon is a marvellous machine which, whatever use one may wish to put it to, produces homogeneous effects of power.

A real subjection is born mechanically from a fictitious relation. So it is not necessary to use force to constrain the convict to good behaviour, the madman to calm, the worker to work, the schoolboy to application, the patient to the observation of the regulations. Bentham was surprised that panoptic institutions could be so light: there were no more bars, no more chains, no more heavy locks; all that was needed was that the separations should be clear and the openings well arranged. The heaviness of the old "houses of security", with their fortress-like architecture, could be replaced by the simple, economic geometry of a "house of certainty". The efficiency of power, its constraining force have, in a sense, passed over to the other side – to the side of its surface of application. He who is subjected to a field of visibility, and who knows it, assumes responsibility for the constraints of power; he makes them play spontaneously upon himself; he inscribes in himself the power relation in which he

simultaneously plays both roles; he becomes the principle of his own subjection. By this very fact, the external power may throw off its physical weight; it tends to the non-corporal; and, the more it approaches this limit, the more constant, profound and permanent are its effects: it is a perpetual victory that avoids any physical confrontation and which is always decided in advance.

Bentham does not say whether he was inspired, in his project, by Le Vaux's menagerie at Versailles: the first menagerie in which the different elements are not, as they traditionally were, distributed in a park (Loisel, 104–7). At the centre was an octagonal pavilion which, on the first floor, consisted of only a single room, the king's *salon*; on every side large windows looked out onto seven cages (the eighth side was reserved for the entrance), containing different species of animals. By Bentham's time, this menagerie had disappeared. But one finds in the programme of the Panopticon a similar concern with individualizing observation, with characterization and classification, with the analytical arrangement of space. The Panopticon is a royal menagerie; the animal is replaced by man, individual distribution by specific grouping and the king by the machinery of a furtive power. With this exception, the Panopticon also does the work of a naturalist. It makes it possible to draw up differences: among patients, to observe the symptoms of each individual, without the proximity of beds, the circulation of miasmas, the effects of contagion confusing the clinical tables; among school children, it makes it possible to observe performances (without there being any imitation or copying), to map aptitudes, to assess characters, to draw up rigorous classifications and, in relation to normal development, to distinguish "laziness and stubbornness" from "incurable imbecility"; among workers, it makes it possible to note the aptitudes of each worker, compare the time he takes to perform a task, and if they are paid by the day, to calculate their wages (Bentham, 60–64).

So much for the question of observation. But the Panopticon was also a laboratory; it could be used as a machine to carry out experiments, to alter behaviour, to train or correct individuals. To experiment with medicines and monitor their effects. To try out different punishments on prisoners, according to their crimes and character, and to seek the most effective ones. To teach different techniques simultaneously to the workers, to decide which is the best. To try out pedagogical experiments – and in particular to take up once again the well-debated problem of secluded education, by using orphans. One would see what would happen when, in

their sixteenth or eighteenth year, they were presented with other boys or girls; one could verify whether, as Helvetius thought, anyone could learn anything; one would follow "the genealogy of every observable idea"; one could bring up different children according to different systems of thought, making certain children believe that two and two do not make four or that the moon is a cheese, then put them together when they are twenty or twenty-five years old; one would then have discussions that would be worth a great deal more than the sermons or lectures on which so much money is spent; one would have at least an opportunity of making discoveries in the domain of metaphysics. The Panopticon is a privileged place for experiments on men, and for analysing with complete certainty the transformations that may be obtained from them. The Panopticon may even provide an apparatus for supervising its own mechanisms. In this central tower, the director may spy on all the employees that he has under his orders: nurses, doctors, foremen, teachers, warders; he will be able to judge them continuously, alter their behaviour, impose upon them the methods he thinks best; and it will even be possible to observe the director himself. An inspector arriving unexpectedly at the centre of the Panopticon will be able to judge at a glance, without anything being concealed from him, how the entire establishment is functioning. And, in any case, enclosed as he is in the middle of this architectural mechanism, is not the director's own fate entirely bound up with it? The incompetent physician who has allowed contagion to spread, the incompetent prison governor or workshop manager will be the first victims of an epidemic or a revolt. "By every tie I could devise", said the master of the Panopticon, "my own fate had been bound up by me with theirs" (Bentham, 177). The Panopticon functions as a kind of laboratory of power. Thanks to its mechanisms of observation, it gains in efficiency and in the ability to penetrate into men's behaviour, knowledge follows the advances of power, discovering new objects of knowledge over all the surfaces on which power is exercised.

The plague-stricken town, the panoptic establishment – the differences are important. They mark, at a distance of a century and a half, the transformations of the disciplinary programme. In the first case, there is an exceptional situation: against an extraordinary evil, power is mobilized; it makes itself everywhere present and visible; it invents new mechanisms; it separates, it immobilizes, it partitions; it constructs for a time what is both a counter-city and the perfect

society; it imposes an ideal functioning, but one that is reduced, in the final analysis, like the evil that it combats, to a simple dualism of life and death: that which moves brings death, and one kills that which moves. The Panopticon, on the other hand, must be understood as a generalizable model of functioning; a way of defining power relations in terms of the everyday life of men. No doubt Bentham presents it as a particular institution, closed in upon itself. Utopias, perfectly closed in upon themselves, are common enough. As opposed to the ruined prisons, littered with mechanisms of torture, to be seen in Piranesi's engravings, the Panopticon presents a cruel, ingenious cage. The fact that it should have given rise, even in our own time, to so many variations, projected or realized, is evidence of the imaginary intensity that it has possessed for almost two hundred years. But the Panopticon must not be understood as a dream building: it is the diagram of a mechanism of power reduced to its ideal form; its functioning, abstracted from any obstacle, resistance or friction, must be represented as a pure architectural and optical system: it is in fact a figure of political technology that may and must be detached from any specific use.

It is polyvalent in its applications; it serves to reform prisoners, but also to treat patients, to instruct school-children, to confine the insane, to supervise workers, to put beggars and idlers to work. It is a type of location of bodies in space, of distribution of individuals in relation to one another, of hierarchical organization, of disposition of centres and channels of power, of definition of the instruments and modes of intervention of power, which can be implemented in hospitals, workshops, schools, prisons. Whenever one is dealing with a multiplicity of individuals on whom a task or a particular form of behaviour must be imposed, the panoptic schema may be used. It is – necessary modifications apart – applicable “to all establishments whatsoever, in which, within a space not too large to be covered or commanded by buildings, a number of persons are meant to be kept under inspection” (Bentham, 40; although Bentham takes the penitentiary house as his prime example, it is because it has many different functions to fulfil – safe custody, confinement, solitude, forced labour and instruction).

In each of its applications, it makes it possible to perfect the exercise of power. It does this in several ways: because it can reduce the number of those who exercise it, while increasing the number of those on whom it is exercised. Because it is possible to intervene at any moment and because the constant pressure acts even

before the offences, mistakes or crimes have been committed. Because, in these conditions, its strength is that it never intervenes, it is exercised spontaneously and without noise, it constitutes a mechanism whose effects follow from one another. Because, without any physical instrument other than architecture and geometry, it acts directly on individuals; it gives “power of mind over mind”. The panoptic schema makes any apparatus of power more intense: it assures its economy (in material, in personnel, in time); it assures its efficacy by its preventative character, its continuous functioning and its automatic mechanisms. It is a way of obtaining from power “in hitherto unexampled quantity”, “a great and new instrument of government...; its great excellence consists in the great strength it is capable of giving to *any* institution it may be thought proper to apply it to” (Bentham, 66).

It's a case of “it's easy once you've thought of it” in the political sphere. It can in fact be integrated into any function (education, medical treatment, production, punishment); it can increase the effect of this function, by being linked closely with it; it can constitute a mixed mechanism in which relations of power (and of knowledge) may be precisely adjusted, in the smallest detail, to the processes that are to be supervised; it can establish a direct proportion between “surplus power” and “surplus production”. In short, it arranges things in such a way that 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 these power relations. Bentham's Preface to *Panopticon* opens with a list of the benefits to be obtained from his “inspection-house”: “*Morals reformed – health preserved – industry invigorated – instruction diffused – public burthens lightened* – Economy seated, as it were, upon a rock – the gordian knot of the Poor-Laws not cut, but untied – all by a simple idea in architecture!” (Bentham, 39).

Furthermore, the arrangement of this machine is such that its enclosed nature does not preclude a permanent presence from the outside: we have seen that anyone may come and exercise in the central tower the functions of surveillance, and that, this being the case, he can gain a clear idea of the way in which the surveillance is practised. In fact, any panoptic institution, even

if it is as rigorously closed as a penitentiary, may without difficulty be subjected to such irregular and constant inspections and not only by the appointed inspectors, but also by the public; any member of society will have the right to come and see with his own eyes how the schools, hospitals, factories, prisons function. There is no risk, therefore, that the increase of power created by the panoptic machine may degenerate into tyranny; the disciplinary mechanism will be democratically controlled, since it will be constantly accessible “to the great tribunal committee of the world”.⁴ This Panopticon, subtly arranged so that an observer may observe, at a glance, so many different individuals, also enables everyone to come and observe any of the observers. The seeing machine was once a sort of dark room into which individuals spied; it has become a transparent building in which the exercise of power may be supervised by society as a whole.

The panoptic schema, without disappearing as such or losing any of its properties, was destined to spread throughout the social body; its vocation was to become a generalized function. The plague-stricken town provided an exceptional disciplinary model: perfect, but absolutely violent; to the disease that brought death, power opposed its perpetual threat of death; life inside it was reduced to its simplest expression; it was, against the power of death, the meticulous exercise of the right of the sword. The Panopticon, on the other hand, has a role of amplification; although it arranges power, although it is intended to make it more economic and more effective, it does so not for power itself, nor for the immediate salvation of a threatened society: its aim is to strengthen the social forces – to increase production, to develop the economy, spread education, raise the level of public morality; to increase and multiply.

How is power to be strengthened in such a way that, far from impeding progress, far from weighing upon it with its rules and regulations, it actually facilitates such progress? What intensifier of power will be able at the same time to be a multiplier of production? How will power, by increasing its forces, be able to increase those of society instead of confiscating them or impeding them? The Panopticon’s solution to this problem is that the productive increase of power can be assured only if, on the one hand, it can be exercised continuously in the very foundations of society, in the subtlest possible way, and if, on the other hand, it functions outside these sudden, violent, discontinuous forms that are bound up with the exercise of sovereignty. The body of the king, with its

strange material and physical presence, with the force that he himself deploys or transmits to some few others, is at the opposite extreme of this new physics of power represented by panopticism; the domain of panopticism is, on the contrary, that whole lower region, that region of irregular bodies, with their details, their multiple movements, their heterogeneous forces, their spatial relations; what are required are mechanisms that analyse distributions, gaps, series, combinations, and which use instruments that render visible, record, differentiate and compare: a physics of a relational and multiple power, which has its maximum intensity not in the person of the king, but in the bodies that can be individualized by these relations. At the theoretical level, Bentham defines another way of analysing the social body and the power relations that traverse it; in terms of practice, he defines a procedure of subordination of bodies and forces that must increase the utility of power while practising the economy of the prince. Panopticism is the general principle of a new “political anatomy” whose object and end are not the relations of sovereignty but the relations of discipline.

The celebrated, transparent, circular cage, with its high tower, powerful and knowing, may have been for Bentham a project of a perfect disciplinary institution; but he also set out to show how one may “unlock” the disciplines and get them to function in a diffused, multiple, polyvalent way throughout the whole social body. These disciplines, which the classical age had elaborated in specific, relatively enclosed places – barracks, schools, workshops – and whose total implementation had been imagined only at the limited and temporary scale of a plague-stricken town, Bentham dreamt of transforming into a network of mechanisms that would be everywhere and always alert, running through society without interruption in space or in time. The panoptic arrangement provides the formula for this generalization. It programmes, at the level of an elementary and easily transferable mechanism, the basic functioning of a society penetrated through and through with disciplinary mechanisms.

There are two images, then, of discipline. At one extreme, the discipline-blockade, the enclosed institution, established on the edges of society, turned inwards towards negative functions: arresting evil, breaking communications, suspending time. At the other extreme, with panopticism, is the discipline-mechanism: a functional mechanism that must improve the exercise of power by making it lighter, more rapid, more effective,

a design of subtle coercion for a society to come. The movement from one project to the other, from a schema of exceptional discipline to one of a generalized surveillance, rests on a historical transformation: the gradual extension of the mechanisms of discipline throughout the seventeenth and eighteenth centuries, their spread throughout the whole social body, the formation of what might be called in general the disciplinary society.

A whole disciplinary generalization – the Benthamite physics of power represents an acknowledgement of this – had operated throughout the classical age. The spread of disciplinary institutions, whose network was beginning to cover an ever larger surface and occupying above all a less and less marginal position, testifies to this: what was an islet, a privileged place, a circumstantial measure, or a singular model, became a general formula; the regulations characteristic of the Protestant and pious armies of William of Orange or of Gustavus Adolphus were transformed into regulations for all the armies of Europe; the model colleges of the Jesuits, or the schools of Batencour or Demia, following the example set by Sturm, provided the outlines for the general forms of educational discipline; the ordering of the naval and military hospitals provided the model for the entire reorganization of hospitals in the eighteenth century. [...]

A few years after Bentham, Julius gave this society its birth certificate (Julius, 384–6). Speaking of the panoptic principle, he said that there was much more there than architectural ingenuity: it was an event in the “history of the human mind”. In appearance, it is merely the solution of a technical problem; but, through it, a whole type of society emerges. Antiquity had been a civilization of spectacle. “To render accessible to a multitude of men the inspection of a small number of objects”: this was the problem to which the architecture of temples, theatres and circuses responded. With spectacle, there was a predominance of public life, the intensity of festivals, sensual proximity. In these rituals in which blood flowed, society found new vigour and formed for a moment a single great: body. The modern age poses the opposite problem: “To procure for a small number, or even for a single individual, the instantaneous view of a great multitude.” In a society in which the principal elements are no longer the community and public life, but, on the one hand, private individuals and, on the other, the state, relations can be regulated only in a form that is the exact reverse of the spectacle: “It was to the modern age, to the ever-growing influence of the

state, to its ever more profound intervention in all the details and all the relations of social life, that was reserved the task of increasing and perfecting its guarantees, by using and directing towards that great aim the building and distribution of buildings intended to observe a great multitude of men at the same time.”

Julius saw as a fulfilled historical process that which Bentham had described as a technical programme. Our society is one not of spectacle, but of surveillance; under the surface of images, one invests bodies in depth; behind the great abstraction of exchange, there continues the meticulous, concrete training of useful forces; the circuits of communication are the supports of an accumulation and a centralization of knowledge; the play of signs defines the anchorages of power; it is not that the beautiful totality of the individual is amputated, repressed, altered by our social order, it is rather that the individual is carefully fabricated in it, according to a whole technique of forces and bodies. We are much less Greeks than we believe. We are neither in the amphitheatre, nor on the stage, but in the panoptic machine, invested by its effects of power, which we bring to ourselves since we are part of its mechanism. The importance, in historical mythology, of the Napoleonic character probably derives from the fact that it is at the point of junction of the monarchical, ritual exercise of sovereignty and the hierarchical, permanent exercise of indefinite discipline. He is the individual who looms over everything with a single gaze which no detail, however minute, can escape: “You may consider that no part of the Empire is without surveillance, no crime, no offence, no contravention that remains unpunished, and that the eye of the genius who can enlighten all embraces the whole of this vast machine, without, however, the slightest detail escaping his attention” (Treillard, 14). At the moment of its full blossoming, the disciplinary society still assumes with the Emperor the old aspect of the power of spectacle. As a monarch who is at one and the same time a usurper of the ancient throne and the organizer of the new state, he combined into a single symbolic, ultimate figure the whole of the long process by which the pomp of sovereignty, the necessarily spectacular manifestations of power, were extinguished one by one in the daily exercise of surveillance, in a panopticism in which the vigilance of intersecting gazes was soon to render useless both the eagle and the sun.

The formation of the disciplinary society is connected with a number of broad historical processes – economic, juridico-political and, lastly, scientific – of which it forms part.

1. Generally speaking, it might be said that the disciplines are techniques for assuring the ordering of human multiplicities. It is true that there is nothing exceptional or even characteristic in this: every system of power is presented with the same problem. But the peculiarity of the disciplines is that they try to define in relation to the multiplicities a tactics of power that fulfils three criteria: firstly, to obtain the exercise of power at the lowest possible cost (economically, by the low expenditure it involves; politically, by its discretion, its low exteriorization, its relative invisibility, the little resistance it arouses); secondly, to bring the effects of this social power to their maximum intensity and to extend them as far as possible, without either failure or interval; thirdly, to link this "economic" growth of power with the output of the apparatuses (educational, military, industrial or medical) within which it is exercised; in short, to increase both the docility and the utility of all the elements of the system. This triple objective of the disciplines corresponds to a well-known historical conjuncture. One aspect of this conjuncture was the large demographic thrust of the eighteenth century, an increase in the floating population (one of the primary objects of discipline is to fix; it is an anti-nomadic technique); a change of quantitative scale in the groups to be supervised or manipulated (from the beginning of the seventeenth century to the eve of the French Revolution, the school population had been increasing rapidly, as had no doubt the hospital population; by the end of the eighteenth century, the peace-time army exceeded 200,000 men). The other aspect of the conjuncture was the growth in the apparatus of production, which was becoming more and more extended and complex; it was also becoming more costly and its profitability had to be increased. The development of the disciplinary methods corresponded to these two processes, or rather, no doubt, to the new need to adjust their correlation. Neither the residual forms of feudal power nor the structures of the administrative monarchy, nor the local mechanisms of supervision, nor the unstable, tangled mass they all formed together could carry out this role: they were hindered from doing so by the irregular and inadequate extension of their network, by their often conflicting functioning, but above all by the "costly" nature of the power that was exercised in them. It was costly in several senses: because directly it cost a great deal to the Treasury; because the system of corrupt offices and farmed-out taxes weighed indirectly, but very heavily, on the population; because the resistance it

encountered forced it into a cycle of perpetual reinforcement; because it proceeded essentially by levying (levying on money or products by royal, seigniorial, ecclesiastical taxation, levying on men or time by *corvées* of press-ganging, by locking up or banishing vagabonds). The development of the disciplines marks the appearance of elementary techniques belonging to a quite different economy: mechanisms of power which, instead of proceeding by deduction, are integrated into the productive efficiency of the apparatuses from within, into the growth of this efficiency and into the use of what it produces. For the old principle of "levying-violence", which governed the economy of power, the disciplines substitute the principle of "mildness-production-profit". These are the techniques that make it possible to adjust the multiplicity of men and the multiplication of the apparatuses of production (and this means not only "production" in the strict sense, but also the production of knowledge and skills in the school, the production of health in the hospitals, the production of destructive force in the army).

In this task of adjustment, discipline had to solve a number of problems for which the old economy of power was not sufficiently equipped. It could reduce the inefficiency of mass phenomena: reduce what, in a multiplicity, makes it much less manageable than a unity; reduce what is opposed to the use of each of its elements and of their sum; reduce everything that may counter the advantages of number. That is why discipline fixes; it arrests or regulates movements; it clears up confusion; it dissipates compact groupings of individuals wandering about the country in unpredictable ways; it establishes calculated distributions. It must also master all the forces that are formed from the very constitution of an organized multiplicity; it must neutralize the effects of counter-power that spring from them and which form a resistance to the power that wishes to dominate it: agitations, revolts, spontaneous organizations, coalitions – anything that may establish horizontal conjunctions. Hence the fact that the disciplines use procedures of partitioning and verticality, that they introduce, between the different elements at the same level, as solid separations as possible, that they define compact hierarchical networks, in short, that they oppose to the intrinsic, adverse force of multiplicity the technique of the continuous, individualizing pyramid. They must also increase the particular utility of each element of the multiplicity, but by means that are the most rapid and the least costly, that is to say, by using the

multiplicity itself as an instrument of this growth. Hence, in order to extract from bodies the maximum time and force, the use of those overall methods known as time-tables, collective training, exercises, total and detailed surveillance. Furthermore, the disciplines must increase the effect of utility proper to the multiplicities, so that each is made more useful than the simple sum of its elements: it is in order to increase the utilizable effects of the multiple that the disciplines define tactics of distribution, reciprocal adjustment of bodies, gestures and rhythms, differentiation of capacities, reciprocal coordination in relation to apparatuses or tasks. Lastly, the disciplines have to bring into play the power relations, not above but inside the very texture of the multiplicity, as discreetly as possible, as well articulated on the other functions of these multiplicities and also in the least expensive way possible: to this correspond anonymous instruments of power, coextensive with the multiplicity that they regiment, such as hierarchical surveillance, continuous registration, perpetual assessment and classification. In short, to substitute for a power that is manifested through the brilliance of those who exercise it, a power that insidiously objectifies those on whom it is applied; to form a body of knowledge about these individuals, rather than to deploy the ostentatious signs of sovereignty. In a word, the disciplines are the ensemble of minute technical inventions that made it possible to increase the useful size of multiplicities by decreasing the inconveniences of the power which, in order to make them useful, must control them. A multiplicity, whether in a workshop or a nation, an army or a school, reaches the threshold of a discipline when the relation of the one to the other becomes favourable.

If the economic take-off of the West began with the techniques that made possible the accumulation of capital, it might perhaps be said that the methods for administering the accumulation of men made possible a political take-off in relation to the traditional, ritual, costly, violent forms of power, which soon fell into disuse and were superseded by a subtle, calculated technology of subjection. In fact, the two processes – the accumulation of men and the accumulation of capital – cannot be separated; it would not have been possible to solve the problem of the accumulation of men without the growth of an apparatus of production capable of both sustaining them and using them; conversely, the techniques that made the cumulative multiplicity of men useful accelerated the accumulation of capital. At a less general level the technological mutations of the apparatus of production, the division of labour and the elaboration of the

disciplinary techniques sustained an ensemble of very close relations (cf. Marx, *Capital*, vol 1, chapter XIII and the very interesting analysis in Guerry and Deleule). Each makes the other possible and necessary; each provides a model for the other. The disciplinary pyramid constituted the small cell of power within which the separation, coordination and supervision of tasks was imposed and made efficient; and analytical partitioning of time, gestures and bodily forces constituted an operational schema that could easily be transferred from the groups to be subjected to the mechanisms of production; the massive projection of military methods onto industrial organization was an example of this modelling of the division of labour following the model laid down by the schemata of power. But, on the other hand, the technical analysis of the process of production, its “mechanical” breaking-down, were projected onto the labour force whose task it was to implement it: the constitution of those disciplinary machines in which the individual forces that they bring together are composed into a whole and therefore increased is the effect of this projection. Let us say that discipline is the unitary technique by which the body is reduced as a “political” force at the least cost and maximized as a useful force. The growth of a capitalist economy gave rise to the specific modality of disciplinary power, whose general formulas, techniques of submitting forces and bodies, in short, “political anatomy”, could be operated in the most diverse political régimes, apparatuses or institutions.

2. The panoptic modality of power – at the elementary, technical, merely physical level at which it is situated – is not under the immediate dependence or a direct extension of the great juridico-political structures of a society; it is nonetheless not absolutely independent. Historically, the process by which the bourgeoisie became in the course of the eighteenth century the politically dominant class was masked by the establishment of an explicit, coded and formally egalitarian juridical framework, made possible by the organization of a parliamentary, representative régime. But the development and generalization of disciplinary mechanisms constituted the other, dark side of these processes. The general juridical form that guaranteed a system of rights that were egalitarian in principle was supported by these tiny, everyday, physical mechanisms, by all those systems of micro-power that are essentially non-egalitarian and asymmetrical that we call the disciplines. And although, in a formal way, the representative régime makes it possible, directly or indirectly, with or without relays, for the will of all to form the fundamental authority of sovereignty, the disciplines

provide, at the base, a guarantee of the submission of forces and bodies. The real, corporal disciplines constituted the foundation of the formal, juridical liberties. The contract may have been regarded as the ideal foundation of law and political power, panopticism constituted the technique, universally widespread, of coercion. It continued to work in depth on the juridical structures of society, in order to make the effective mechanisms of power function in opposition to the formal framework that it had acquired. The "Enlightenment", which discovered the liberties, also invented the disciplines.

In appearance, the disciplines constitute nothing more than an infra-law. They seem to extend the general forms defined by law to the infinitesimal level of individual lives, or they appear as methods of training that enable individuals to become integrated into these general demands. They seem to constitute the same type of law on a different scale, thereby making it more meticulous and more indulgent. The disciplines should be regarded as a sort of counter-law. They have the precise role of introducing insuperable asymmetries and excluding reciprocities. First, because discipline creates between individuals a "private" link, which is a relation of constraints entirely different from contractual obligation; the acceptance of a discipline may be underwritten by contract; the way in which it is imposed, the mechanisms it brings into play, the non-reversible subordination of one group of people by another, the "surplus" power that is always fixed on the same side, the inequality of position of the different "partners" in relation to the common regulation, all these distinguish the disciplinary link from the contractual link, and make it possible to distort the contractual link systematically from the moment it has as its content a mechanism of discipline. We know, for example, how many real procedures undermine the legal fiction of the work contract: workshop discipline is not the least important. Moreover, whereas the juridical systems define juridical subjects according to universal norms, the disciplines characterize, classify, specialize; they distribute along a scale, around a norm, hierarchize individuals in relation to one another and, if necessary, disqualify and invalidate. In any case, in the space and during the time in which they exercise their control and bring into play the asymmetries of their power, they effect a suspension of the law that is never total, but is never annulled either. Regular and institutional as it may be, the discipline, in its mechanism, is a "counter-law". And, although the universal juridicism of modern

society seems to fix limits on the exercise of power, its universally widespread panopticism enables it to operate, on the underside of the law, a machinery that is both immense and minute, which supports, reinforces, multiplies the asymmetry of power and undermines the limits that are traced around the law. The minute disciplines, the panoptisms of every day may well be below the level of emergence of the great apparatuses and the great political struggles. But, in the genealogy of modern society, they have been, with the class domination that traverses it, the political counterpart of the juridical norms according to which power was redistributed. Hence, no doubt, the importance that has been given for so long to the small techniques of discipline, to those apparently insignificant tricks that it has invented, and even to those "sciences" that give it a respectable face; hence the fear of abandoning them if one cannot find any substitute; hence the affirmation that they are at the very foundation of society, and an element in its equilibrium, whereas they are a series of mechanisms for unbalancing power relations definitively and everywhere; hence the persistence in regarding them as the humble, but concrete form of every morality, whereas they are a set of physico-political techniques.

To return to the problem of legal punishments, the prison with all the corrective technology at its disposal is to be resituated at the point where the codified power to punish turns into a disciplinary power to observe; at the point where the universal punishments of the law are applied selectively to certain individuals and always the same ones; at the point where the redefinition of the juridical subject by the penalty becomes a useful training of the criminal; at the point where the law is inverted and passes outside itself, and where the counter-law becomes the effective and institutionalized content of the juridical forms. What generalizes the power to punish, then, is not the universal consciousness of the law in each juridical subject; it is the regular extension, the infinitely minute web of panoptic techniques.

3. Taken one by one, most of these techniques have a long history behind them. But what was new, in the eighteenth century, was that, by being combined and generalized, they attained a level at which the formation of knowledge and the increase of power regularly reinforce one another in a circular process. At this point, the disciplines crossed the "technological" threshold. First the hospital, then the school, then, later, the workshop were not simply "reordered" by the disciplines; they

became, thanks to them, apparatuses such that any mechanism of objectification could be used in them as an instrument of subjection, and any growth of power could give rise in them to possible branches of knowledge; it was this link, proper to the technological systems, that made possible within the disciplinary element the formation of clinical medicine, psychiatry, child psychology, educational psychology, the rationalization of labour. It is a double process, then: an epistemo-logical “thaw” through a refinement of power relations; a multiplication of the effects of power through the formation and accumulation of new forms of knowledge.

The extension of the disciplinary methods is inscribed in a broad historical process: the development at about the same time of many other technologies – agronomical, industrial, economic. But it must be recognized that, compared with the mining industries, the emerging chemical industries or methods of national accountancy, compared with the blast furnaces or the steam engine, panopticism has received little attention. It is regarded as not much more than a bizarre little Utopia, a perverse dream – rather as though Bentham had been the Fourier of a police society, and the Phalanstery had taken on the form of the Panopticon. And yet this represented the abstract formula of a very real technology, that of individuals. There were many reasons why it received little praise; the most obvious is that the discourses to which it gave rise rarely acquired, except in the academic classifications, the status of sciences; but the real reason is no doubt that the power that it operates and which it augments is a direct, physical power that men exercise upon one another. An inglorious culmination had an origin that could be only grudgingly acknowledged. But it would be unjust to compare the disciplinary techniques with such inventions as the steam engine or Amici’s microscope. They are much less; and yet, in a way, they are much more. If a historical equivalent or at least a point of comparison had to be found for them, it would be rather in the “inquisitorial” technique.

The eighteenth century invented the techniques of discipline and the examination, rather as the Middle Ages invented the judicial investigation. But it did so by quite different means. The investigation procedure, an old fiscal and administrative technique, had developed above all with the reorganization of the Church and the increase of the princely states in the twelfth and thirteenth centuries. At this time it permeated to a very large degree the jurisprudence first of the

ecclesiastical courts, then of the lay courts. The investigation as an authoritarian search for a truth observed or attested was thus opposed to the old procedures of the oath, the ordeal, the judicial duel, the judgement of God or even of the transaction between private individuals. The investigation was the sovereign power arrogating to itself the right to establish the truth by a number of regulated techniques. Now, although the investigation has since then been an integral part of western justice (even up to our own day), one, must not forget either its political origin, its link with the birth of the states and of monarchical sovereignty, or its later extension and its role in the formation of knowledge. In fact, the investigation has been the no doubt crude, but fundamental element in the constitution of the empirical sciences; it has been the juridico-political matrix of this experimental knowledge, which, as we know, was very rapidly released at the end of the Middle Ages. It is perhaps true to say that, in Greece, mathematics were born from techniques of measurement; the sciences of nature, in any case, were born, to some extent, at the end of the Middle Ages, from the practices of investigation. The great empirical knowledge that covered the things of the world and transcribed them into the ordering of an indefinite discourse that observes, describes and establishes the “facts” (at a time when the western world was beginning the economic and political conquest of this same world) had its operating model no doubt in the Inquisition – that immense invention that our recent mildness has placed in the dark recesses of our memory. But what this politico-juridical, administrative and criminal, religious and lay, investigation was to the sciences of nature, disciplinary analysis has been to the sciences of man. These sciences, which have so delighted our “humanity” for over a century, have their technical matrix in the petty, malicious minutiae of the disciplines and their investigations. These investigations are perhaps to psychology, psychiatry, pedagogy, criminology, and so many other strange sciences, what the terrible power of investigation was to the calm knowledge of the animals, the plants or the earth. Another power, another knowledge. On the threshold of the classical age, Bacon, lawyer and statesman, tried to develop a methodology of investigation for the empirical sciences. What Great Observer will produce the methodology of examination for the human sciences? Unless, of course, such a thing is not possible.

For, although it is true that, in becoming a technique for the empirical sciences, the investigation has detached itself from the inquisitorial procedure, in which it was historically rooted, the examination has remained extremely close to the disciplinary power that shaped it. It has always been and still is an intrinsic element of the disciplines. Of course it seems to have undergone a speculative purification by integrating itself with such sciences as psychology and psychiatry. And, in effect, its appearance in the form of tests, interviews, interrogations and consultations is apparently in order to rectify the mechanisms of discipline: educational psychology is supposed to correct the rigours of the school, just as the medical or psychiatric interview is supposed to rectify the effects of the discipline of work. But we must not be misled; these techniques merely refer individuals from one disciplinary authority to another, and they reproduce, in a concentrated or formalized form, the schema of power-knowledge proper to each discipline (on this subject, cf. Tort). The great investigation that gave rise to the sciences of nature has become detached from its politico-judicial model; the examination, on the other hand, is still caught up in disciplinary technology.

In the Middle Ages, the procedure of investigation gradually superseded the old accusatory justice, by a process initiated from above; the disciplinary technique, on the other hand, insidiously and as if from below, has invaded a penal justice that is still, in principle, inquisitorial. All the great movements of extension that characterize modern penalty – the problematization of the criminal behind his crime, the concern with a punishment that is a correction, a therapy, a normalization, the division of the act of judgement between various authorities that are supposed to measure, assess, diag-

nose, cure, transform individuals – all this betrays the penetration of the disciplinary examination into the judicial inquisition.

What is now imposed on penal justice as its point of application, its “useful” object, will no longer be the body of the guilty man set up against the body of the king; nor will it be the juridical subject of an ideal contract; it will be the disciplinary individual. The extreme point of penal justice under the Ancien Régime was the infinite segmentation of the body of the regicide: a manifestation of the strongest power over the body of the greatest criminal, whose total destruction made the crime explode into its truth. The ideal point of penalty today would be an indefinite discipline: an interrogation without end, an investigation that would be extended without limit to a meticulous and ever more analytical observation, a judgement that would at the same time be the constitution of a file that was never closed, the calculated leniency of a penalty that would be interlaced with the ruthless curiosity of an examination, a procedure that would be at the same time the permanent measure of a gap in relation to an inaccessible norm and the asymptotic movement that strives to meet in infinity. The public execution was the logical culmination of a procedure governed by the Inquisition. The practice of placing individuals under “observation” is a natural extension of a justice imbued ‘with disciplinary methods and examination procedures. Is it surprising that the cellular prison, with its regular chronologies, forced labour, its authorities of surveillance and registration, its experts in normality, who continue and multiply the functions of the judge, should have become the modern instrument of penalty? Is it surprising that prisons resemble factories, schools, barracks, hospitals, which all resemble prisons?

Notes

- 1 Archives militaires de Vincennes, A 1,516 91 sc. Pièce. This regulation is broadly similar to a whole series of others that date from the same period and earlier.
- 2 In the *Postscript to the Panopticon*, 1791, Bentham adds dark inspection galleries painted in black around the inspector's lodge, each making it possible to observe two storeys of cells.
- 3 In his first version of the *Panopticon*, Bentham had also imagined an acoustic surveillance, operated by means of pipes leading from the cells to the central tower. In the *Postscript* he abandoned the idea, perhaps because he could not introduce into it the principle of dissymmetry

and prevent the prisoners from hearing the inspector as well as the inspector hearing them. Julius tried to develop a system of dissymmetrical listening (Julius, 18).

- 4 Imagining this continuous flow of visitors entering the central tower by an underground passage and then observing the circular landscape of the Panopticon, was Bentham aware of the Panoramas that Barker was constructing at exactly the same period (the first seems to have dated from 1787) and in which the visitors, occupying the central place, saw unfolding around them a landscape, a city or a battle? The visitors occupied exactly the place of the sovereign gaze.

References

Archives militaires de Vincennes, A 1,516 91 sc.

Bentham, J., *Works*, ed. Bowring, IV, 1843.

Guerry, E. and Deleule, D., *Le Corps productif*, 1973.

Julius, N. H., *Leçons sur les prisons*, I, 1831 (Fr. trans.).

Loisel, G., *Histoire des ménageries*, II, 1912.

Marx, Karl, *The Eighteenth Brumaire of Louis Bonaparte*, ed. 1954.

Capital, vol. I, ed. 1970.

Tort, Michel, *Q.I.*, 1974.

Treilhard, J. B., *Motifs du code d'instruction criminelle*, 1808.

Do Artifacts Have Politics?

Langdon Winner

No idea is more provocative in controversies about technology and society than the notion that technical things have political qualities. At issue is the claim that the machines, structures, and systems of modern material culture can be accurately judged not only for their contributions to efficiency and productivity and their positive and negative environmental side effects, but also for the ways in which they can embody specific forms of power and authority. Since ideas of this kind are a persistent and troubling presence in discussions about the meaning of technology, they deserve explicit attention.

Writing in the early 1960s, Lewis Mumford gave classic statement to one version of the theme, arguing that “from late neolithic times in the Near East, right down to our own day, two technologies have recurrently existed side by side: one authoritarian, the other democratic, the first system-centered, immensely powerful, but inherently unstable, the other man-centered, relatively weak, but resourceful and durable.”¹ This thesis stands at the heart of Mumford’s studies of the city, architecture, and history of technics, and mirrors concerns voiced earlier in the works of Peter Kropotkin, William Morris, and other nineteenth-century critics of industrialism. During the 1970s, antinuclear and pro-solar energy movements in Europe and the United States adopted a similar notion as the centerpiece of their arguments. According to environmentalist Denis Hayes, “The

increased deployment of nuclear power facilities must lead society toward authoritarianism. Indeed, safe reliance upon nuclear power as the principal source of energy may be possible only in a totalitarian state.” Echoing the views of many proponents of appropriate technology and the soft energy path, Hayes contends that “dispersed solar sources are more compatible than centralized technologies with social equity, freedom and cultural pluralism.”²

An eagerness to interpret technical artifacts in political language is by no means the exclusive property of critics of large-scale, high-technology systems. A long lineage of boosters has insisted that the biggest and best that science and industry made available were the best guarantees of democracy, freedom, and social justice. The factory system, automobile, telephone, radio, television, space program, and of course nuclear power have all at one time or another been described as democratizing, liberating forces. David Lillienthal’s *T.V.A.: Democracy on the March*, for example, found this promise in the phosphate fertilizers and electricity that technical progress was bringing to rural Americans during the 1940s.³ Three decades later Daniel Boorstin’s *The Republic of Technology* extolled television for “its power to disband armies, to cashier presidents, to create a whole new democratic world – democratic in ways never before imagined, even in America.”⁴ Scarcely a new invention comes

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along that someone doesn't proclaim it as the salvation of a free society.

It is no surprise to learn that technical systems of various kinds are deeply interwoven in the conditions of modern politics. The physical arrangements of industrial production, warfare, communications, and the like have fundamentally changed the exercise of power and the experience of citizenship. But to go beyond this obvious fact and to argue that certain technologies *in themselves* have political properties seems, at first glance, completely mistaken. We all know that people have politics; things do not. To discover either virtues or evils in aggregates of steel, plastic, transistors, integrated circuits, chemicals, and the like seems just plain wrong, a way of mystifying human artifice and of avoiding the true sources, the human sources of freedom and oppression, justice and injustice. Blaming the hardware appears even more foolish than blaming the victims when it comes to judging conditions of public life.

Hence, the stern advice commonly given those who flirt with the notion that technical artifacts have political qualities: What matters is not technology itself, but the social or economic system in which it is embedded. This maxim, which in a number of variations is the central premise of a theory that can be called the social determination of technology, has an obvious wisdom. It serves as a needed corrective to those who focus uncritically upon such things as "the computer and its social impacts" but who fail to look behind technical devices to see the social circumstances of their development, deployment, and use. This view provides an antidote to naive technological determinism – the idea that technology develops as the sole result of an internal dynamic and then, unmediated by any other influence, molds society to fit its patterns. Those who have not recognized the ways in which technologies are shaped by social and economic forces have not gotten very far.

But the corrective has its own shortcomings; taken literally, it suggests that technical *things* do not matter at all. Once one has done the detective work necessary to reveal the social origins – power holders behind a particular instance of technological change – one will have explained everything of importance. This conclusion offers comfort to social scientists. It validates what they had always suspected, namely, that there is nothing distinctive about the study of technology in the first place. Hence, they can return to their standard models of social power – those of interest-group politics, bureaucratic politics, Marxist models of class struggle, and the like – and have everything

they need. The social determination of technology is, in this view, essentially no different from the social determination of, say, welfare policy or taxation.

There are, however, good reasons to believe that technology is politically significant in its own right, good reasons why the standard models of social science only go so far in accounting for what is most interesting and troublesome about the subject. Much of modern social and political thought contains recurring statements of what can be called a theory of technological politics, an odd mongrel of notions often crossbred with orthodox liberal, conservative, and socialist philosophies.⁵ The theory of technological politics draws attention to the momentum of large-scale sociotechnical systems, to the response of modern societies to certain technological imperatives, and to the ways human ends are powerfully transformed as they are adapted to technical means. This perspective offers a novel framework of interpretation and explanation for some of the more puzzling patterns that have taken shape in and around the growth of modern material culture. Its starting point is a decision to take technical artifacts seriously. Rather than insist that we immediately reduce everything to the interplay of social forces, the theory of technological politics suggests that we pay attention to the characteristics of technical objects and the meaning of those characteristics. A necessary complement to, rather than a replacement for, theories of the social determination of technology, this approach identifies certain technologies as political phenomena in their own right. It points us back, to borrow Edmund Husserl's philosophical injunction, *to the things themselves*.

In what follows I will outline and illustrate two ways in which artifacts can contain political properties. First are instances in which the invention, design, or arrangement of a specific technical device or system becomes a way of settling an issue in the affairs of a particular community. Seen in the proper light, examples of this kind are fairly straightforward and easily understood. Second are cases of what can be called "inherently political technologies," man-made systems that appear to require or to be strongly compatible with particular kinds of political relationships. Arguments about cases of this kind are much more troublesome and closer to the heart of the matter. By the term "politics" I mean arrangements of power and authority in human associations as well as the activities that take place within those arrangements. For my purposes here, the term "technology" is understood to mean all of modern practical artifice, but to avoid

confusion I prefer to speak of “technologies” plural, smaller or larger pieces or systems of hardware of a specific kind.⁶ My intention is not to settle any of the issues here once and for all, but to indicate their general dimensions and significance.

Technical Arrangements and Social Order

Anyone who has traveled the highways of America and has gotten used to the normal height of overpasses may well find something a little odd about some of the bridges over the parkways on Long Island, New York. Many of the overpasses are extraordinarily low, having as little as nine feet of clearance at the curb. Even those who happened to notice this structural peculiarity would not be inclined to attach any special meaning to it. In our accustomed way of looking at things such as roads and bridges, we see the details of form as innocuous and seldom give them a second thought.

It turns out, however, that some two hundred or so low-hanging overpasses on Long Island are there for a reason. They were deliberately designed and built that way by someone who wanted to achieve a particular social effect. Robert Moses, the master builder of roads, parks, bridges, and other public works of the 1920s to the 1970s in New York, built his overpasses according to specifications that would discourage the presence of buses on his parkways. According to evidence provided by Moses’ biographer, Robert A. Caro, the reasons reflect Moses’ social class bias and racial prejudice. Automobile-owning whites of “upper” and “comfortable middle” classes, as he called them, would be free to use the parkways for recreation and commuting. Poor people and blacks, who normally used public transit, were kept off the roads because the twelve-foot tall buses could not handle the overpasses. One consequence was to limit access of racial minorities and low-income groups to Jones Beach, Moses’ widely acclaimed Public Park. Moses made doubly sure of this result by vetoing a proposed extension of the Long Island Railroad to Jones Beach.

Robert Moses’ life is a fascinating story in recent U.S. political history. His dealings with mayors, governors, and presidents; his careful manipulation of legislatures, banks, labor unions, the press, and public opinion could be studied by political scientists for years. But the most important and enduring results of his work are his technologies,

the vast engineering projects that give New York much of its present form. For generations after Moses’ death and the alliances he forged have fallen apart, his public works, especially the highways and bridges he built to favor the use of the automobile over the development of mass transit, will continue to shape that city. Many of his monumental structures of concrete and steel embody a systematic social inequality, a way of engineering relationships among people that, after a time, became just another part of the landscape. As New York planner Lee Koppleman told Caro about the low bridges on Wantagh Parkway, “The old son of a gun had made sure that buses would *never* be able to use his goddamned parkways.”⁷

Histories of architecture, city planning, and public works contain many examples of physical arrangements with explicit or implicit political purposes. One can point to Baron Haussmann’s broad Parisian thoroughfares, engineered at Louis Napoleon’s direction to prevent any recurrence of street fighting of the kind that took place during the revolution of 1848. Or one can visit any number of grotesque concrete buildings and huge plazas constructed on university campuses in the United States during the late 1960s and early 1970s to defuse student demonstrations. Studies of industrial machines and instruments also turn up interesting political stories, including some that violate our normal expectations about why technological innovations are made in the first place. If we suppose that new technologies are introduced to achieve increased efficiency, the history of technology shows that we will sometimes be disappointed. Technological change expresses a panoply of human motives, not the least of which is the desire of some to have dominion over others even though it may require an occasional sacrifice of cost savings and some violation of the normal standard of trying to get more from less.

One poignant illustration can be found in the history of nineteenth-century industrial mechanization. At Cyrus McCormick’s reaper manufacturing plant in Chicago in the middle 1880s, pneumatic molding machines, a new and largely untested innovation, were added to the foundry at an estimated cost of \$500,000. The standard economic interpretation would lead us to expect that this step was taken to modernize the plant and achieve the kind of efficiencies that mechanization brings. But historian Robert Ozanne has put the development in a broader context. At the time, Cyrus McCormick II was engaged in a battle with the National Union of Iron Molders. He saw the addition of the new machines as a way to “weed out the bad element among the men,”

namely, the skilled workers who had organized the union local in Chicago.⁸ The new machines, manned by unskilled laborers, actually produced inferior castings at a higher cost than the earlier process. After three years of use the machines were, in fact, abandoned, but by that time they had served their purpose – the destruction of the union. Thus, the story of these technical developments at the McCormick factory cannot be adequately understood outside the record of workers' attempts to organize, police repression of the labor movement in Chicago during that period, and the events surrounding the bombing at Haymarket Square. Technological history and U.S. political history were at that moment deeply intertwined.

In the examples of Moses' low bridges and McCormick's molding machines, one sees the importance of technical arrangements that precede the *use* of the things in question. It is obvious that technologies can be used in ways that enhance the power, authority, and privilege of some over others, for example, the use of television to sell a candidate. In our accustomed way of thinking technologies are seen as neutral tools that can be used well or poorly, for good, evil, or something in between. But we usually do not stop to inquire whether a given device might have been designed and built in such a way that it produces a set of consequences logically and temporally *prior to any of its professed uses*. Robert Moses' bridges, after all, were used to carry automobiles from one point to another; McCormick's machines were used to make metal castings; both technologies, however, encompassed purposes far beyond their immediate use. If our moral and political language for evaluating technology includes only categories having to do with tools and uses, if it does not include attention to the meaning of the designs and arrangements of our artifacts, then we will be blinded to much that is intellectually and practically crucial.

Because the point is most easily understood in the light of particular intentions embodied in physical form, I have so far offered illustrations that seem almost conspiratorial. But to recognize the political dimensions in the shapes of technology does not require that we look for conscious conspiracies or malicious intentions. The organized movement of handicapped people in the United States during the 1970s pointed out the countless ways in which machines, instruments, and structures of common use – buses, buildings, sidewalks, plumbing fixtures, and so forth – made it impossible for many handicapped persons to move freely about, a condition that systematically excluded them from public life. It is

safe to say that designs unsuited for the handicapped arose more from long-standing neglect than from anyone's active intention. But once the issue was brought to public attention, it became evident that justice required a remedy. A whole range of artifacts have been redesigned and rebuilt to accommodate this minority.

Indeed, many of the most important examples of technologies that have political consequences are those that transcend the simple categories "intended" and "unintended" altogether. These are instances in which the very process of technical development is so thoroughly biased in a particular direction that it regularly produces results heralded as wonderful breakthroughs by some social interests and crushing setbacks by others. In such cases it is neither correct nor insightful to say, "Someone intended to do somebody else harm." Rather one must say that the technological deck has been stacked in advance to favor certain social interests and that some people were bound to receive a better hand than others.

The mechanical tomato harvester, a remarkable device perfected by researchers at the University of California from the late 1940s to the present offers an illustrative tale. The machine is able to harvest tomatoes in a single pass through a row, cutting the plants from the ground, shaking the fruit loose, and (in the newest models) sorting the tomatoes electronically into large plastic gondolas that hold up to twenty-five tons of produce headed for canning factories. To accommodate the rough motion of these harvesters in the field, agricultural researchers have bred new varieties of tomatoes that are hardier, sturdier, and less tasty than those previously grown. The harvesters replace the system of handpicking in which crews of farm workers would pass through the fields three or four times, putting ripe tomatoes in lug boxes and saving immature fruit for later harvest.⁹ Studies in California indicate that the use of the machine reduces costs by approximately five to seven dollars per ton as compared to hand harvesting.¹⁰ But the benefits are by no means equally divided in the agricultural economy. In fact, the machine in the garden has in this instance been the occasion for a thorough reshaping of social relationships involved in tomato production in rural California.

By virtue of their very size and cost of more than \$50,000 each, the machines are compatible only with a highly concentrated form of tomato growing. With the introduction of this new method of harvesting, the number of tomato growers declined from approximately 4,000 in the early 1960s to about 600 in 1973, and yet

there was a substantial increase in tons of tomatoes produced. By the late 1970s an estimated 32,000 jobs in the tomato industry had been eliminated as a direct consequence of mechanization.¹¹ Thus, a jump in productivity to the benefit of very large growers has occurred at the sacrifice of other rural agricultural communities.

The University of California's research on and development of agricultural machines such as the tomato harvester eventually became the subject of a lawsuit filed by attorneys for California Rural Legal Assistance, an organization representing a group of farm workers and other interested parties. The suit charged that university officials are spending tax monies on projects that benefit a handful of private interests to the detriment of farm workers, small farmers, consumers, and rural California generally and asks for a court injunction to stop the practice. The university denied these charges, arguing that to accept them "would require elimination of all research with any potential practical application."¹²

As far as I know, no one argued that the development of the tomato harvester was the result of a plot. Two students of the controversy, William Friedland and Amy Barton, specifically exonerate the original developers of the machine and the hard tomato from any desire to facilitate economic concentration in that industry.¹³ What we see here instead is an ongoing social process in which scientific knowledge, technological invention, and corporate profit reinforce each other in deeply entrenched patterns, patterns that bear the unmistakable stamp of political and economic power. Over many decades agricultural research and development in U.S. land-grant colleges and universities has tended to favor the interests of large agribusiness concerns.¹⁴ It is in the face of such subtly ingrained patterns that opponents of innovations such as the tomato harvester are made to seem "antitechnology" or "antiprogress." For the harvester is not merely the symbol of a social order that rewards some while punishing others; it is in a true sense an embodiment of that order.

Within a given category of technological change there are, roughly speaking, two kinds of choices that can affect the relative distribution of power, authority, and privilege in a community. Often the crucial decision is a simple "yes or no" choice – are we going to develop and adopt the thing or not? In recent years many local, national, and international disputes about technology have centered on "yes or no" judgments about such things as food additives, pesticides, the building of highways, nuclear reactors, dam projects, and proposed high-tech

weapons. The fundamental choice about an antiballistic missile or supersonic transport is whether or not the thing is going to join society as a piece of its operating equipment. Reasons given for and against are frequently as important as those concerning the adoption of an important new law.

A second range of choices, equally critical in many instances, has to do with specific features in the design or arrangement of a technical system after the decision to go ahead with it has already been made. Even after a utility company wins permission to build a large electric power line, important controversies can remain with respect to the placement of its route and the design of its towers; even after an organization has decided to institute a system of computers, controversies can still arise with regard to the kinds of components, programs, modes of access, and other specific features the system will include. Once the mechanical tomato harvester had been developed in its basic form, a design alteration of critical social significance – the addition of electronic sorters, for example – changed the character of the machine's effects upon the balance of wealth and power in California agriculture. Some of the most interesting research on technology and politics at present focuses upon the attempt to demonstrate in a detailed, concrete fashion how seemingly innocuous design features in mass transit systems, water projects, industrial machinery, and other technologies actually mask social choices of profound significance. Historian David Noble has studied two kinds of automated machine tool systems that have different implications for the relative power of management and labor in the industries that might employ them. He has shown that although the basic electronic and mechanical components of the record/playback and numerical control systems are similar, the choice of one design over another has crucial consequences for social struggles on the shop floor. To see the matter solely in terms of cost cutting, efficiency, or the modernization of equipment is to miss a decisive element in the story.¹⁵

From such examples I would offer some general conclusions. These correspond to the interpretation of technologies as "forms of life" presented in the previous chapter, filling in the explicitly political dimensions of that point of view.

The things we call "technologies" are ways of building order in our world. Many technical devices and systems important in everyday life contain possibilities for many different ways of ordering human activity. Consciously

or unconsciously, deliberately or inadvertently, societies choose structures for technologies that influence how people are going to work, communicate, travel, consume, and so forth over a very long time. In the processes by which structuring decisions are made, different people are situated differently and possess unequal degrees of power as well as unequal levels of awareness. By far the greatest latitude of choice exists the very first time a particular instrument, system, or technique is introduced. Because choices tend to become strongly fixed in material equipment, economic investment, and social habit, the original flexibility vanishes for all practical purposes once the initial commitments are made. In that sense technological innovations are similar to legislative acts or political foundings that establish a framework for public order that will endure over many generations. For that reason the same careful attention one would give to the rules, roles, and relationships of politics must also be given to such things as the building of highways, the creation of television networks, and the tailoring of seemingly insignificant features on new machines. The issues that divide or unite people in society are settled not only in the institutions and practices of politics proper, but also, and less obviously, in tangible arrangements of steel and concrete, wires and semiconductors, nuts and bolts.

Inherently Political Technologies

None of the arguments and examples considered thus far addresses a stronger, more troubling claim often made in writings about technology and society – the belief that some technologies are by their very nature political in a specific way. According to this view, the adoption of a given technical system unavoidably brings with it conditions for human relationships that have a distinctive political cast – for example, centralized or decentralized, egalitarian or inegalitarian, repressive or liberating. This is ultimately what is at stake in assertions such as those of Lewis Mumford that two traditions of technology, one authoritarian, the other democratic, exist side by side in Western history. In all the cases cited above the technologies are relatively flexible in design and arrangement and variable in their effects. Although one can recognize a particular result produced in a particular setting, one can also easily imagine how a roughly similar device or system might have been built or situated with very much different political consequences. The idea we must now

examine and evaluate is that certain kinds of technology do not allow such flexibility, and that to choose them is to choose unalterably a particular form of political life.

A remarkably forceful statement of one version of this argument appears in Friedrich Engels's little essay "On Authority" written in 1872. Answering anarchists who believed that authority is an evil that ought to be abolished altogether, Engels launches into a panegyric for authoritarianism, maintaining, among other things, that strong authority is a necessary condition in modern industry. To advance his case in the strongest possible way, he asks his readers to imagine that the revolution has already occurred. "Supposing a social revolution dethroned the capitalists, who now exercise their authority over the production and circulation of wealth. Supposing, to adopt entirely the point of view of the anti-authoritarians, that the land and the instruments of labour had become the collective property of the workers who use them. Will authority have disappeared or will it have only changed its form?"¹⁶

His answer draws upon lessons from three sociotechnical systems of his day, cotton-spinning mills, railways, and ships at sea. He observes that on its way to becoming finished thread, cotton moves through a number of different operations at different locations in the factory. The workers perform a wide variety of tasks, from running the steam engine to carrying the products from one room to another. Because these tasks must be coordinated and because the timing of the work is "fixed by the authority of the steam," laborers must learn to accept a rigid discipline. They must, according to Engels, work at regular hours and agree to subordinate their individual wills to the persons in charge of factory operations. If they fail to do so, they risk the horrifying possibility that production will come to a grinding halt. Engels pulls no punches. "The automatic machinery of a big factory," he writes, "is much more despotic than the small capitalists who employ workers ever have been."¹⁷

Similar lessons are adduced in Engels's analysis of the necessary operating conditions for railways and ships at sea. Both require the subordination of workers to an "imperious authority" that sees to it that things run according to plan. Engels finds that far from being an idiosyncrasy of capitalist social organization, relationships of authority and subordination arise "independently of all social organization, [and] are imposed upon us together with the material conditions under which we produce and make products circulate." Again, he intends this to be stern advice to the anarchists who, according

to Engels, thought it possible simply to eradicate subordination and superordination at a single stroke. All such schemes are nonsense. The roots of unavoidable authoritarianism are, he argues, deeply implanted in the human involvement with science and technology. "If man, by dint of his knowledge and inventive genius, has subdued the forces of nature, the latter avenge themselves upon him by subjecting him, insofar as he employs them, to a veritable despotism independent of all social organization."¹⁸

Attempts to justify strong authority on the basis of supposedly necessary conditions of technical practice have an ancient history. A pivotal theme in the *Republic* is Plato's quest to borrow the authority of *technē* and employ it by analogy to buttress his argument in favor of authority in the state. Among the illustrations he chooses, like Engels, is that of a ship on the high seas. Because large sailing vessels by their very nature need to be steered with a firm hand, sailors must yield to their captain's commands; no reasonable person believes that ships can be run democratically. Plato goes on to suggest that governing a state is rather like being captain of a ship or like practicing medicine as a physician. Much the same conditions that require central rule and decisive action in organized technical activity also create this need in government.

In Engels's argument, and arguments like it, the justification for authority is no longer made by Plato's classic analogy, but rather directly with reference to technology itself. If the basic case is as compelling as Engels believed it to be, one would expect that as a society adopted increasingly complicated technical systems as its material basis, the prospects for authoritarian ways of life would be greatly enhanced. Central control by knowledgeable people acting at the top of a rigid social hierarchy would seem increasingly prudent. In this respect his stand in "On Authority" appears to be at variance with Karl Marx's position in Volume I of *Capital*. Marx tries to show that increasing mechanization will render obsolete the hierarchical division of labor and the relationships of subordination that, in his view, were necessary during the early stages of modern manufacturing. "Modern Industry," he writes, "sweeps away by technical means the manufacturing division of labor, under which each man is bound hand and foot for life to a single detail operation. At the same time, the capitalistic form of that industry reproduces this same division of labour in a still more monstrous shape; in the factory proper, by converting the workman into a living appendage of the

machine."¹⁹ In Marx's view the conditions that will eventually dissolve the capitalist division of labor and facilitate proletarian revolution are conditions latent in industrial technology itself. The differences between Marx's position in *Capital* and Engels's in his essay raise an important question for socialism: What, after all, does modern technology make possible or necessary in political life? The theoretical tension we see here mirrors many troubles in the practice of freedom and authority that had muddled the tracks of socialist revolution.

Arguments to the effect that technologies are in some sense inherently political have been advanced in a wide variety of contexts, far too many to summarize here. My reading of such notions, however, reveals there are two basic ways of stating the case. One version claims that the adoption of a given technical system actually requires the creation and maintenance of a particular set of social conditions as the operating environment of that system. Engels's position is of this kind. A similar view is offered by a contemporary writer who holds that "if you accept nuclear power plants, you also accept a techno-scientific-industrial-military elite. Without these people in charge, you could not have nuclear power."²⁰ In this conception some kinds of technology require their social environments to be structured in a particular way in much the same sense that an automobile requires wheels in order to move. The thing could not exist as an effective operating entity unless certain social as well as material conditions were met. The meaning of "required" here is that of practical (rather than logical) necessity. Thus, Plato thought it a practical necessity that a ship at sea have one captain and an unquestionably obedient crew.

A second, somewhat weaker, version of the argument holds that a given kind of technology is strongly compatible with, but does not strictly require, social and political relationships of a particular stripe. Many advocates of solar energy have argued that technologies of that variety are more compatible with a democratic, egalitarian society than energy systems based on coal, oil, and nuclear power; at the same time they do not maintain that anything about solar energy requires democracy. Their case is, briefly, that solar energy is decentralizing in both a technical and political sense: technically speaking, it is vastly more reasonable to build solar systems in a disaggregated, widely distributed manner than in large-scale centralized plants; politically speaking, solar energy accommodates the attempts of individuals and local communities to manage their affairs effectively because they are dealing with systems that are more accessible,

comprehensible, and controllable than huge centralized sources. In this view solar energy is desirable not only for its economic and environmental benefits, but also for the salutary institutions it is likely to permit in other areas of public life.²¹

Within both versions of the argument there is a further distinction to be made between conditions that are internal to the workings of a given technical system and those that are external to it. Engels's thesis concerns internal social relations said to be required within cotton factories and railways, for example; what such relationships mean for the condition of society at large is, for him, a separate question. In contrast, the solar advocate's belief that solar technologies are compatible with democracy pertains to the way they complement aspects of society removed from the organization of those technologies as such.

There are, then, several different directions that arguments of this kind can follow. Are the social conditions predicated said to be required by, or strongly compatible with, the workings of a given technical system? Are those conditions internal to that system or external to it (or both)? Although writings that address such questions are often unclear about what is being asserted, arguments in this general category are an important part of modern political discourse. They enter into many attempts to explain how changes in social life take place in the wake of technological innovation. More important, they are often used to buttress attempts to justify or criticize proposed courses of action involving new technology. By offering distinctly political reasons for or against the adoption of a particular technology, arguments of this kind stand apart from more commonly employed, more easily quantifiable claims about economic costs and benefits, environmental impacts, and possible risks to public health and safety that technical systems may involve. The issue here does not concern how many jobs will be created, how much income generated, how many pollutants added, or how many cancers produced. Rather, the issue has to do with ways in which choices about technology have important consequences for the form and quality of human associations.

If we examine social patterns that characterize the environments of technical systems, we find certain devices and systems almost invariably linked to specific ways of organizing power and authority. The important question is: Does this state of affairs derive from an unavoidable social response to intractable properties in the things themselves, or is it instead a pattern imposed

independently by a governing body, ruling class, or some other social or cultural institution to further its own purposes?

Taking the most obvious example, the atom bomb is an inherently political artifact. As long as it exists at all, its lethal properties demand that it be controlled by a centralized, rigidly hierarchical chain of command closed to all influences that might make its workings unpredictable. The internal social system of the bomb must be authoritarian; there is no other way. The state of affairs stands as a practical necessity independent of any larger political system in which the bomb is embedded, independent of the type of regime or character of its rulers. Indeed, democratic states must try to find ways to ensure that the social structures and mentality that characterize the management of nuclear weapons do not "spin off" or "spill over" into the polity as a whole.

The bomb is, of course, a special case. The reasons very rigid relationships of authority are necessary in its immediate presence should be clear to anyone. If, however, we look for other instances in which particular varieties of technology are widely perceived to need the maintenance of a special pattern of power and authority, modern technical history contains a wealth of examples.

Alfred D. Chandler in *The Visible Hand*, a monumental study of modern business enterprise, presents impressive documentation to defend the hypothesis that the construction and day-to-day operation of many systems of production, transportation, and communication in the nineteenth and twentieth centuries require the development of particular social form – a large-scale centralized, hierarchical organization administered by highly skilled managers. Typical of Chandler's reasoning is his analysis of the growth of the railroads.²²

Technology made possible fast, all-weather transportation; but safe, regular, reliable movement of goods and passengers, as well as the continuing maintenance and repair of locomotives, rolling stock, and track, roadbed, stations, roundhouses, and other equipment, required the creation of a sizable administrative organization. It meant the employment of a set of managers to supervise these functional activities over an extensive geographical area; and the appointment of an administrative command of middle and top executives to monitor, evaluate, and coordinate the work of managers responsible for the day-to-day operations.

Throughout his book Chandler points to ways in which technologies used in the production and distribution of electricity, chemicals, and a wide range of industrial

goods “demanded” or “required” this form of human association. “Hence, the operational requirements of railroads demanded the creation of the first administrative hierarchies in American business.”²³

Were there other conceivable ways of organizing these aggregates of people and apparatus? Chandler shows that a previously dominant social form, the small traditional family firm, simply could not handle the task in most cases. Although he does not speculate further, it is clear that he believes there is, to be realistic, very little latitude in the forms of power and authority appropriate within modern sociotechnical systems. The properties of many modern technologies – oil pipelines and refineries, for example – are such that overwhelmingly impressive economies of scale and speed are possible. If such systems are to work effectively, efficiently, quickly, and safely, certain requirements of internal social organization have to be fulfilled; the material possibilities that modern technologies make available could not be exploited otherwise. Chandler acknowledges that as one compares sociotechnical institutions of different nations, one sees “ways in which cultural attitudes, values, ideologies, political systems, and social structure affect these imperatives.”²⁴ But the weight of argument and empirical evidence in *The Visible Hand* suggests that any significant departure from the basic pattern would be, at best, highly unlikely.

It may be that other conceivable arrangements of power and authority, for example, those of decentralized, democratic worker self-management, could prove capable of administering factories, refineries, communications systems, and railroads as well as or better than the organizations Chandler describes. Evidence from automobile assembly teams in Sweden and worker-managed plants in Yugoslavia and other countries is often presented to salvage these possibilities. Unable to settle controversies over this matter here, I merely point to what I consider to be their bone of contention. The available evidence tends to show that many large, sophisticated technological systems are in fact highly compatible with centralized, hierarchical managerial control. The interesting question, however, has to do with whether or not this pattern is in any sense a requirement of such systems, a question that is not solely empirical. The matter ultimately rests on our judgments about what steps, if any, are practically necessary in the workings of particular kinds of technology and what, if anything, such measures require of the structure of human associations. Was Plato right in saying that a ship at sea needs steering by a decisive

hand and that this could only be accomplished by a single captain and an obedient crew? Is Chandler correct in saying that the properties of large-scale systems require centralized, hierarchical managerial control?

To answer such questions, we would have to examine in some detail the moral claims of practical necessity (including those advocated in the doctrines of economics) and weigh them against moral claims of other sorts, for example, the notion that it is good for sailors to participate in the command of a ship or that workers have a right to be involved in making and administering decisions in a factory. It is characteristic of societies based on large, complex technological systems, however, that moral reasons other than those of practical necessity appear increasingly obsolete, “idealistic,” and irrelevant. Whatever claims one may wish to make on behalf of liberty, justice, or equality can be immediately neutralized when confronted with arguments to the effect, “Fine, but that’s no way to run a railroad” (or steel mill, or airline, or communication system, and so on). Here we encounter an important quality in modern political discourse and in the way people commonly think about what measures are justified in response to the possibilities technologies make available. In many instances, to say that some technologies are inherently political is to say that certain widely accepted reasons of practical necessity – especially the need to maintain crucial technological systems as smoothly working entities – have tended to eclipse other sorts of moral and political reasoning.

One attempt to salvage the autonomy of politics from the bind of practical necessity involves the notion that conditions of human association found in the internal workings of technological systems can easily be kept separate from the polity as a whole. Americans have long rested content in the belief that arrangements of power and authority inside industrial corporations, public utilities, and the like have little bearing on public institutions, practices, and ideas at large. That “democracy stops at the factory gates” was taken as a fact of life that had nothing to do with the practice of political freedom. But can the internal politics of technology and the politics of the whole community be so easily separated? A recent study of business leaders in the United States, contemporary exemplars of Chandler’s “visible hand of management,” found them remarkably impatient with such democratic scruples as “one man, one vote.” If democracy doesn’t work for the firm, the most critical institution in all of society, American executives ask, how well can it be expected to work for the government of a nation – particularly when that

government attempts to interfere with the achievements of the firm? The authors of the report observe that patterns of authority that work effectively in the corporation become for businessmen “the desirable model against which to compare political and economic relationships in the rest of society.”²⁵ While such findings are far from conclusive, they do reflect a sentiment increasingly common in the land: what dilemmas such as the energy crisis require is not a redistribution of wealth or broader public participation but, rather, stronger, centralized public and private management.

An especially vivid case in which the operational requirements of a technical system might influence the quality of public life is the debates about the risks of nuclear power. As the supply of uranium for nuclear reactors runs out, a proposed alternative fuel is the plutonium generated as a by-product in reactor cores. Well-known objections to plutonium recycling focus on its unacceptable economic costs, its risks of environmental contamination, and its dangers in regard to the international proliferation of nuclear weapons. Beyond these concerns, however, stands another less widely appreciated set of hazards – those that involve the sacrifice of civil liberties. The widespread use of plutonium as a fuel increases the chance that this toxic substance might be stolen by terrorists, organized crime, or other persons. This raises the prospect, and not a trivial one, that extraordinary measures would have to be taken to safeguard plutonium from theft and to recover it should the substance be stolen. Workers in the nuclear industry as well as ordinary citizens outside could well become subject to background security checks, covert surveillance, wiretapping, informers, and even emergency measures under martial law – all justified by the need to safeguard plutonium.

Russell W. Ayres’s study of the legal ramifications of plutonium recycling concludes: “With the passage of time and the increase in the quantity of plutonium in existence will come pressure to eliminate the traditional checks the courts and legislatures place on the activities of the executive and to develop a powerful central authority better able to enforce strict safeguards.” He avers that “once a quantity of plutonium had been stolen, the case for literally turning the country upside down to get it back would be overwhelming.” Ayres anticipates and worries about the kinds of thinking that, I have argued, characterize inherently political technologies. It is still true that in a world in which human beings make and maintain artificial systems nothing is “required” in an absolute sense. Nevertheless, once a course of action is

under way, once artifacts such as nuclear power plants have been built and put in operation, the kinds of reasoning that justify the adaptation of social life to technical requirements pop up as spontaneously as flowers in the spring. In Ayres’s words, “Once recycling begins and the risks of plutonium theft become real rather than hypothetical, the case for governmental infringement of protected rights will seem compelling.”²⁶ After a certain point, those who cannot accept the hard requirements and imperatives will be dismissed as dreamers and fools.

The two varieties of interpretation I have outlined indicate how artifacts can have political qualities. In the first instance we noticed ways in which specific features in the design or arrangement of a device or system could provide a convenient means of establishing patterns of power and authority in a given setting. Technologies of this kind have a range of flexibility in the dimensions of their material form. It is precisely because they are flexible that their consequences for society must be understood with reference to the social actors able to influence which designs and arrangements are chosen. In the second instance we examined ways in which the intractable properties of certain kinds of technology are strongly, perhaps unavoidably, linked to particular institutionalized patterns of power and authority. Here the initial choice about whether or not to adopt something is decisive in regard to its consequences. There are no alternative physical designs or arrangements that would make a significant difference; there are, furthermore, no genuine possibilities for creative intervention by different social systems – capitalist or socialist – that could change the intractability of the entity or significantly alter the quality of its political effects.

To know which variety of interpretation is applicable in a given case is often what is at stake in disputes, some of them passionate ones, about the meaning of technology for how we live. I have argued a “both/and” position here, for it seems to me that both kinds of understanding are applicable in different circumstances. Indeed, it can happen that within a particular complex of technology – a system of communication or transportation, for example – some aspects may be flexible in their possibilities for society, while other aspects may be (for better or worse) completely intractable. The two varieties of interpretation I have examined here can overlap and intersect at many points.

These are, of course, issues on which people can disagree. Thus, some proponents of energy from renewable resources now believe they have at last discovered a set of intrinsically democratic, egalitarian, communitarian technologies. In my best estimation, however, the social consequences of building renewable energy systems will surely depend on the specific configurations of both hardware and the social institutions created to bring that energy to us. It may be that we will find ways to turn this silk purse into a sow's ear. By comparison, advocates of the further development of nuclear power seem to believe that they are working on a rather flexible technology whose adverse social effects can be fixed by changing the design parameters of reactors and nuclear waste disposal systems. For reasons indicated above, I believe them to be dead wrong in that faith. Yes, we may be able to manage some of the "risks" to public health and safety that nuclear power brings. But as society adapts to the more dangerous and apparently indelible

features of nuclear power, what will be the long-range toll in human freedom?

My belief that we ought to attend more closely to technical objects themselves is not to say that we can ignore the contexts in which those objects are situated. A ship at sea may well require, as Plato and Engels insisted a single captain and obedient crew. But a ship out of service, parked at the dock, needs only a caretaker. To understand which technologies and which contexts are important to us, and why, is an enterprise that must involve both the study of specific technical systems and their history as well as a thorough grasp of the concepts and controversies of political theory. In our times people are often willing to make drastic changes in the way they live to accommodate technological innovation while at the same time resisting similar kinds of changes justified on political grounds. If for no other reason than that, it is important for us to achieve a clearer view of these matters than has been our habit so far.

Notes

- 1 Lewis Mumford, "Authoritarian and Democratic Technics," *Technology and Culture* 5:1-8, 1964.
- 2 Denis Hayes, *Rays of Hope: The Transition to a Post-Petroleum World* (New York: W. W. Norton, 1977), 71, 159.
- 3 David Lillienthal, *T.V.A.: Democracy on the March* (New York: Harper and Brothers, 1944), 72-83.
- 4 Daniel J. Boorstin, *The Republic of Technology* (New York: Harper and Row, 1978), 7.
- 5 Langdon Winner, *Autonomous Technology: Technics-Out-of-Control as a Theme in Political Thought* (Cambridge: MIT Press, 1977).
- 6 The meaning of "technology" I employ in this essay does not encompass some of the broader definitions of that concept found in contemporary literature, for example, the notion of "technique" in the writings of Jacques Ellul. My purposes here are more limited. For a discussion of the difficulties that arise in attempts to define "technology," see *Autonomous Technology*, 8-12.
- 7 Robert A. Caro, *The Power Broker: Robert Moses and the Fall of New York* (New York: Random House, 1974), 318, 481, 514, 546, 951-958, 952.
- 8 Robert Ozanne, *A Century of Labor-Management Relations at McCormick and International Harvester* (Madison: University of Wisconsin Press, 1967), 20.
- 9 The early history of the tomato harvester is told in Wayne D. Rasmussen, "Advances in American Agriculture: The Mechanical Tomato Harvester as a Case Study," *Technology and Culture* 9:531-543, 1968.
- 10 Andrew Schmitz and David Seckler, "Mechanized Agriculture and Social Welfare: The Case of the Tomato Harvester," *American Journal of Agricultural Economics* 52:569-577, 1970.
- 11 William H. Friedland and Amy Barton, "Tomato Technology," *Society* 13:6, September/October 1976. See also William H. Friedland, *Social Sleep-walkers: Scientific and Technological Research in California Agriculture*, University of California, Davis, Department of Applied Behavioral Sciences, Research Monograph No. 13, 1974.
- 12 *University of California Clip Sheet* 54:36, May 1, 1979.
- 13 "Tomato Technology."
- 14 A history and critical analysis of agricultural research in the land-grant colleges is given in James Hightower, *Hard Tomatoes, Hard Times* (Cambridge: Schenkman, 1978).
- 15 David F. Noble, *Forces of Production: A Social History of Machine Tool Automation* (New York: Alfred A. Knopf, 1984).
- 16 Friedrich Engels, "On Authority," in *The Marx-Engels Reader*, ed. 2, Robert Tucker (ed.) (New York: W. W. Norton, 1978), 731.
- 17 *Ibid.*
- 18 *Ibid.*, 732, 731.
- 19 Karl Marx, *Capital*, vol. 1, ed. 3, translated by Samuel Moore and Edward Aveling (New York: Modern Library, 1906), 530.
- 20 Jerry Mander, *Four Arguments for the Elimination of Television* (New York: William Morrow, 1978), 44.

- 21 See, for example, Robert Argue, Barbara Emanuel, and Stephen Graham, *The Sun Builders: A People's Guide to Solar, Wind and Wood Energy in Canada* (Toronto: Renewable Energy in Canada, 1978). "We think decentralization is an implicit component of renewable energy; this implies the decentralization of energy systems, communities and of power. Renewable energy doesn't require mammoth generation sources of disruptive transmission corridors. Our cities and towns, which have been dependent on centralized energy supplies, may be able to achieve some degree of autonomy, thereby controlling and administering their own energy needs." (16)
- 22 Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge: Belknap, 1977), 244.
- 23 Ibid.
- 24 Ibid., 500.
- 25 Leonard Silk and David Vogel, *Ethics and Profits: The Crisis of Confidence in American Business* (New York: Simon and Schuster, 1976), 191.
- 26 Russell W. Ayres, "Policing Plutonium: The Civil Liberties Fallout," *Harvard Civil Rights – Civil Liberties Law Review* 10 (1975): 443, 413–414, 374.

The Social Impact of Technological Change

Emmanuel G. Mesthene

Technology and Wisdom

My objective is to suggest some of the broader implications of what is new about our age. It might be well to start, therefore, by noting what is new about our age.

The fact itself that there is something new is not new. There has been something new about every age, otherwise we would not be able to distinguish them in history. What we need to examine is what in particular is new about our age, for the new is not less new just because the old was also at one time new.

The mere prominence in our age of science and technology is not strikingly new, either. A veritable explosion of industrial technology gave its name to a whole age two centuries ago, and it is doubtful that any scientific idea will ever again leave an imprint on the world so penetrating and pervasive as did Isaac Newton's a century before that.

It is not clear, finally, that what is new about our age is the rate at which it changes. What partial evidence we have, in the restricted domain of economics, for example, indicates the contrary. The curve of growth, for the hundred years or so that it can be traced, is smooth, and will not support claims of explosive change or discontinuous rise. For the rest, we lack the stability of concept, the

precision of intellectual method, and the necessary data to make any reliable statements about the rate of social change in general.

I would, therefore, hold suspect all argument that purports to show that novelty is new with us, or that major scientific and technological influences are new with us, or that rapidity of social change is new with us. Such assertions, I think, derive more from revolutionary fervor and the wish to persuade than from tested knowledge and the desire to instruct.

Yet there is clearly something new, and its implications are important. I think our age is different from all previous ages in two major respects: first, we dispose, in absolute terms, of a staggering amount of physical power; second, and most important, we are beginning to think and act in conscious realization of that fact. We are therefore the first age who can aspire to be free of the tyranny of physical nature that has plagued man since his beginnings.

I

The consciousness of physical impossibility has had a long and depressing history. One might speculate that it began with early man's awe of the bruteness and

Emmanuel G. Mesthene, "Technology and Wisdom," from *Technology and Social Change*, ed. Emmanuel G. Mesthene (Indianapolis: Bobbs-Merrill Inc., 1967), pp. 57–62. "I. Social Change," "II. Values," "III. Economic and Political Organization," and "IV. Conclusion," from Emmanuel G. Mesthene, "Some General Implications of the Research of the Harvard University Program on Technology and Society," *Technology and Culture*, 10/4 (Oct. 1969), pp. 489–490, 495–501, 507–511, 513, abridged. Published by The Johns Hopkins University Press on behalf of the Society for the History of Technology.

recalcitrance of nature. Earth, air, fire, and water – the eternal, immutable elements of ancient physics – imposed their requirements on men, dwarfed them, outlived them, remained indifferent when not downright hostile to them. The physical world loomed large in the affairs of men, and men were impotent against it. Homer celebrated this fact by investing nature with gods, and the earliest philosophers recognized it by erecting each of the natural elements in turn – water, air, earth, and fire – into fundamental principles of all existence.

From that day to this, only the language has changed as successive ages encountered and tried to come to terms with physical necessity, with the sheer “rock-bottomness” of nature. It was submitted to as fate in the Athenian drama. It was conceptualized as ignorance by Socrates and as metaphysical matter by his pupils. It was labeled evil by the pre-Christians. It has been exorcised as the Devil, damned as flesh, or condemned as illicit by the Church. It has been the principle of non-reason in modern philosophy, in the form of John Locke’s Substance, as Immanuel Kant’s formless manifold, or as Henri Bergson’s pure duration. It has conquered the mystic as nirvana, the psyche as the Id, and recent Frenchmen as the blind object of existential commitment.

What men have been saying in all these different ways is that physical nature has seemed to have a structure, almost a will of its own, that has not yielded easily to the designs and purposes of man. It has been a brute thereness, a residual, a sort of ultimate existential stage that allowed, but also limited, the play of thought and action.

It would be difficult to overestimate the consequences of this recalcitrance of the physical on the thinking and outlook of men. They have learned, for most of history, to plan and act *around* a permanent realm of impossibility. Man could travel on the sea, by sail or oar or breast stroke. But he could not travel *in* the sea. He could cross the land on foot, on horseback, or by wheel, but he could not fly over it. Legends such as those of Daedalus and Poseidon celebrated in art what men could not aspire to in fact.

Thinking was similarly circumscribed. There were myriad possibilities in existence, but they were not unlimited, because they did not include altering the physical structure of existence itself. Man could in principle know all that was possible, once and for all time. What else but this possibility of complete knowledge does Plato name in his Idea of the Good? The task of thought was to discern and compare and select from

among this fixed and eternal realm of possibilities. Its options did not extend beyond it, anymore than the chess player’s options extend beyond those allowed by the board and the pieces of his game. There was a natural law, men said, to which all human law was forever subservient, and which fixed the patterns and habits of what was thinkable.

There was, occasionally, an invention during all this time that did induce a physical change. It thus made something new possible, like adding a pawn to the chess game. New physical possibilities are the result of invention; of technology, as we call it today. That is what *invention* and *technology* mean. Every invention, from the wheel to the rocket, has created new possibilities that did not exist before. But inventions in the past were few, rare, exceptional, and marvelous. They were unexpected departures from the norm. They were surprises that societies adjusted to after the fact. They were generally infrequent enough, moreover, so that the adjustments could be made slowly and unconsciously, without radical alteration of world views, or of traditional patterns of thought and action. The Industrial Revolution, as we call it, was revolutionary precisely because it ran into attitudes, values, and habits of thought and action that were completely unprepared to understand, accept, absorb, and change with it.

Today, if I may put it paradoxically, technology is becoming less revolutionary, as we recognize and seek after the power that it gives us. Inventions are now many, frequent, planned, and increasingly taken for granted. We were not a bit surprised when we got to the moon. On the contrary, we would have been very surprised if we had not. We are beginning to use invention as a deliberate way to deal with the future, rather than seeing it only as an uncontrolled disrupting of the present. We no longer wait upon invention to occur accidentally. We foster and force it, because we see it as a way out of the heretofore inviolable constraints that physical nature has imposed upon us in the past.

Francis Bacon, in the sixteenth century, was the first to foresee the physical power potential in scientific knowledge. We are the first, I am suggesting, to have enough of that power actually at hand to create new possibilities almost at will. By massive physical changes deliberately induced, we can literally pry new alternatives out of nature. The ancient tyranny of matter has been broken, and we know it. We found, in the seventeenth century, that the physical world was not at all like what Aristotle had thought and Aquinas had taught. We are today

coming to the further realization that the physical world need not be as it is. We can change it and shape it to suit our purposes.

Technology, in short, has come of age, not merely as technical capability, but as a social phenomenon. We have the power to create new possibilities, and the will to do so. By creating new possibilities, we give ourselves more choices. With more choices, we have more opportunities. With more opportunities, we can have more freedom, and with more freedom we can be more human. That, I think, is what is new about our age. We are recognizing that our technical prowess literally bursts with the promise of new freedom, enhanced human dignity, and unfettered aspiration. Belatedly, we are also realizing the new opportunities that technological development offers us to make new and potentially big mistakes.

II

At its best, then, technology is nothing if not liberating. Yet many fear it increasingly as enslaving, degrading, and destructive of man's most cherished values. It is important to note that this is so, and to try to understand why. I can think of four reasons.

First, we must not blink at the fact that technology does indeed destroy some values. It creates a million possibilities heretofore undreamed of, but it also makes impossible some others heretofore enjoyed. The automobile makes real the legendary foreign land, but it also makes legendary the once real values of the ancient market place. Mass production puts Bach and Brueghel in every home, but it also deprives the careful craftsman of a market for the skill and pride he puts into his useful artifact. Modern plumbing destroys the village pump, and modern cities are hostile to the desire to sink roots into and grow upon a piece of land. Some values are unquestionably bygone. To try to restore them is futile, and simply to deplore their loss is sterile. But it is perfectly human to regret them.

Second, technology often reveals what technology has not created: the cost in brutalized human labor, for example, of the few cases of past civilization whose values only a small elite could enjoy. Communications now reveal the hidden and make the secret public. Transportation displays the better to those whose lot has been the worse. Increasing productivity buys more education, so that more people read and learn and compare and hope and are unsatisfied. Thus technology often seems the final straw, when it is only illuminating rather than adding to the human burden.

Third, technology might be deemed an evil, because evil is unquestionably potential in it. We can explore the heavens with it, or destroy the world. We can cure disease, or poison entire populations. We can free enslaved millions, or enslave millions more. Technology spells only possibility, and is in that respect neutral. Its massive power can lead to massive error so efficiently perpetrated as to be well-nigh irreversible. Technology is clearly not synonymous with the good. It *can* lead to evil.

Finally, and in a sense most revealing, technology is upsetting, because it complicates the world. This is a vague concern, hard to pin down, but I think it is a real one. The new alternatives that technology creates require effort to examine, understand, and evaluate them. We are offered more choices, which makes choosing more difficult. We are faced with the need to change, which upsets routines, inhibits reliance on habit, and calls for personal readjustments to more flexible postures. We face dangers that call for constant re-examination of values and a readiness to abandon old commitments for new ones more adequate to changing experience. The whole business of living seems to become harder.

This negative face of technology is sometimes confused with the whole of it. It can then cloud the understanding in two respects that are worth noting. It can lead to a generalized distrust of the power and works of the human mind by erecting a false dichotomy between the modern scientific and technological enterprises, on the one hand, and some idealized and static prescientific conception of human values, on the other. It can also color discussion of some important contemporary issues, that develop from the impact of technology on society, in a way that obscures rather than enhances understanding, and that therefore inhibits rather than facilitates the social action necessary to resolve them.

Because the confusions and discomfort attendant on technology are more immediate and therefore sometimes loom larger than its power and its promise, technology appears to some an alien and hostile trespasser upon the human scene. It thus seems indistinguishable from that other, older alien and hostile trespasser: the ultimate and unbreachable physical necessity of which I have spoken. Then, since habit dies hard, there occurs one of those curious inversions of the imagination that are not unknown to history. Our new-found control over nature is seen as but the latest form of the tyranny of nature. The knowledge and therefore the mastery of the physical world that we have gained, the tools that we have hewed from nature and the human wonders we are

building into her, are themselves feared as rampant, uncontrollable, impersonal technique that must surely, we are told, end by robbing us of our livelihood, our freedom, and our humanity.

It is not an unfamiliar syndrome. It is reminiscent of the long-term prisoner who may shrink from the responsibility of freedom in preference for the false security of his accustomed cell. It is reminiscent even more of Socrates, who asked about that other prisoner, in the cave of ignorance, whether his eyes would not ache if he were forced to look upon the light of knowledge, "so that he would try to escape and turn back to the things which he could see distinctly, convinced that they really were clearer than these other objects now being shown to him." Is it so different a form of escapism from that, to ascribe impersonality and hostility to the knowledge and the tools that can free us finally from the age-long impersonality and hostility of a recalcitrant physical nature?

Technology has *two* faces: one that is full of promise, and one that can discourage and defeat us. The freedom that our power implies from the traditional tyranny of matter – from the evil we have known – carries with it the added responsibility and burden of learning to deal with matter and to blunt the evil, along with all the other problems we have always had to deal with. That is another way of saying that more power and more choice and more freedom require more wisdom if they are to add up to more humanity. But that, surely, is a challenge to be wise, not an invitation to despair.

An attitude of despair can also, as I have suggested, color particular understandings of particular problems, and thus obstruct intelligent action. I think, for example, that it has distorted the public debate about the effects of technology on work and employment.

The problem has persistently taken the form of fear that machines will put people permanently out of work. That fear has prevented recognition of a distinction between two fundamentally different questions. The first is a question of economic analysis and economic and manpower policy about which a great deal is known, which is susceptible to analysis by well-developed and rigorous methods, and on the dimensions and implications of which there is a very high degree of consensus among the professionally competent.

That consensus is that there is not much that is significantly new in the probable consequences of automation on employment. Automation is but the latest form of mechanization, which has been recognized as an

important factor in economic change at least since the Industrial Revolution. What *is* new is a heightened social awareness of the implications of machines for men, which derives from the unprecedented scale, prevalence, and visibility of modern technological innovation. That is the second question. It, too, is a question of work, to be sure, but it is not one of employment in the economic connotation of the term. It is a distinct question, that has been too often confused with the economic one because it has been formulated, incorrectly, as a question of automation and employment.

This question is much less a question of whether people will be employed than of what they can most usefully do, given the broader range of choices that technology can make available to them. It is less a technical economic question than a question of the values and quality of work. It is not a question of what to do with increasing leisure, but of how to define new occupations that combine social utility and personal satisfaction.

I see no evidence, in other words, that society will need less work done on some day in the future when machines may be largely satisfying its material needs, or that it will not value and reward that work. But we are, first, a long way still from that day, so long as there remain societies less affluent than the most affluent. Second, there is a work of education, integration, creation, and eradication of disease and discontent to do that is barely tapped so long as most people must labor to produce the goods that we consume. The more machines can take over what we do, the more we can do what machines cannot do. That, too, is liberation: the liberation of history's slaves, finally to be people

III

Such basically irrational fears of technology have a counterpart in popular fears of science itself. Here, too, anticipatory despair in the face of some genuine problems posed by science and technology can cloud the understanding.

It is admittedly horrible, for example, to contemplate the unintentional evil implicit in the ignorance and fallibility of man as he strives to control his environment and improve his lot. What untoward effects might our grandchildren suffer from the drugs that cure our ills today? What monsters might we breed unwittingly while we are learning to manipulate the genetic code? What are the tensions on the human psyche of a cold and rapid automated world? What political disaster do we court by

providing 1984's Big Brother with all the tools he will ever need? Better, perhaps, in Hamlet's words, to

....bear those ills we have
Than fly to others that we know not of.

Why not stop it all? Stop automation! Stop tampering with life and heredity! Stop the senseless race into space! The cry is an old one. It was first heard, no doubt, when the wheel was invented. The technologies of the bomb, the automobile, the spinning jenny, gunpowder, printing, all provoked social dislocation accompanied by similar cries of "Stop!" Well, but why not stop now, while there may still be a minute left before the clock strikes twelve?

We do not stop, I think, for three reasons: we do not want to; we cannot, and still be men; and we therefore should not.

It is not at all clear that atom bombs will kill more people than wars have ever done, but energy from the atom might one day erase the frightening gap between the more and less favored peoples of the world. Was it more tragic to infect a hundred children with a faulty polio vaccine than to have allowed the scourge free reign forever? It is not clear that the monster that the laboratory may create, in searching the secret of life, will be more monstrous than those that nature will produce unaided if its secrets remain forever hidden. Is it really clear that rampant multiplication is a better ultimate fate for man than to suffer, but eventually survive, the mistakes that go with learning? The first reason we do not stop is that I do not think we would decide, on close examination, that we really want to.

The second reason is that we cannot so long as we are men. Aristotle saw a long time ago that "man by nature desires to know." He will probe and learn all that his curiosity prompts him to and his brain allows, so long as there is life within him. The stoppers of the past have always lost in the end, whether it was Socrates, or Christ, or Galileo, or Einstein, or Bonhoeffer, or Boris Pasternak they tried to stop. Their intended victims are the *heroes*.

We do not stop, finally, because we would not stop being men. I do not believe that even those who decry science the loudest would willingly concede that the race has now been proved incapable of coping with its own creations. That admission would be the ultimate in dehumanization, for it would be to surrender the very qualities of intelligence, courage, vision, and aspiration that make us human. "Stop," in the end, is the last desperate cry of the man who abandons man because he is

defeated by the responsibility of being human. It is the final failure of nerve.

I am recalling that celebrated phrase, "the failure of nerve," in order to introduce a third and final example of how fear and pessimism can color understanding and confuse our values. It is the example of those who see the sin of pride in man's confident mastery of nature. I have dealt with this theme before, but I permit myself to review it briefly once more, because it points up the real meaning of technology for our age.

The phrase, "the failure of nerve," was first used by the eminent classical scholar, Gilbert Murray, to characterize the change of temper that occurred in Hellenistic civilization at the turn of our era. The Greeks of the fifth and fourth centuries B.C. believed in the ultimate intelligibility of the universe. There was nothing in the nature of existence or of man that was inherently unknowable. They accordingly believed also in the power of the human intelligence to know all there was to know about the world, and to guide man's career in it.

The wars and mixing of cultures that marked the subsequent period brought with them vicissitude and uncertainty that shook this classic faith in the intelligibility of the world and in the capacity of men to know and to do. There was henceforth to be a realm of knowledge and action available only to God, not subjected to reason or to human effort. Men, in other words, more and more turned to God to do for them what they no longer felt confident to do for themselves. That was the failure of nerve.

The burden of what I have been saying is that times are changing. We have the power and will to probe and change physical nature. No longer are God, the human soul, or the mysteries of life improper objects of inquiry. We are ready to examine whatever our imagination prompts us to. We are convinced again, for the first time since the Greeks, of the essential intelligibility of the universe: there is nothing in it that is in principle not knowable. As the sociologist Daniel Bell has put it, "Today we feel that there are no inherent secrets in the universe, and this is one of the significant changes in the modern moral temper." That is another way of stating what is new about our age. We are witnessing a widespread recovery of nerve.

Is this confidence a sin? According to Gilbert Murray, most people "are inclined to believe that without some failure and sense of failure, without a contrite heart and conviction of sin, man can hardly attain the religious life." I would suspect that this statement is still true of most people, although it is clear that a number of

contemporary theologians are coming to a different view. To see a sense of failure as a condition of religious experience is a historical relic, dating from a time when an indifferent nature and hostile world so overwhelmed men that they gave up thought for consolation. To persist in such a view today, when nature is coming increasingly under control as a result of restored human confidence and power, is both to distort reality and to sell religion short. It surely does no glory to God to rest his power on the impotence of man.

The challenge of our restored faith in knowledge and the power of knowledge is rather a challenge to wisdom – not to God.

Some who have seen farthest and most clearly in recent decades have warned of a growing imbalance between man's capabilities in the physical and in the social realms. John Dewey, for example, said: "We have displayed enough intelligence in the physical field to create the new and powerful instrument of science and technology. We have not as yet had enough intelligence to use this instrument deliberately and systematically to control its social operations and consequences." Dewey said this more than thirty years ago, before television, before atomic power, before electronic computers, before space satellites. He had been saying it, moreover, for at least thirty years before that. He saw early the problems that would arise when man learned to do anything he wanted before he learned what he wanted.

I think the time Dewey warned about is here. My more thoughtful scientific friends tell me that we now have, or know how to acquire, the technical capability to do very nearly anything we want. Can we . . . control our biology and our personality, order the weather that suits us, travel to Mars or to Venus? Of course we can, if not now or in five or ten years, then certainly in twenty-five, or in fifty or a hundred.

But if the answer to the question What can we do? is "Anything," then the emphasis shifts fat-more heavily than before onto the question What should we do? The commitment to universal intelligibility entails moral responsibility. Abandonment of the belief in intelligibility two thousand years ago was justly described as a failure of nerve because it was the prelude to moral surrender. Men gave up the effort to be wise because they found it too hard. Renewed belief in intelligibility two thousand years later means that men must take up again the hard work of becoming wise. And it is much harder work now, because we have so much more power than the Greeks. On the other hand, the benefits of

wisdom are potentially greater, too, because we have the means at hand to *make* the good life, right here and now, rather than just to go on contemplating it in Plato's heaven.

The question What should we do? is thus no idle one but challenges each one of us. That, I think, is the principal moral implication of our new world. It is what all the shouting is about in the mounting concern about the relations of science and public policy, and about the impact of technology on society. Our almost total mastery of the physical world entails a challenge to the public intelligence of a degree heretofore unknown in history.

I. Social Change

Three unhelpful views about technology

While a good deal of research is aimed at discerning the particular effects of technological change on industry, government, or education, systematic inquiry devoted to seeing these effects together and to assessing their implications for contemporary society as a whole is relatively recent and does not enjoy the strong methodology and richness of theory and data that mark more established fields of scholarship. It therefore often has to contend with facile or one-dimensional views about what technology means for society. Three such views, which are prevalent at the present time, may be mildly caricatured somewhat as follows.

The first holds that technology is an unalloyed blessing for man and society. Technology is seen as the motor of all progress, as holding the solution to most of our social problems, as helping to liberate the individual from the clutches of a complex and highly organized society, and as the source of permanent prosperity; in short, as the promise of Utopia in our time. This view has its modern origins in the social philosophies of such 19th-century thinkers as Saint-Simon, Karl Marx, and Auguste Comte. It tends to be held by many scientists and engineers, by many military leaders and aerospace industrialists, by people who believe that man is fully in command of his tools and his destiny, and by many of the devotees of modern techniques of "scientific management."

A second view holds that technology is an unmitigated curse. Technology is said to rob people of their jobs, their privacy, their participation in democratic government, and even, in the end, their dignity as human beings. It is seen as autonomous and uncontrollable, as

fostering materialistic values and as destructive of religion, as bringing about a technocratic society and bureaucratic state in which the individual is increasingly submerged, and as threatening, ultimately, to poison nature and blow up the world. This view is akin to historical “back-to-nature” attitudes toward the world and is propounded mainly by artists, literary commentators, popular social critics, and existentialist philosophers. It is becoming increasingly attractive to many of our youth, and it tends to be held, understandably enough, by segments of the population that have suffered dislocation as a result of technological change.

The third view is of a different sort. It argues that technology as such is not worthy of special notice, because it has been well recognized as a factor in social change at least since the Industrial Revolution, because it is unlikely that the social effects of computers will be nearly so traumatic as the introduction of the factory system in 18th-century England, because research has shown that technology has done little to accelerate the rate of economic productivity since the 1880s, because there has been no significant change in recent decades in the time period between invention and widespread adoption of new technology, and because improved communications and higher levels of education make people much more adaptable than heretofore to new ideas and to new social reforms required by technology.

While this view is supported by a good deal of empirical evidence, however, it tends to ignore a number of social, cultural, psychological, and political effects of technological change that are less easy to identify with precision. It thus reflects the difficulty of coming to grips with a new or broadened subject matter by means of concepts and intellectual categories designed to deal with older and different subject matters. This view tends to be held by historians, for whom continuity is an indispensable methodological assumption, and by many economists, who find that their instruments measure some things quite well while those of the other social sciences do not yet measure much of anything.

Stripped of caricature, each of these views contains a measure of truth and reflects a real aspect of the relationship of technology and society. Yet they are oversimplifications that do not contribute much to understanding. One can find empirical evidence to support each of them without gaining much knowledge about the actual mechanism by which technology leads to social change or significant insight into its implications for the future. All three remain too uncritical or too

partial to guide inquiry. Research and analysis lead to more differentiated conclusions and reveal more subtle relationships.

[...]

How society reacts to technological change

The heightened prominence of technology in our society makes the interrelated tasks of profiting from its opportunities and containing its dangers a major intellectual and political challenge of our time.

Failure of society to respond to the opportunities created by new technology means that much actual or potential technology lies fallow, that is, is not used at all or is not used to its full capacity. This can mean that potentially solvable problems are left unsolved and potentially achievable goals unachieved, because we waste our technological resources or use them inefficiently. A society has at least as much stake in the efficient utilization of technology as in that of its natural or human resources.

There are often good reasons, of course, for not developing or utilizing a particular technology. The mere fact that it can be developed is not sufficient reason for doing so. The costs of development may be too high in the light of the expected benefits, as in the case of the project to develop a nuclear-powered aircraft. Or, a new technological device may be so dangerous in itself or so inimical to other purposes that it is never developed. [...]

But there are also cases where technology lies fallow because existing social structures are inadequate to exploit the opportunities it offers. [...] Vested economic and political interests serve to obstruct adequate provision of low-cost housing. Community institutions wither for want of interest and participation by residents. City agencies are unable to marshal the skills and take the systematic approach needed to deal with new and intensified problems of education, crime control, and public welfare. Business corporations finally, which are organized around the expectation of private profit, are insufficiently motivated to bring new technology and management know-how to bear on urban projects where the benefits will be largely social. All these factors combine to dilute what may otherwise be a genuine desire to apply our best knowledge and adequate resources to the resolution of urban tensions and the eradication of poverty in the nation.

There is also institutional failure of another sort. Government in general and agencies of public information in particular are not yet equipped for the massive task of public education that is needed if our society is to make full use of its technological potential, although the federal government has been making significant strides in this direction in recent years. Thus, much potentially valuable technology goes unused because the public at large is insufficiently informed about the possibilities and their costs to provide support for appropriate political action. As noted, we have done very well with our technology in the face of what were or were believed to be crisis situations, as with our military technology in World War II and with our space efforts when beating the Russians to the moon was deemed a national goal of first priority. We have also done very well when the potential benefits of technology were close to home or easy to see, as in improved health care and better and more varied consumer goods and services. We have done much less well in developing and applying technology where the need or opportunity has seemed neither so clearly critical nor so clearly personal as to motivate political action, as in the instance of urban policy already cited. Technological possibility continues to lie fallow in those areas where institutional and political innovation is a precondition of realizing it.

Containing the negative effects of technology

The kinds and magnitude of the negative effects of technology are no more independent of the institutional structures and cultural attitudes of society than is realization of the new opportunities that technology offers. In our society, there are individuals or individual firms always on the lookout for new technological opportunities, and large corporations hire scientists and engineers to invent such opportunities. In deciding whether to develop a new technology, individual entrepreneurs engage in calculations of expected benefits and expected costs to themselves, and proceed if the former are likely to exceed the latter. Their calculations do not take adequate account of the probable benefits and costs of the new development to others than themselves or to society generally. These latter are what economists call external benefits and costs.

The external benefits potential in new technology will thus not be realized by the individual developer and will rather accrue to society as a result of deliberate social action, as has been argued above. Similarly with the external costs. In minimizing only expected costs to

himself, the individual decision maker helps to contain only some of the potentially negative effects of the new technology. The external costs and therefore the negative effects on society at large are not of principal concern to him and, in our society, are not expected to be.

Most of the consequences of technology that are causing concern at the present time – pollution of the environment, potential damage to the ecology of the planet, occupational and social dislocations, threats to the privacy and political significance of the individual, social and psychological malaise – are negative externalities of this kind. They are with us in large measure because it has not been anybody's explicit business to foresee and anticipate them. They have fallen between the stools of innumerable individual decisions to develop individual technologies for individual purposes without explicit attention to what all these decisions add up to for society as a whole and for people as human beings. This freedom of individual decision making is a value that we have cherished and that is built into the institutional fabric of our society. The negative effects of technology that we deplore are a measure of what this traditional freedom is beginning to cost us. They are traceable, less to some mystical autonomy presumed to lie in technology, and much more to the autonomy that our economic and political institutions grant to individual decision making.

When the social costs of individual decision making in the economic realm achieved crisis proportions in the great depression of the 1930s, the federal government introduced economic policies and measures many of which had the effect of abridging the freedom of individual decision. Now that some of the negative impacts of technology are threatening to become critical, the government is considering measures of control that will have the analogous effect of constraining the freedom of individual decision makers to develop and apply new technologies irrespective of social consequence. Congress is actively seeking to establish technology- assessment boards of one sort or another which it hopes may be able to foresee potentially damaging effects of technology on nature and man. In the executive branch, attention is being directed (1) to development of a system of social indicators to help gauge the social effects of technology, (2) to establishment of some body of social advisers to the president to help develop policies in anticipation of such effects, and generally (3) to strengthening the role of the social sciences in policy making.

Measures to control and mitigate the negative effects of technology, however, often appear to threaten freedoms

that our traditions still take for granted as inalienable rights of men and good societies, however much they may have been tempered in practice by the social pressures of modern times: the freedom of the market, the freedom of private enterprise, the freedom of the scientist to follow truth wherever it may lead, and the freedom of the individual to pursue his fortune and decide his fate. There is thus set up a tension between the need to control technology and our wish to preserve our values, which leads some people to conclude that technology is inherently inimical to human values. The political effect of this tension takes the form of inability to adjust our decision-making structures to the realities of technology so as to take maximum advantage of the opportunities it offers and so that we can act to contain its potential ill effects before they become so pervasive and urgent as to seem uncontrollable.

To understand why such tensions are so prominent a social consequence of technological change, it becomes necessary to look explicitly at the effects of technology on social and individual values.

II. Values

Technology's challenge to values

Despite the practical importance of the techniques, institutions, and processes of knowledge in contemporary society, political decision making and the resolution of social problems are clearly not dependent on knowledge alone. Numerous commentators have noted that ours is a "knowledge" society, devoted to rational decision making and an "end of ideology," but none would deny the role that values play in shaping the course of society and the decisions of individuals. On the contrary, questions of values become more pointed and insistent in a society that organizes itself to control technology and that engages in deliberate social planning. Planning demands explicit recognition of value hierarchies and often brings into the open value conflicts which remain hidden in the more impersonal working of the market.

In economic planning, for example, we have to make choices between the values of leisure and increased productivity, without a common measure to help us choose. In planning education, we come face to face with the traditional American value dilemma of equality versus achievement: do we opt for equality and nondiscrimination and give all students the same basic education, or do we foster achievement by tailoring

education to the capacity for learning, which is itself often conditioned by socioeconomic background?

The new science-based decision-making techniques also call for clarity: in the specification of goals, thus serving to make value preferences explicit. The effectiveness of systems analysis, for example, depends on having explicitly stated objectives and criteria of evaluation to begin with, and the criteria and objectives of specific actions invariably relate to the society's system of values. That, incidentally, is why the application of systems analysis meets with less relative success in educational or urban planning than in military planning: the value conflicts are fewer in the latter and the objectives and criteria easier to specify and agree on. This increased awareness of conflicts among our values contributes to a general questioning attitude toward traditional values that appears to be endemic to a high-technology, knowledge-based society: "A society in which the store of knowledge concerning the consequences of action is large and is rapidly increasing is a society in which received norms and their 'justifying' values will be increasingly subjected to questioning and reformulation."¹

This is another way of pointing to the tension alluded to earlier, between the need for social action based on knowledge on the one hand, and the pull of our traditional values on the other. The increased questioning and reformulation of values that Williams speaks of, coupled with a growing awareness that our values are in fact changing under the impact of technological change, leads many people to believe that technology is by nature destructive of values. But this belief presupposes a conception of values as eternal and unchanging and therefore tends to confuse the valuable with the stable. The fact that values come into question as our knowledge increases and that some traditional values cease to function adequately when technology leads to changes in social conditions does not mean that values per se are being destroyed by knowledge and technology.

What does happen is that values change through a process of accommodation between the system of existing values and the technological and social changes that impinge on it. [...]

Technology as a cause of value change

Technology has a direct impact on values by virtue of its capacity for creating new opportunities. By making possible what was not possible before, it offers individuals and society new options to choose from. For example, space technology makes it possible for the first time to go to the moon

or to communicate by satellite and thereby adds those two new options to the spectrum of choices available to society. By adding new options in this way, technology can lead to changes in values in the same way that the appearance of new dishes on the heretofore standard menu of one's favorite restaurant can lead to changes in one's tastes and choices of food. Specifically, technology can lead to value change either (1) by bringing some previously unattainable goal within the realm of choice or (2) by making some values easier to implement than heretofore, that is, by changing the costs associated with realizing them.

[...] When technology facilitates implementation of some social ideal and society fails to act upon this new possibility, the conflict between principle and practice is sharpened, thus leading to new tensions. For example, the economic affluence that technology has helped to bring to American society makes possible fuller implementation than heretofore of our traditional values of social and economic equality. [...]

Another example related to the effect of technological change on values is implicit in our concept of democracy. The ideal we associate with the old New England town meeting is that each citizen should have a direct voice in political decisions. Since this has not been possible, we have elected representatives to serve our interests and vote our opinions. Sophisticated computer technology, however, now makes possible rapid and efficient collection and analysis of voter opinion and could eventually provide for "instant voting" by the whole electorate on any issue presented to it via television a few hours before. It thus raises the possibility of instituting a system of direct democracy and gives rise to tensions between those who would be violently opposed to such a prospect and those who are already advocating some system of participatory democracy.

This new technological possibility challenges us to clarify what we mean by democracy. Do we construe it as the will of an undifferentiated majority, as the resultant of transient coalitions of different interest groups representing different value commitments, as the considered judgment of the people's elected representatives, or as by and large the kind of government we actually have in the United States, minus the flaws in it that we would like to correct? By bringing us face to face with such questions, technology has the effect of calling society's bluff and thereby preparing the ground for changes in its values.

In the case where technological change alters the relative costs of implementing different values, it impinges on inherent contradictions in our value system. To pursue

the same example, modern technology can enhance the values we associate with democracy. But it can also enhance another American value – that of "secular rationality," as sociologists call it – by facilitating the use of scientific and technical expertise in the process of political decision making. This can in turn further reduce citizen participation in the democratic process. Technology thus has the effect of facing us with contradictions in our own value system and of calling for deliberate attention to their resolution.

[...]

III. Economic and Political Organization

The enlarged scope of public decision making

When technology brings about social changes which impinge on our existing system of values it poses for society a number of problems that are ultimately political in nature. The term "political" is used here in the broadest sense: it encompasses all of the decision-making structures and procedures that have to do with the allocation and distribution of wealth and power in society. The political organization of society thus includes not only the formal apparatus of the state but also industrial organizations and other private institutions that play a role in the decision-making process. It is particularly important to attend to the organization of the entire body politic when technological change leads to a blurring of once clear distinctions between the public and private sectors of society and to changes in the roles of its principal institutions.

It was suggested above that the political requirements of our modern technological society call for a relatively greater public commitment on the part of individuals than in previous times. The reason for this, stated most generally, is that technological change has the effect of enhancing the importance of public decision making in society, because technology is continually creating new possibilities for social action as well as new problems that have to be dealt with.

A society that undertakes to foster technology on a large scale, in fact, commits itself to social complexity and to facing and dealing with new problems as a normal feature of political life. Not much is yet known with any precision about the political imperatives inherent in

technological change, but one may nevertheless speculate about the reasons why an increasingly technological society seems to be characterized by enlargement of the scope of public decision making.

For one thing, the development and application of technology seems to require large-scale, and hence increasingly complex, social concentrations, whether these be large cities, large corporations, big universities, or big government. In instances where technological advance appears to facilitate reduction of such first-order concentrations, it tends instead to enlarge the relevant *system* of social organization, that is, to lead to increased centralization. Thus, the physical dispersion made possible by transportation and communications technologies enlarges the urban complex that must be governed as a unit.

A second characteristic of advanced technology is that its effects cover large distances, in both the geographical and social senses of the term. Both its positive and negative features are more extensive. Horse-powered transportation technology was limited in its speed and capacity, but its nuisance value was also limited, in most cases to the owner and to the occupant of the next farm. The supersonic transport can carry hundreds across long distances in minutes, but its noise and vibration damage must also be suffered willy-nilly by everyone within the limits of a swath 3,000 miles long and several miles wide.

The concatenation of increased density (or enlarged system) and extended technological “distance” means that technological applications have increasingly wider ramifications and that increasingly large concentrations of people and organizations become dependent on technological systems. A striking illustration of this was provided by the widespread effects of the power blackout in the northeastern part of the United States. The result is not only that more and more decisions must be social decisions taken in public ways, as already noted, but that, once made, decisions are likely to have a shorter useful life than heretofore. That is partly because technology is continually altering the spectrum of choices and problems that society faces, and partly because any decision taken is likely to generate a need to take ten more.

These speculations about the effects of technology on public decision making raise the problem of restructuring our decision-making mechanisms – including the system of market incentives – so that the increasing number and importance of social issues that confront us can be resolved equitably and effectively.

Private firms and public goods

Among these issues, as noted earlier, is that created by the shift in the composition of demand in favor of public goods and services – such as education, health, transportation, slum clearance, and recreational facilities – which, it is generally agreed, the market has never provided effectively and in the provision of which government has usually played a role of some significance. This shift in demand raises serious questions about the relationship between technological change and existing decision-making structures in general and about the respective roles of government and business in particular.

In Western industrialized countries, new technological developments generally originate in and are applied through joint stock companies whose shares are widely traded on organized capital markets. Corporations thus play a dominant role in the development of new methods of production, of new methods of satisfying consumer wants, and even of new wants. Most economists appear to accept the thesis originally proposed by Schumpeter that corporations play a key role in the actual process of technological innovation in the economy. Marris has recently characterized this role as a perceiving of latent consumer needs and of fostering and regulating the rate at which these are converted into felt wants.²

There is no similar agreement about the implications of all this for social policy. J. K. Galbraith, for example, argues that the corporation is motivated by the desire for growth subject to a minimum profit constraint and infers (1) a higher rate of new-want development than would be the case if corporations were motivated principally to maximize profit, (2) a bias in favor of economic activities heavy in “technological content” in contrast to activities requiring sophisticated social organization, and (3) a bias in the economy as a whole in favor of development and satisfaction of private needs to the neglect of public needs and at the cost of a relatively slow rate of innovation in the public sector.

But Galbraith’s picture is not generally accepted by economists, and his model of the corporation is not regarded as established economic theory. There is, in fact, no generally accepted economic theory of corporate behavior, as Marris points out, so that discussions about the future of the system of corporate enterprise usually get bogged down in an exchange of unsubstantiated assertions about how the existing system actually operates. What seems needed at this time, then, is less

a new program of empirical research than an attempt to synthesize what we know for the purpose of arriving at a more adequate theory of the firm.
[...]

The promise and problems of scientific decision making

There are two further consequences of the expanding role of public decision making. The first is that the latest information-handling devices and techniques tend to be utilized in the decision-making process. This is so (1) because public policy can be effective only to the degree that it is based on reliable knowledge about the actual state of the society, and thus requires a strong capability to collect, aggregate, and analyze detailed data about economic activities, social patterns, popular attitudes, and political trends, and (2) because it is recognized increasingly that decisions taken in one area impinge on and have consequences for other policy areas often thought of as unrelated, so that it becomes necessary to base decisions on a model of society that sees it as a system and that is capable of signaling as many as possible of the probable consequences of a contemplated action.

[R]eactions to the prospect of more decision making based on computerized data banks and scientific management techniques run the gamut of optimism to pessimism mentioned in the opening of this essay. Negative reactions take the form of rising political demands for greater popular participation in decision making, for more equality among different segments of the population, and for greater regard for the dignity of individuals. The increasing dependence of decision making on scientific and technological devices and techniques is seen as posing a threat to these goals, and pressures are generated in opposition to further "rationalization" of decision-making processes. These pressures have the paradoxical effect, however, not of deflecting the supporters of technological decision making from their course, but of spurring them on to renewed effort to save the society before it explodes under planlessness and inadequate administration.

The paradox goes further, and helps to explain much of the social discontent that we are witnessing at the present time. The greater complexity and the more extensive ramifications that technology brings about in society tend to make social processes increasingly circuitous and indirect. The effects of actions are widespread and difficult to keep track of, so that experts

and sophisticated techniques are increasingly needed to detect and analyze social events and to formulate policies adequate to the complexity of social issues. The "logic" of modern decision making thus appears to require greater and greater dependence on the collection and analysis of data and on the use of technological devices and scientific techniques. Indeed, many observers would agree that there is an "increasing relegation of questions which used to be matters of political debate to professional cadres of technicians and experts which function almost independently of the democratic political process." In recent times, that process has been most noticeable, perhaps, in the areas of economic policy and national security affairs.

This "logic" of modern decision making, however, runs counter to that element of traditional democratic theory that places high value on direct participation in the political processes and generates the kind of discontent referred to above. If it turns out on more careful examination that direct participation is becoming less relevant to a society in which the connections between causes and effects are long and often hidden – which is an increasingly "indirect" society, in other words – elaboration of a new democratic ethos and of new democratic processes more adequate to the realities of modern society will emerge as perhaps the major intellectual and political challenge of our time.
[...]

IV. Conclusion

As we review what we are learning about the relationship of technological and social change, a number of conclusions begin to emerge. We find, on the one hand, that the creation of new physical possibilities and social options by technology tends toward and appears to require the emergence of new values, new forms of economic activity, and new political organizations. On the other hand, technological change also poses problems of social and psychological displacement.

The two phenomena are not unconnected, nor is the tension between them new: man's technical prowess always seems to run ahead of his ability to deal with and profit from it. In America, especially, we are becoming adept at extracting the new techniques, the physical power, and the economic productivity that are inherent in our knowledge and its associated technologies. Yet we have not fully accepted the fact that our progress in the technical realm does not leave our institutions, values,

and political processes unaffected. Individuals will be fully integrated into society only when we can extract from our knowledge not only its technological potential

but also its implications for a system of values and a social, economic, and political organization appropriate to a society in which technology is so prevalent.

Notes

1 Robin Williams, "Individual and Group Values," *Annals of the American Academy of Political and Social Science* 37 (May 1967): 30.

2 Robin Marris, *The Economic Theory of "Managerial" Capitalism* (New York, 1964).

Technology: The Opiate of the Intellectuals, with the Author's 2000 Retrospective

John McDermott

Technology: The Opiate of the Intellectuals

If religion was formerly the opiate of the masses, then surely technology is the opiate of the educated public today, or at least of its favorite authors. No other single subject is so universally invested with high hopes for the improvement of mankind generally and of Americans in particular. . . .

These hopes for mankind's, or technology's, future, however, are not unalloyed. Technology's defenders, being otherwise reasonable men, are also aware that the world population explosion and the nuclear missiles race are also the fruit of the enormous advances made in technology during the past half century or so. But here too a cursory reading of their literature would reveal widespread though qualified optimism that these scourges too will fall before technology's might. Thus population (and genetic) control and permanent peace are sometimes added to the already imposing roster of technology's promises. What are we to make of such extravagant optimism?

[In early 1968] Harvard University's Program on Technology and Society, "... an inquiry in depth into the effects of technological change on the economy, on public policies, and on the character of society, as well as into the reciprocal effects of social progress on the nature,

dimension, and directions of scientific and technological development," issued its Fourth Annual Report to the accompaniment of full front-page coverage in *The New York Times* (January 18). Within the brief (fewer than 100) pages of that report and most clearly in the concluding essay by the Program's Director, Emmanuel G. Mesthene, one can discern some of the important threads of belief which bind together much current writing on the social implications of technology. Mesthene's essay is worth extended analysis because these beliefs are of interest in themselves and, of greater importance, because they form the basis not of a new but of a newly aggressive right-wing ideology in this country, an ideology whose growing importance was accurately measured by the magnitude of the *Times's* news report.

At the very beginning of Mesthene's essay, which attempts to characterize the relationships between technological and social change, the author is careful to dissociate himself from what he believes are several extreme views of those relationships. For example, technology is neither the relatively "unalloyed blessing" which, he claims, Marx, Comte, and the Air Force hold it to be, nor an unmitigated curse, a view he attributes to "many of our youth." (This is but the first of several reproofs Mesthene casts in the direction of youth.) Having denounced straw men to the right and left of him he is free to pursue that middle or moderate course favored by virtually all political writers of the day.

John McDermott, "Technology: The Opiate of the Intellectuals," originally from *The New York Review of Books* (1969); abridged. © John McDermott. Reprinted by kind permission of the author. "Technology: The Opiate of the Intellectuals," with author's 2000 retrospective © John McDermott. Reprinted by kind permission of the author.

This middle course consists of an extremely abstract and – politically speaking – sanitary view of technology and technological progress.

For Mesthene, it is characteristic of technology that it:

... creates new possibilities for human choice and action but leaves their disposition uncertain. What its effects will be and what ends it will serve are not inherent in the technology, but depend on what man will do with technology. Technology thus makes possible a future of open-ended options ...

This essentially optimistic view of the matter rests on the notion that technology is merely "... the organization of knowledge for practical purposes ..." and therefore cannot be purely boon or wholly burden. The matter is somewhat more complex:

New technology creates new opportunities for men and societies and it also generates new problems for them. It has both positive and negative effects, and it usually has the two at the same time and in virtue of each other.

This dual effect he illustrates with an example drawn from the field of medicine. Recent advances there

have created two new opportunities: (1) they have made possible treatment and cures that were never possible before, and (2) they provide a necessary condition for the delivery of adequate medical care to the population at large as a matter of right rather than privilege.

Because of the first, however,

the medical profession has become increasingly differentiated and specialized and is tending to concentrate its best efforts in a few major, urban centers of medical excellence.

Mesthene clearly intends but does not state the corollary to this point, namely that the availability of adequate medical care is declining elsewhere.¹ Moreover, because of the second point, there have been

... big increases in demand for medical services, partly because a healthy population has important economic advantages in a highly industrialized society. This increased demand accelerates the process of differentiation and multiplies the levels of paramedical personnel between the physician at the top and the patient at the bottom of the hospital pyramid.

... Mesthene believes there are two distinct problems in technology's relation to society, a positive one of taking full

advantage of the opportunities it offers and the negative one of avoiding unfortunate consequences which flow from the exploitation of those opportunities. Positive opportunities may be missed because the costs of technological development outweigh likely benefits (e.g., Herman Kahn's "Doomsday Machine"). Mesthene seems convinced, however, that a more important case is that in which

... technology lies fallow because existing social structures are inadequate to exploit the opportunities it offers. This is revealed clearly in the examination of institutional failure in the ghetto carried on by [the Program]. At point after point, ... analyses confirm ... that existing institutions and traditional approaches are by and large incapable of coming to grips with the new problems of our cities – many of them caused by technological change ... – and unable to realize the possibilities for resolving them that are also inherent in technology. ...

His diagnosis of these problems is generous in the extreme:

All these factors combine to dilute what may be otherwise a genuine desire to apply our best knowledge and adequate resources to the resolution of urban tensions and the eradication of poverty in the nation.

Moreover, because government and the media "... are not yet equipped for the massive task of public education that is needed ..." if we are to exploit technology more fully, many technological opportunities are lost because of the lack of public support. This too is a problem primarily of "institutional innovation."

Mesthene believes that institutional innovation is no less important in combatting the negative effects of technology. Individuals or individual firms which decide to develop new technologies normally do not take "adequate account" of their likely social benefits or costs. His critique is anti-capitalist in spirit, but lacks bite, for he goes on to add that

... [most of the negative] consequences of technology that are causing concern at the present time – pollution of the environment, potential damage to the ecology of the planet, occupational and social dislocations, threats to the privacy and political significance of the individual, social and psychological malaise – are *negative externalities of this kind*. They are with us in large measure because it has not been anybody's explicit business to foresee and anticipate them.

Mesthene's abstract analysis and its equally abstract diagnosis in favor of "institutional innovation" places

him in a curious and, for us, instructive position. If existing social structures are inadequate to exploit technology's full potential, or if, on the other hand, so-called negative externalities assail us because it is nobody's business to foresee and anticipate them, doesn't this say that we should apply technology to this problem too? That is, we ought to apply and organize the appropriate *organizational* knowledge for the practical purpose of solving the problems of institutional inadequacy and "negative externalities." Hence, in principle, Mesthene is in the position of arguing that the cure for technology's problems, whether positive or negative, is still more technology. This is the first theme of the technological school of writers and its ultimate First Principle.

Technology, in their view, is a self-correcting system. Temporary oversight or "negative externalities" will and should be corrected by technological means. Attempts to restrict the free play of technological innovation are, in the nature of the case, self-defeating. Technological innovation exhibits a distinct tendency to work for the general welfare in the long run. *Laissez innover!*

I have so far deliberately refrained from going into any greater detail than does Mesthene on the empirical character of contemporary technology (see below) for it is important to bring out the force of the principle of *laissez innover* in its full generality. Many writers on technology appear to deny in their definition of the subject — organized knowledge for practical purposes — that contemporary technology exhibits distinct trends which can be identified or projected. Others, like Mesthene, appear to accept these trends, but then blunt the conclusion by attributing to technology so much flexibility and "scientific" purity that it becomes an abstraction infinitely malleable in behalf of good, pacific, just, and egalitarian purposes. Thus the analogy to the *laissez-faire* principle of another time is quite justified. Just as the market or the free play of competition provided in theory the optimum long-run solution for virtually every aspect of virtually every social and economic problem, so too does the free play of technology, according to its writers. Only if technology or innovation (or some other synonym) is allowed the freest possible rein, they believe, will the maximum social good be realized.

What reasons do they give to believe that the principle of *laissez innover* will normally function for the benefit of mankind rather than, say, merely for the benefit of the immediate practitioners of technology, their managerial cronies, and for the profits accruing to their corporations? As Mesthene and other writers of his school are aware, this is a very real

problem, for they all believe that the normal tendency of technology is, and ought to be, the increasing concentration of decision-making power in the hands of larger and larger scientific-technical bureaucracies. *In principle*, their solution is relatively simple, though not often explicitly stated.²

Their argument goes as follows: the men and women who are elevated by technology into commanding positions within various decision-making bureaucracies exhibit no generalized drive for power such as characterized, say, the landed gentry of preindustrial Europe or the capitalist entrepreneur of the last century. For their social and institutional position and its supporting culture as well are defined solely by the fact that these men are problem solvers. (Organized knowledge for practical purposes again.) That is, they gain advantage and reward only to the extent that they can bring specific technical knowledge to bear on the solution of specific technical problems. Any more general drive for power would undercut the bases of their usefulness and legitimacy.

Moreover their specific training and professional commitment to solving technical problems creates a bias against ideologies in general which inhibits any attempts to formulate a justifying ideology for the group. Consequently, they do not constitute a class and have no general interests antagonistic to those of their problem-beset clients. We may refer to all of this as the disinterested character of the scientific-technical decision-maker, or, more briefly and cynically, as the principle of the Altruistic Bureaucrat.

As if not satisfied by the force of this (unstated) principle, Mesthene like many of his schoolfellows spends many pages commenting around the belief that the concentration of power at the top of technology's organizations is a problem, but that like other problems technology should be able to solve it successfully through institutional innovation. You may trust in it; the principle of *laissez innover* knows no logical or other hurdle.

This combination of guileless optimism with scientific toughmindedness might seem to be no more than an eccentric delusion were the American technology it supports not moving in directions that are strongly antidemocratic. To show why this is so we must examine more closely Mesthene's seemingly innocuous distinction between technology's positive opportunities and its "negative externalities." In order to do this I will make use of an example drawn from the very frontier of American technology, the war in Vietnam.

II

At least two fundamentally different bombing programs [have been] carried out in South Vietnam. There are fairly conventional attacks against targets which consist of identified enemy troops, fortifications, medical centers, vessels, and so forth. The other program is quite different and, at least since March 1968, infinitely more important. With some oversimplification it can be described as follows:

Intelligence data is gathered from all kinds of sources, of all degrees of reliability, on all manner of subjects, and fed into a computer complex located, I believe, at Bien Hoa. From this data and using mathematical models developed for the purpose, the computer then assigns probabilities to a range of potential targets, probabilities which represent the likelihood that the latter contain enemy forces or supplies. These potential targets might include: a canal-river crossing known to be used occasionally by the NLF; a section of trail which would have to be used to attack such and such an American base, now overdue for attack; a square mile of plain rumored to contain enemy troops; a mountainside from which camp fire smoke was seen rising. Again using models developed for the purpose, the computer divides pre-programmed levels of bombardment among those potential targets which have the highest probability of containing actual targets. Following the raids, data provided by further reconnaissance is fed into the computer and conclusions are drawn (usually optimistic ones) on the effectiveness of the raids. This estimate of effectiveness then becomes part of the data governing current and future operations, and so on.

Two features must be noted regarding this program's features, which are superficially hinted at but fundamentally obscured by Mesthene's distinction between the abstractions of positive opportunity and "negative externality." First, when considered from the standpoint of its planners, the bombing program is extraordinarily rational, for it creates previously unavailable "opportunities" to pursue their goals in Vietnam. It would make no sense to bomb South Vietnam simply at random, and no serious person or air force general would care to mount the effort to do so. So the system employed in Vietnam significantly reduces, though it does not eliminate, that randomness. That canal-river crossing which is bombed at least once every eleven days or so is a very poor target compared to an NLF battalion observed in a village. But it is an infinitely more promising target than would be

selected by throwing a dart at a grid map of South Vietnam. In addition to bombing the battalion, why not bomb the canal crossing to the frequency and extent that it *might* be used by enemy troops?

Even when we take into account the crudity of the mathematical models and the consequent slapstick way in which poor information is evaluated, it is a "good" program. No single raid will definitely kill an enemy soldier but a whole series of them increases the "opportunity" to kill a calculable number of them (as well, of course, as a calculable but not calculated number of nonsoldiers). This is the most rational bombing system to follow if American lives are very expensive and American weapons and Vietnamese lives very cheap. Which, of course, is the case.

Secondly, however, considered from the standpoint of goals and values not programmed in by its designers, the bombing program is incredibly irrational. In Mesthene's terms, these "negative externalities" would include, in the present case, the lives and well-being of various Vietnamese as well as the feelings and opinions of some less important Americans. Significantly, this exclusion of the interests of people not among the managerial class is based quite as much on the so-called technical means being employed as on the political goals of the system. In the particular case of the Vietnamese bombing system, the political goals of the bombing system clearly exclude the interests of certain Vietnamese. After all, the victims of the bombardment are communists or their supporters, they are our enemies, they resist US intervention. In short, their interests are fully antagonistic to the goals of the program and simply must be excluded from consideration. The technical reasons for this exclusion require explanation, being less familiar and more important, especially in the light of Mesthene's belief in the malleability of technological systems.

Advanced technological systems such as those employed in the bombardment of South Vietnam make use not only of extremely complex and expensive equipment but, quite as important, of large numbers of relatively scarce and expensive-to-train technicians. They have immense capital costs; a thousand aircraft of a very advanced type, literally hundreds of thousands of spare parts, enormous stocks of rockets, bombs, shells and bullets, in addition to tens of thousands of technical specialists; pilots, bombardiers, navigators, radar operators, computer programmers, accountants, engineers, electronic and mechanical technicians, to name only a few. In short, they are "capital intensive."

Moreover, the coordination of this immense mass of esoteric equipment and its operators in the most effective

possible way depends upon an extremely highly developed technique both in the employment of each piece of equipment by a specific team of operators and in the management of the program itself. Of course, all large organizations standardize their operating procedures, but it is peculiar to advanced technological systems that their operating procedures embody a very high degree of information drawn from the physical sciences, while their managerial procedures are equally dependent on information drawn from the social sciences. We may describe this situation by saying that advanced technological systems are both "technique intensive" and "management intensive."

It should be clear, moreover, even to the most casual observer that such intensive use of capital, technique, and management spills over into almost every area touched by the technological system in question. An attack program delivering 330,000 tons of munitions more or less selectively to several thousand different targets monthly would be an anomaly if forced to rely on sporadic intelligence data, erratic maintenance systems, or a fluctuating and unpredictable supply of heavy bombs, rockets, jet fuel, and napalm tanks. Thus it is precisely because the bombing program requires an intensive use of capital, technique, and management that the same properties are normally transferred to the intelligence, maintenance, supply, coordination and training systems which support it. Accordingly, each of these supporting systems is subject to sharp pressures to improve and rationalize the performance of its machines and men, the reliability of its techniques, and the efficiency and sensitivity of the management controls under which it operates. Within integrated technical systems, higher levels of technology drive out lower, and the normal tendency is to integrate systems.

From this perverse Gresham's Law of Technology follow some of the main social and organizational characteristics of contemporary technological systems: the radical increase in the scale and complexity of operations that they demand and encourage; the rapid and widespread diffusion of technology to new areas; the great diversity of activities which can be directed by central management; an increase in the ambition of management's goals; and, as a corollary, especially to the last, growing resistance to the influence of so-called negative externalities.

Complex technological systems are extraordinarily resistant to intervention by persons or problems operating outside or below their managing groups, and this is so regardless of the "politics" of a given situation. Technology creates its own politics. The point of such advanced

systems is to minimize the incidence of personal or social behavior which is erratic or otherwise not easily classified, of tools and equipment with poor performance, of improvisory techniques, and of unresponsiveness to central management.

For example, enlisted men who are "unrealistically soft" on the subject of civilian casualties and farmers in contested districts pose a mortal threat to the integral character of systems like that used in Vietnam. In the case of the soldier this means he must be kept under tight military discipline. In the case of the farmer, he must be easily placed in one of two categories; collaborator or enemy. This is done by assigning a probability to him, his hamlet, his village, or his district, and by incorporating that probability into the targeting plans of the bombing system. Then the enlisted man may be controlled by training and indoctrination as well as by highly developed techniques of command and coercion, and the farmers may be bombed according to the most advanced statistical models. In both cases the system's authority over its farmer subjects or enlisted men is a technical one. The technical means which make that system rational and efficient in its aggregate terms, i.e., as viewed from the top, themselves tend by design to filter out the "nonrational" or "nonefficient" elements of its components and subjects, i.e., those rising from the bottom.

To define technology so abstractly that it obscures these observable characteristics of contemporary technology — as Mesthene and his school have done — makes no sense. It makes even less sense to claim some magical malleability for something as undefined as "institutional innovation." Technology, in its concrete, empirical meaning, refers fundamentally to systems of rationalized control over large groups of men, events, and machines by small groups of technically skilled men operating through organizational hierarchy. The latent "opportunities" provided by that control and its ability to filter out discordant "negative externalities" are, of course, best illustrated by extreme cases. Hence the most instructive and accurate example should be of a technology able to suppress the humanity of its rank-and-file and to commit genocide as a by-product of its rationality. The Vietnam bombing program fits technology to a "T."

III

It would certainly be difficult to attempt to translate in any simple and direct way the social and organizational properties of highly developed technological systems

from the battlefields of Vietnam to the different cultural and institutional setting of the US. Yet before we conclude that any such attempt would be futile or even absurd, we might consider the following story.

In early 1967 I stayed for several days with one of the infantry companies of the US Fourth Division whose parent battalion was then based at Dau Tieng. From the camp at Dau Tieng the well-known Black Lady Mountain, sacred to the Cao Dai religious sect, was easily visible and in fact dominated the surrounding plain and the camp itself. One afternoon when I began to explain the religious significance of the mountain to some GI friends, they interrupted my somewhat academic discourse to tell me a tale beside which even the strange beliefs of the Cao Dai sect appeared prosaic.

According to GI reports which the soldiers had heard and believed, the Viet Cong had long ago hollowed out most of the mountain in order to install a very big cannon there. The size of the cannon was left somewhat vague – “huge, fucking ...” – but clearly the GPs imagined that it was in the battleship class. In any event, this huge cannon had formerly taken a heavy toll of American aircraft and had been made impervious to American counterattacks by the presence of two – “huge, fucking” – sliding steel doors, behind which it retreated whenever the Americans attacked. Had they seen this battleship cannon, and did it ever fire on the camp, which was easily within its range? No, they answered, for a brave flyer, recognizing the effectiveness of the cannon against his fellow pilots, had deliberately crashed his jet into those doors one day, jamming them, and permitting the Americans to move into the area unhindered.

I had never been in the army, and at the time of my trip to Vietnam had not yet learned how fantastic GI stories can be. Thus I found it hard to understand how they could be convinced of so improbable a tale. Only later, after talking to many soldiers and hearing many other wild stories from them as well, did I realize what the explanation for this was. Unlike officers and civilian correspondents who are almost daily given detailed briefings on a unit’s situation capabilities and objectives. GI’s are told virtually nothing of this sort by the army. They are simply told what to do, where, and how, and it is a rare officer, in my experience anyway, who thinks they should be told any more than this. Officers don’t think soldiers are stupid; they simply assume it, and act accordingly. For the individual soldier’s personal life doesn’t make too much difference; he still has to deal with the facts of personal feelings, his own well-being, and that of his family.

But for the soldier’s group life this makes a great deal of difference. In their group life, soldiers are cut off from sources of information about the situation of the group and are placed in a position where their social behavior is governed largely by the principle of blind obedience. Under such circumstances, reality becomes elusive. Because the soldiers are not permitted to deal with facts in their own ways, facts cease to discipline their opinions. Fantasy and wild tales are the natural outcome. In fact, it is probably a mark of the GI’s intelligence to fantasize, for it means that he has not permitted his intellectual capacity to atrophy. The intelligence of the individual is thus expressed in the irrationality of the group.

It is this process which we may observe when we look to the social effect of modern technological systems in America itself. Here the process is not so simple and clear as in Vietnam, for it involves not simply the relations of today’s soldiers to their officers and to the Army but the historical development of analogous relations between the lower and upper orders of our society. Moreover, these relations are broadly cultural rather than narrowly social in nature. It is to a brief review of this complex subject that I now wish to turn.

IV

Among the conventional explanations for the rise and spread of the democratic ethos in Europe and North America in the seventeenth, eighteenth, and nineteenth centuries, the destruction of the gap in political culture between the mass of the population and that of the ruling classes is extremely important. There are several sides to this explanation. For example, it is often argued that the invention of the printing press and the spread of Protestant Christianity encouraged a significant growth in popular literacy. In its earliest phases this literacy was largely expended on reading the Old and New Testaments, but it quickly broadened to include other religious works such as Bunyan’s *Pilgrim’s Progress*, and after that to such secular classics as *Gulliver’s Travels*. The dating of these developments is, in the nature of the case, somewhat imprecise. But certainly by the middle of the eighteenth century, at least in Britain and North America, the literacy of the population was sufficient to support a variety of newspapers and periodicals not only in the larger cities but in the smaller provincial towns as well. The decline of Latin as the first language of politics and religion paralleled this development, of course. Thus, even before the advent of Tom Paine, Baheuf, and other

popular tribunes, literacy and the information it carried were widely and securely spread throughout the population and the demystification of both the religious and the political privileges of the ruling classes was well developed. Common townsmen had closed at least one of the cultural gaps between themselves and the aristocracy of the larger cities.

Similarly, it is often argued that with the expansion and improvement of road and postal systems, the spread of new tools and techniques, the growth in the number and variety of merchants, the consequent invigoration of town life, and other numerous and familiar related developments, the social experiences of larger numbers of people became richer, more varied, and similar in fact to those of the ruling classes. This last, the growth in similarity of the social experiences of the upper and lower classes, is especially important. Social skills and experiences which underlay the monopoly of the upper classes over the processes of law and government were spreading to important segments of the lower orders of society. For carrying on trade, managing a commercial – not a subsistence – farm, participating in a vestry of workingmen's guild, or working in an up-to-date manufactory or business, unlike the relatively narrow existence of the medieval serf or artisan, were experiences which contributed to what I would call the social rationality of the lower orders.

Activities which demand frequent intercourse with strangers, accurate calculation of near means and distant ends, and a willingness to devise collective ways of resolving novel and unexpected problems demand and reward a more discriminating attention to the realities and deficiencies of social life, and provide thereby a rich variety of social experiences analogous to those of the governing classes. As a result not only were the processes of law and government, formerly treated with semireligious veneration, becoming demystified but, equally important, a population was being fitted out with sufficient skills and interests to contest their control. Still another gap between the political cultures of the upper and lower ends of the social spectrum was being closed.

The same period also witnesses a growth in the organized means of popular expression. In Britain, these would include the laboring people's organizations whose development is so ably described in Edward Thompson's *The Making of the English Working Class*. In America, the increase in the organized power of the populace was expressed not only in the growing conflict between the colonies and the Crown but more sharply and

fundamentally in the continuous antagonism between the coastal areas and the backwoods, expressed, for example, in Shay's rebellion in western Massachusetts in 1786. Clearly these organizational developments were related to the two foregoing as both cause and effect. For the English working-men's movement and the claims to local self-government in America spurred, and were spurred by, the growth in individual literacy and in social rationality among the lower classes. They were in fact its organizational expression.

These same developments were also reflected in the spread of egalitarian and republican doctrines such as those of Richard Price and Thomas Paine, which pointed up the arbitrary character of what had heretofore been considered the rights of the higher orders of society, and thus provided the popular ideological base which helped to define and legitimate lower-class demands.

This description by no means does justice to the richness and variety of the historical process underlying the rise and spread of what has come to be called the democratic ethos. But it does, I hope, isolate some of the important structural elements and, moreover, it enables us to illuminate some important ways in which the new technology, celebrated by Mesthene and his associates for its potential contributions to democracy, contributes instead to the erosion of that same democratic ethos. For if, in an earlier time, the gap between the political cultures of the higher and lower orders of society was being widely attacked and closed, this no longer appears to be the case. On the contrary, I am persuaded that the direction has been reversed and that we now observe evidence of a growing separation between ruling and lower-class culture in America, a separation which is particularly enhanced by the rapid growth of technology and the spreading influence of its *laissez-innovator* ideologues.

Certainly, there has been a decline in popular literacy, that is to say, in those aspects of literacy which bear on an understanding of the political and social character of the new technology. Not one person in a hundred is even aware of, much less understands, the nature of technologically highly advanced systems such as are used in the Vietnam bombing program. People's ignorance in these things is revealed in their language. No clearer illustration of this ignorance is needed than the growing and already enormous difference between the speech of organizational and technical specialists and that of the man in the street, including many of the educated ones. To the extent that technical forms of speech within which the

major business of American society is carried on are not understood or are poorly understood, there is a decline in one of the essentials of democracy.

This is not to say that the peculiar jargon which characterizes the speech of, say, aerospace technicians, crisis managers, or economic mandarins is intrinsically superior to the vocabulary of ordinary conversation, though sometimes this is indeed the case. What is important about technical language is that the words, being alien to ordinary speech, hide their meaning from ordinary speakers; terms like foreign aid or technical assistance have a good sound in ordinary speech; only the initiate recognizes them as synonyms for the old-fashioned, nasty word, imperialism. Such instances can be corrected but when almost all of the public's business is carried on in specialized jargon correction makes little difference. Like Latin in the past, the new language of social and technical organization is divorced from the general population. . . .

Secondly, the social organization of this new technology, by systematically denying to the general population experiences which are analogous to those of its higher management, contributes very heavily to the growth of social irrationality in our society. For example, modern technological organization defines the roles and values of its members, not vice versa. An engineer or a sociologist is one who does all those things but only those things called for by the "table of organization" and the "job description" used by his employer. Professionals who seek self-realization through creative and autonomous behavior without regard to the defined goals, needs, and channels of their respective departments have no more place in a large corporation or government agency than squeamish soldiers in the army. . . .

However, those at the top of technology's more advanced organizations hardly suffer the same experience. For reasons which are clearly related to the principle of the Altruistic Bureaucracy the psychology of an individual's fulfillment through work has been incorporated into management ideology. As the pages of *Fortune*, *Time*, or *Business Week* . . . serve to show, the higher levels of business and government are staffed by men and women who spend killing hours looking after the economic welfare and national security of the rest of us. The rewards of this life are said to be very few: the love of money would be demeaning and, anyway, taxes are said to take most of it; its sacrifices are many, for failure brings economic depression to the masses or gains for communism as well as disgrace to the erring managers. Even the essential high-mindedness

or altruism of our managers earns no reward, for the public is distracted, fickle, and, on occasion, vengeful. (The extensive literature on the "ordeal" of Lyndon Johnson is a case in point.) Hence for these "real revolutionaries of our time," as Walt Rostow has called them, self-fulfillment through work and discipline is the only reward. The managerial process is seen as an expression of the vital personalities of our leaders and the right to it an inalienable right of the national elite.

In addition to all of this, their lonely and unrewarding eminence in the face of crushing responsibility, etc., tends to create an air of mystification around technology's managers. When the august mystery of science and the perquisites of high office are added to their halos, they glow very blindingly indeed. Thus, in ideology as well as in reality and appearance, the experiences of the higher managers tend to separate and isolate themselves from those of the managed. Again the situation within the US is not so severe nor so stark as in the army in Vietnam but the effect on those who are excluded from self-management is very similar. Soldiers in Vietnam are not alone in believing huge, secret guns threaten them from various points; that same feeling is a national malady in the US.

It seems fundamental to the social organization of modern technology that the quality of the social experience of the lower orders of society declines as the level of technology grows no less than does their literacy. And, of course, this process feeds on itself, for with the consequent decline in the real effectiveness and usefulness of local and other forms of organization open to easy and direct popular influence their vitality declines still further, and the cycle is repeated.

The normal life of men and women in the lower and, I think, middle levels of American society now seems cut off from those experiences in which near social means and distant social ends are balanced and rebalanced, adjusted, and readjusted. But it is from such widespread experience with effective balancing and adjusting that social rationality derives. To the degree that it is lacking, social irrationality becomes the norm, and social paranoia a recurring phenomenon.

. . . With no great effort and using no great skill, Presidents Johnson and Nixon have managed to direct disorganized popular frustration over the continuation of the war and popular abhorrence over its unremitting violence on to precisely that element in the population most actively and effectively opposed to the war and its violence. . . .

People often say that America is a sick society when what they really mean is that it has lots of sick individuals.

But they were right the first time: the society is so sick that individual efforts to right it and individual rationality come to be expressed in fundamentally sick ways. Like the soldiers in Vietnam, we try to avoid atrophy of our social intelligence only to be led into fantasy and, often, violence. It is a good thing to want the war in Vietnam over for, as everyone now recognizes, it hurts us almost as much as the Vietnamese who are its intended victims. But for many segments of our population, especially those cut off from political expression because of their own social disorganization, the rationality of various alternatives for ending the war is fundamentally obscure. Thus their commendable desire to end the war is expressed in what they believe is the clearest and most certain alternative: use the bomb!

Mesthene himself recognizes that such “negative externalities” are on the increase. His list includes “... pollution of the environment, potential damage to the ecology of the planet, occupational and social dislocations, threats to the privacy and political significance of the individual, social and psychological malaise ...” Minor matters all, however, when compared to the marvelous opportunities *laissez innover* holds out to us: mote GNP, continued free world leadership, supersonic transports, urban renewal on a regional basis, institutional innovation, and the millennial promises of his school.

This brings us finally to the ideologies and doctrines of technology and their relation to what I have argued is a growing gap in political culture between the lower and upper classes in American society. Even more fundamentally than the principles of *laissez innover* and the altruistic bureaucrat, technology in its very definition as the organization of knowledge for practical purposes assumes that the primary and really creative role in the social processes consequent on technological change is reserved for a scientific and technical elite, the elite which presumably discovers and organizes that knowledge. But if the scientific and technical elite and their indispensable managerial cronies are the really creative (and hardworking and altruistic) element in American society, what is this but to say that the common mass of men are essentially drags on the social weal? This is precisely the implication which is drawn by the *laissez innover* school. Consider the following quotations from an article which appeared in *The New Republic* in December 1967, written by Zbigniew Brzezinski, one of the intellectual leaders of the school.

Brzezinski is describing a nightmare which he calls the “technetronic society” (the word like the concept is a pastiche of technology and electronics). This society

will be characterized, he argues, by the application of “... the principle of equal opportunity for all but ... special opportunity for the singularly talented few.” It will thus combine “... continued *respect* for the popular will with an increasing *role* in the key decision-making institutions of individuals with special intellectual and scientific attainments.” (Italics added.) Naturally, “The educational and social systems [will make] it increasingly attractive and easy for those meritocratic few to develop to the fullest of their special potential.”

However, while it will be “... necessary to require every one at a sufficiently responsible post to take, say, two years of [scientific and technical] retraining every ten years ...,” the rest of us can develop a new “... interest in the cultural and humanistic aspects of life, *in addition to purely hedonistic preoccupations.*” (Italics added.) The latter, he is careful to point out, “would serve as a social valve, reducing tensions and political frustration.”

Is it not fair to ask how much *respect* we carefree pleasure lovers and culture consumers will get from the hard-working bureaucrats, going to night school two years in every ten, while working like beavers in the “key decision-making institutions”? The altruism of our bureaucrats has a heavy load to bear.

Stripped of their euphemisms these are simply arguments which enhance the social legitimacy of the interests of new technical and scientific elites and detract from the interests of the rest of us; that is to say, if we can even formulate those interests, blinded as we will be by the mad pursuit of pleasures (and innovation?!) heaped up for us by advanced technology. Mesthene and his schoolfellows try to argue around their own derogation of the democratic ethos by frequent references, as we have seen, to their own fealty to it. But it is instructive in this regard to note that they tend, with Brzezinski, to find the real substance of that democratic ethos in the principle of the equality of opportunity. Before we applaud, however, we ought to examine the role which that principle plays within the framework of the advanced technological society they propose.

As has already been made clear the *laissez innover* school accepts as inevitable and desirable the centralizing tendencies of technology’s social organization, and they accept as well the mystification which comes to surround the management process. Thus equality of opportunity, as they understand it, has precious little to do with creating a more egalitarian society. On the contrary, it functions as an indispensable feature of the highly stratified society they envision for the future. For in their society of meritocratic hierarchy, equality of opportunity assures that talented

young meritocrats (the word is no uglier than the social system it refers to) will be able to climb into the “key decision-making” slots reserved for trained talent, and thus generate the success of the new society, and its cohesion against popular “tensions and political frustration.”

The structures which formerly guaranteed the rule of wealth, age, and family will not be destroyed (or at least not totally so). They will be firmed up and rationalized by the perpetual addition of trained (and, of course, acculturated) talent. In technologically advanced societies, equality of opportunity functions as a hierarchical principle, in opposition to the egalitarian social goals it pretends to serve. To the extent that it has already become the kind of “equality” we seek to institute in our society, it is one of the main factors contributing to the widening gap between the cultures of upper- and lower-class America.

V

Approximately a century ago, the philosophy of *laissez-faire* began its period of hegemony in American life. Its success in achieving that hegemony clearly had less to do with its merits as a summary statement of economic truth than with its role in the social struggle of the time. It helped to identify the interests of the institutions of entrepreneurial capitalism for the social classes which dominated them and profited from them. Equally, it sketched in bold strokes the outlines of a society within which the legitimate interests of all could supposedly be served only by systematic deference to the interests of entrepreneurial capitalists, their institutions, and their social allies. In short, the primary significance of *laissez-faire* lay in its role as ideology, as the cultural or intellectual expression of the interests of a class.

Something like the same thing must be said of *laissez innover*. As a summary statement of the relationship between social and technological change it obscures far more than it clarifies, but that is often the function and genius of ideologues. *Laissez innover* is now the premier ideology of the technological impulse in American society, which is to say, of the institutions which monopolize and profit from advanced technology and of the social classes which find in the free exploitation of *their* technology the most likely guarantee of their power, status, and wealth.

This said, it is important to stress both the significance and limitations of what has in fact been said. Here Mesthene’s distinction between the positive opportunities and negative “externalities” inherent in technological change is pivotal; for everything else which I’ve argued

follows inferentially from the actual social meaning of that distinction. As my analysis of the Vietnam bombing program suggested, those technological effects which are sought after as positive opportunities and those which are dismissed as negative externalities are decisively influenced by the fact that this distinction between positive and negative within advanced technological organizations tends to be made among the planners and managers themselves. Within these groups there are, as was pointed out, extremely powerful organizational, hierarchical, doctrinal, and other “*technical*” factors, which tend by design to filter out “irrational” demands from below, substituting for them the “rational” demands of technology itself. As a result, technological rationality is as socially neutral today as market rationality was a century ago.

Turning from the inner social logic of advanced technological organizations and systems to their larger social effect, we can observe a significant convergence. For both the social tendency of technology and the ideology (or rhetoric) of the *laissez-innover* school converge to encourage a political and cultural gap between the upper and lower ends of American society. As I have pointed out, these can now be characterized as those who manage and those who are managed by advanced technological systems.

This analysis lends some weight (though perhaps no more than that) to a number of wide-ranging and unorthodox conclusions about American society today and the directions in which it is tending. It may be useful to sketch out the most important of those conclusions in the form of a set of linked hypotheses, not only to clarify what appear to be the latent tendencies of America’s advanced technological society but also to provide more useful guides to the investigation of the technological impulse than those offered by the obscurantism and abstractions of the school of *laissez innover*.

First, and most important, technology should be considered as an institutional system, not more and certainly not less. Mesthene’s definition of the subject is inadequate, for it obscures the systematic and decisive social changes, especially their political and cultural tendencies, that follow the widespread application of advanced technological systems. At the same time, technology is less than a social system per se, though it has many elements of a social system, viz., an elite, a group of linked institutions, an ethos, and so forth. Perhaps the best summary statement of the case resides in an analogy – with all the vagueness and imprecision attendant on such things: today’s technology stands in relation to today’s capitalism as, a century ago, the latter stood to the free market capitalism of the time.

The analogy suggests, accurately enough I believe, the likelihood that the institutional links and shared interests among the larger corporations, the federal government, especially its military sector, the multiversity and the foundations, will grow rather than decline. It suggests further a growing entanglement of their elites, probably in the neo-corporations of technology, such as urban development corporations and institutes for defense analysis, whose importance seems likely to increase markedly in the future.

Finally, it suggests a growing convergence in the ethos and ideology of technology's leading classes along lines which would diminish slightly the relative importance of rhetoric about "property" and even about "national security," while enhancing the rhetoric of *laissez innover*. This does not necessarily imply any sacrifice in the prerogatives of either the private sector or of the crisis managers and the military, for one can readily understand how the elite strictures of *laissez innover* may be applied to strengthen the position of the corporate and military establishments.

[...]

Galbraith's concept of an "educational and scientific" elite class overlooks the peculiar relationship which the members of that supposed class have to advanced technology. Specifically, it overlooks the fact that most technical, scientific, and educational people are employed at relatively specialized tasks within very large organizations whose managing and planning levels are hardly less insulated from their influence than from the influence of the technically unskilled.

The obvious growth in status and, I think, power of such men as Ithiel de Sola Pool, Herman Kahn, Samuel Huntington, Daniel Patrick Moynihan, Henry Kissinger, Charles Hitch, and Paul Samuelson hardly represents the triumph of wisdom over power — an implication not absent from Galbraith's analysis. An examination of the role which these men now play in our national life should emphasize that they are scientific and technical entrepreneurs whose power is largely based on their ability to mobilize *organized* intellectual, scientific, and technical manpower and other resources, including foundation grants and university sponsorship, in behalf of the objectives of going institutions. They are much more like managers than like intellectuals, much more like brokers than like analysts. ...

A second major hypothesis would argue that the most important dimension of advanced technological institutions is the social one, that is, the institutions are agencies of highly centralized and intensive social control. Technology conquers nature, as the saying goes. But to do

so it must first conquer man. More precisely, it demands a very high degree of control over the training, mobility, and skills of the work force. The absence (or decline) of direct controls or of coercion should not serve to obscure from our view the reality and intensity of the social controls which are employed (such as the internalized belief in equality of opportunity, indebtedness through credit, advertising, selective service channeling, and so on).

Advanced technology has created a vast increase in occupational specialties, many of them requiring many, many years of highly specialized training. It must motivate this training. It has made ever more complex and "rational" the ways in which these occupational specialties are combined in our economic and social life. It must win passivity and obedience to this complex activity. Formerly, technical rationality had been employed only to organize the production of rather simple physical objects, for example, aerial bombs. Now technical rationality is increasingly employed to organize all of the processes necessary to the utilization of physical objects, such as bombing systems. For this reason it seems a mistake to argue that we are in a "postindustrial" age, a concept favored by the *laissez innover* school. On the contrary, the rapid spread of technical rationality into organizational and economic life and, hence, into social life is more aptly described as a second and much more intensive phase of the industrial revolution. One might reasonably suspect that it will create analogous social problems.

Accordingly, a third major hypothesis would argue that there are very profound social antagonisms or contradictions not less sharp or fundamental than those ascribed by Marx to the development of nineteenth-century industrial society. The general form of the contradictions might be described as follows: a society characterized by the employment of advanced technology requires an ever more socially disciplined population, yet retains an ever declining capacity to enforce the required discipline.

[...]

Politically, the advance of technology tends to concentrate authority within its managing groups in the ways I have described. But at the same time the increasing skill and educational levels of the population create latent capacities for self-management in the work place and in society.

[...]

These are brief and, I believe, barely adequate reviews of extremely complex hypotheses. But, in outline, each of these contradictions appears to bear on roughly the

same group of the American population, a technological underclass. If we assume this to be the case, a fourth hypothesis would follow, namely that technology is creating the basis for new and sharp class conflict in our society. That is, technology is creating its own working and managing classes just as earlier industrialization created its working and owning classes. Perhaps this suggests a return to the kind of class-based politics which characterized the US in the last quarter of the nineteenth century, rather than the somewhat more ambiguous politics which was a feature of the second quarter of this century. I am inclined to think that this is the case, though I confess the evidence for it is as yet inadequate.

This leads to a final hypothesis, namely that *laissez innover* should be frankly recognized as a conservative or right-wing ideology. This is an extremely complex subject for the hypothesis must confront the very difficult fact that the intellectual genesis of *laissez innover* is traceable much more to leftist and socialist theorizing on the wonders of technical rationality and social planning than it is to the blood politics of a De Maistre or the traditionalism of a Burke. So be it. Much more important is the fact that *laissez innover* is now the most powerful and influential statement of the demands and program of the technological impulse in our society, an impulse rooted in its most powerful institutions. More than any other statement, it succeeds in identifying and rationalizing the interests of the most authoritarian elites within this country, and the expansionism of their policies overseas. Truly it is no accident that the leading figures of *laissez innover*, the Rostows, Kahn, Huntington, Brzezinski, to name but a few, are among the most unreconstructed cold warriors in American intellectual life.

The point of this final hypothesis is not primarily to reimpress the language of European politics on the American scene. Rather it is to summarize the fact that many of the forces in American life hostile to the democratic ethos have enrolled under the banner of *laissez innover*. Merely to grasp this is already to take the first step toward a politics of radical reconstruction and against the malaise, irrationality, powerlessness, and official violence that characterize American life today.

Author's Retrospective (2000): Atavism and Modernism

"Technology" is embedded in a very distinctive way in modern American institutions, a way which has tended to be copied in other modern societies. In fact, much of

what is most attractive and unattractive, "modern" and "backward" in our society stems from this distinctive social embeddedness.

We can adapt the French concept of *cadre* to our purposes here. Its ambit is wider than, say, Galbraith's older concept of a "technostructure" since it incorporates not only "technical" specialties but also all those professional and managerial specialties which, together, innovate, deploy, maintain, and direct those industrial, sales, communications, military and other systems in which modern, up-to-date technology is employed. This usage emphasizes that a director for the TV show, a sales manager for frozen food products, or a line manager presiding over a shipping department represents a contemporary, changing, university-based "technology," "technique," and credentialing not radically different in its practical and institutional character from an engineer designing new radar components or the maintenance manager for the latest jet engines. That is, if we avoid sacralizing "hardware" or the results of the purely physical sciences as on a higher plane than the sorts of things studied in business schools or design departments, if instead we look to the ensembles of relations which connect different employees to the physical world through their professions and their employing institutions, to the latter's hierarchies, to the way in which different modern professions are recruited, trained, acculturated, deployed, and paid, we can see a quite remarkable convergence of all sorts of once different "fields" to the common patterns exhibited across today's *cadre*.

Typically these *cadre* are located within a management echelon in which their authority, job tenure, personal emoluments, and technological authority are markedly greater – carefully distinguished in institutional practice and even in law – from those of their subordinates in the workforce and, of course, from persons located outside of the main technology-employing institutions.³

This double action – the convergence of the different professions to a common pattern, and especially their separation from "the workforce" into a special managerial echelon – deeply affects the way technology is deployed in a modern society. What in fact we call "technology" is increasingly what these *cadre* learn, understand, do, and effect, and the technology's social characteristics are deeply marked by that dual convergence and separation. We have, essentially, a "technology" of a special minority whose embeddedness within very large, hierarchically organized institutions profoundly insulates the direction and magnitude of technological change from the experience, knowledge, and authority of the great majority.

Obviously, this sort of social organization has certain advantages. The classic “Market” of Economics orthodoxy would never have had the financial patience, scale of physical resources, and access to multiple technologies by as many different cooperating institutions, including the marketing resources and skills, to have brought about the mass usage of the LP, the cassette tape and the CD. If late Beethoven is within easy reach of Everyman, it must be accounted a cultural triumph of our distinct way of socially embedding technology. Its other achievements, in industrial productivity, in medicine, in travel and financial services, in PCs and the Internet, are equally triumphs for the special autonomy we accord our technological *cadre* and the scale of inter-institutional resources made available to them.

Of course, there is a social price to this. As I suggested in my old essay, there has been an emerging divide between *cadre* and the mass. I think the increasing maldistribution of income, not only in the advanced countries but everywhere, is subtly linked to the perhaps excessive social and economic esteem accorded *cadre* and the idea that the others, the masses of “the mass market,” enjoy an undeserved free ride on the technology so laboriously created by others.⁴

There is also a certain irony in the fact that our most modern of societies is arguably re-producing a premodern kind of politics. The concept of “the political classes” seemed to have disappeared for good at the turn of the

nineteenth to the twentieth century, especially given the rise of the mass electorate, liberalism and social democracy, and increasing literacy. That only a minority – the titled, the connected, the propertied, and the educated – would exert a semi-monopoly of influence on the political process, others being overlooked and excluded, was then seen as an anachronism being wiped out by the march of Progress. Whatever our expectations in this regard, I do think that the ranks of the politically significant have shrunk; in the US and the UK, for example, both the Democrats and the Labour Party increasingly value and seek the votes of the same “middle class” (= *cadre*) that the Republicans and the Tories vie for. The French, the German and other European Socialists have gone much the same route. In my youth this historical tendency to privilege the *cadre* against the rest was defended by an Economic Growth narrative. In the 1950s that changed to a Cold War narrative. In my essay of the late 1960s more or less the same social privileging was championed by “Laissez innover!” Today it’s “the Market” which demands that we especially privilege the interests and the autonomy of the *cadre* and, of course, of the elite who call our larger institutions their own. It is this very plasticity of ideology, its frequent change of form around a stable core of social interests, that leads me to think that the way we socially embed our technology is, whatever its other merits, a main source of the deeply political atavism of what we deem “technologically advanced society.”

Notes

- 1 This is almost certainly true of persons living in rural areas or in smaller towns and cities. However, a New York-based New Left project, the Health-Policy Advisory Center, has argued with considerable documentation, that roughly half of New York City’s population is now medically indigent and perhaps 80 percent of the population is indigent with respect to major medical care.
- 2 For a more complete statement of the argument which follows, see Suzanne Keller, *Beyond the Ruling Class* (New York: Random House, 1963).
- 3 I analyzed the rise and significance of the managerial echelon in *Corporate Society: Class, Property and Contemporary Capitalism* (Boulder: Westview, 1991).
- 4 A notable difference between the older and the modern “professions” is that in the latter the purely professional ethos has been radically de-rated. For example, scores of

Ford Motors’ *cadre* had to have known that certain Ford ignition systems, like the Ford/Firestone tires, were a source of multiple deaths and injuries (*New York Times*, September 12, 2000, p.A1). It would be facetious to say that we need more “whistle-blowers”. Most modern professions are definitively acculturated to give their first, almost exclusive loyalty to their employers when in fact the social/technological impact of modern *cadre* and their relative autonomy from the public’s scrutiny and intervention really demand far more. All of the modern professions, on the model of medicine, should be under both the moral/professional obligation – and the legal requirement – to practice their specialties with the interests of the public, not their employers, foremost in mind. A radical resocialization of the modern professions, including all kinds of management, seems a utopian idea, but it is imperatively called for.

Democratic Rationalization: Technology, Power, and Freedom

Andrew Feenberg

I The Limits of Democratic Theory

Technology is one of the major sources of public power in modern societies. So far as decisions affecting our daily lives are concerned, political democracy is largely overshadowed by the enormous power wielded by the masters of technical systems: corporate and military leaders, and professional associations of groups such as physicians and engineers. They have far more to do with control over patterns of urban growth, the design of dwellings and transportation systems, the selection of innovations, our experience as employees, patients, and consumers, than all the governmental institutions of our society put together.

Marx saw this situation coming in the middle of the nineteenth century. He argued that traditional democratic theory erred in treating the economy as an extrapolitical domain ruled by natural laws such as the law of supply and demand. He claimed that we will remain disenfranchised and alienated so long as we have no say in industrial decision-making. Democracy must be extended from the political domain into the world of work. This is the underlying demand behind the idea of socialism.

Modern societies have been challenged by this demand for over a century. Democratic political theory offers no persuasive reason of principle to reject it. Indeed, many democratic theorists endorse it.¹ What is more, in a number of countries socialist parliamentary

victories or revolutions have brought parties to power dedicated to achieving it. Yet today we do not appear to be much closer to democratizing industrialism than in Marx's time.

This state of affairs is usually explained in one of the following two ways.

On the one hand, the common-sense view argues that modern technology is incompatible with workplace democracy. Democratic theory cannot reasonably press for reforms that would destroy the economic foundations of society. For evidence, consider the Soviet case: although they were socialists, the communists did not democratize industry, and the current democratization of Soviet society extends only to the factory gate. At least in the ex-Soviet Union, everyone can agree on the need for authoritarian industrial management.

On the other hand, a minority of radical theorists claim that technology is not responsible for the concentration of industrial power. That is a political matter, due to the victory of capitalist and communist elites in struggles with the underlying population. No doubt modern technology lends itself to authoritarian administration, but in a different social context it could just as well be operated democratically.

In what follows, I will argue for a qualified version of this second position, somewhat different from both the usual Marxist and democratic formulations. The qualification concerns the role of technology, which I see as

Andrew Feenberg, "Democratic [originally "Subversive"] Rationalization: Technology, Power, and Democracy," revised version of an article in *Inquiry*, 35 (1992), pp. 301–322. Reprinted by permission of Taylor & Francis.

neither determining nor as neutral. I will argue that modern forms of hegemony are based on the technical mediation of a variety of social activities, whether it be production or medicine, education or the military, and that, consequently, the democratization of our society requires radical technical as well as political change.

This is a controversial position. The common-sense view of technology limits democracy to the state. By contrast, I believe that unless democracy can be extended beyond its traditional bounds into the technically mediated domains of social life, its use value will continue to decline, participation will wither, and the institutions we identify with a free society will gradually disappear.

Let me turn now to the background to my argument. I will begin by presenting an overview of various theories that claim that insofar as modern societies depend on technology, they require authoritarian hierarchy. These theories presuppose a form of technological determinism which is refuted by historical and sociological arguments I will briefly summarize. I will then present a sketch of a non-deterministic theory of modern society I call "critical theory of technology." This alternative approach emphasizes contextual aspects of technology ignored by the dominant view. I will argue that technology is not just the rational control of nature; both its development and impact are intrinsically social. I will then show that this view undermines the customary reliance on efficiency as a criterion of technological development. That conclusion, in turn, opens broad possibilities of change foreclosed by the usual understanding of technology.

II Dystopian Modernity

Max Weber's famous theory of rationalization is the original argument against industrial democracy. The title of this essay implies a provocative reversal of Weber's conclusions. He defined rationalization as the increasing role of calculation and control in social life, a trend leading to what he called the "iron cage" of bureaucracy.² "Democratic" rationalization is thus a contradiction in terms.

Once traditionalist struggle against rationalization has been defeated, further resistance in a Weberian universe can only reaffirm irrational life forces against routine and drab predictability. This is not a democratic program but a romantic anti-dystopian one, the sort of thing that is already

foreshadowed in Dostoevsky's *Notes from Underground* and various back-to-nature ideologies.

My title is meant to reject the dichotomy between rational hierarchy and irrational protest implicit in Weber's position. If authoritarian social hierarchy is truly a contingent dimension of technical progress, as I believe, and not a technical necessity, then there must be an alternative way of rationalizing society that democratizes rather than centralizes control. We need not go underground or native to preserve threatened values such as freedom and individuality.

But the most powerful critiques of modern technological society follow directly in Weber's footsteps in rejecting this possibility. I am thinking of Heidegger's formulation of "the question of technology" and Ellul's theory of "the technical phenomenon."³ According to these theories, we have become little more than objects of technique, incorporated into the mechanism we have created. As Marshall McLuhan once put it, technology has reduced us to the "sex organs of machines." The only hope is a vaguely evoked spiritual renewal that is too abstract to inform a new technical practice.

These are interesting theories, important for their contribution to opening a space of reflection on modern technology. I will return to Heidegger's argument in the conclusion to this essay. But first, to advance my own argument, I will concentrate on the principal flaw of dystopianism, the identification of technology in general with the specific technologies that have developed in the last century in the West. These are technologies of conquest that pretend to an unprecedented autonomy; their social sources and impacts are hidden. I will argue that this type of technology is a particular feature of our society and not a universal dimension of "modernity" as such.

III Technological Determinism

Determinism rests on the assumption that technologies have an autonomous functional logic that can be explained without reference to society. Technology is presumably social only through the purpose it serves, and purposes are in the mind of the beholder. Technology would thus resemble science and mathematics by its intrinsic independence of the social world.

Yet unlike science and mathematics, technology has immediate and powerful social impacts. It would seem

that society's fate is at least partially dependent on a non-social factor which influences it without suffering a reciprocal influence. This is what is meant by "technological determinism." Such a deterministic view of technology is commonplace in business and government, where it is often assumed that progress is an exogenous force influencing society rather than an expression of changes in culture and values.

The dystopian visions of modernity I have been describing are also deterministic. If we want to affirm the democratic potentialities of modern industrialism, we will therefore have to challenge their deterministic premises. These I will call the thesis of unilinear progress, and the thesis of determination by the base. Here is a brief summary of these two positions.

- (1) Technical progress appears to follow a unilinear course, a fixed track, from less to more advanced configurations. Although this conclusion seems obvious from a backward glance at the development of any familiar technical object, in fact it is based on two claims of unequal plausibility: first, that technical progress proceeds from lower to higher levels of development; and second, that that development follows a single sequence of necessary stages. As we will see, the first claim is independent of the second and not necessarily deterministic.
- (2) Technological determinism also affirms that social institutions must adapt to the "imperatives" of the technological base. This view, which no doubt has its source in a certain reading of Marx, is now part of the common sense of the social sciences.⁴ Below, I will discuss one of its implications in detail: the supposed "trade-off" between prosperity and environmental values.

These two theses of technological determinism present decontextualized, self-generating technology as the unique foundation of modern society. Determinism thus implies that our technology and its corresponding institutional structures are universal, indeed, planetary in scope. There may be many forms of tribal society, many feudalisms, even many forms of early capitalism, but there is only one modernity, and it is exemplified in our society for good or ill. Developing societies should take note: as Marx once said, calling the attention of his backward German compatriots to British advances: *De te fabula narratur* – of you the tale is told.⁵

IV Constructivism

The implications of determinism appear so obvious that it is surprising to discover that neither of its two theses can withstand close scrutiny. Yet contemporary sociology of technology undermines the first thesis of unilinear progress while historical precedents are unkind to the second thesis of determination by the base.

Recent constructivist sociology of technology grows out of new social studies of science. These studies challenge our tendency to exempt scientific theories from the sort of sociological examination to which we submit non-scientific beliefs. They affirm the "principle of symmetry," according to which all contending beliefs are subject to the same type of social explanation, regardless of their truth or falsity.⁶ A similar approach to technology rejects the usual assumption that technologies succeed on purely functional grounds.

Constructivism argues that theories and technologies are underdetermined by scientific and technical criteria. Concretely, this means two things: first, there is generally a surplus of workable solutions to any given problem, and social actors make the final choice among a batch of technically viable options; and second, the problem-definition often changes in the course of solution. The latter point is the more conclusive but also more difficult of the two.

Two sociologists of technology, Trevor Pinch and Wiebe Bijker, illustrate it with the early history of the bicycle.⁷ The object we take to be a self-evident "black box" actually started out as two very different devices, a sportsman's racer and a utilitarian transportation vehicle. The high front wheel of the sportsman's bike was necessary at the time to attain high speeds, but it also caused instability. Equal-sized wheels made for a safer but less exciting ride. These two designs met different needs and were in fact different technologies with many shared elements. Pinch and Bijker call this original ambiguity of the object designated as a "bicycle," "interpretative flexibility."

Eventually the "safety" design won out, and it benefited from all the later advances that occurred in the field. In retrospect, it seems as though the high-wheelers were a clumsy and less efficient stage in a progressive development leading through the old "safety" bicycle to current designs. In fact, the high-wheeler and the safety shared the field for years and neither was a stage in the other's development. The high-wheeler represents a possible alternative path of bicycle development that addressed different problems at the origin.

Determinism is a species of Whig history which makes it seem as though the end of the story was inevitable from the very beginning by projecting the abstract technical logic of the finished object back into the past as a cause of development. That approach confuses our understanding of the past and stifles the imagination of a different future. Constructivism can open up that future, although its practitioners have hesitated so far to engage the larger social issues implied in their method.⁸

V Indeterminism

If the thesis of unilinear progress falls, the collapse of the notion of determination by the technological base cannot be far behind. Yet it is still frequently invoked in contemporary political debates.

I shall return to these debates later in this essay. For now, let us consider the remarkable anticipation of current attitudes in the struggle over the length of the workday and child labor in mid- nineteenth-century England. The debate on the Factory Bill of 1844 is entirely structured around the deterministic opposition of technological imperatives and ideology. Lord Ashley, the chief advocate of regulation, protests in the name of familial ideology that “The tendency of the various improvements in machinery is to supersede the employment of adult males, and substitute in its place, the labour of children and females. What will be the effect on future generations, if their tender frames be subjected, without limitation or control, to such destructive agencies?”⁹

He went on to deplore the decline of the family consequent upon the employment of women, which “disturbs the order of nature,” and deprives children of proper upbringing. “It matters not whether it be prince or peasant, all that is best, all that is lasting in the character of a man, he has learnt at his mother’s knees.” Lord Ashley was outraged to find that “females not only perform the labour, but occupy the places of men; they are forming various clubs and associations, and gradually acquiring all those privileges which are held to be the proper portion of the male sex ... they meet together to drink, sing, and smoke; they use, it is stated, the lowest, most brutal, and most disgusting language imaginable”

Proposals to abolish child labor met with consternation on the part of factory owners, who regarded the little worker as an “imperative” of the technologies created to employ him. They denounced the “inefficiency” of using

full-grown workers to accomplish tasks done as well or better by children, and they predicted all the usual catastrophic economic consequences – increased poverty, unemployment, loss of international competitiveness – from the substitution of more costly adult labor. Their eloquent representative, Sir James Graham, therefore urged caution: “We have arrived at a state of society when without commerce and manufactures this great community cannot be maintained. Let us, as far as we can, mitigate the evils arising out of this highly artificial state of society; but let us take care to adopt no step that may be fatal to commerce and manufactures.”

He further explained that a reduction in the workday for women and children would conflict with the depreciation cycle of machinery and lead to lower wages and trade problems. He concluded that “in the close race of competition which our manufacturers are now running with foreign competitors ... such a step would be fatal ...” Regulation, he and his fellows maintained in words that echo still, is based on a “false principle of humanity, which in the end is certain to defeat itself.” One might almost believe that Ludd had risen again in the person of Lord Ashley: the issue is not really the length of the workday, “but it is in principle an argument to get rid of the whole system of factory labour.” Similar protestations are heard today on behalf of industries threatened with what they call environmental “Luddism.”

Yet what actually happened once the regulators succeeded in imposing limitations on the workday and expelling children from the factory? Did the violated imperatives of technology come back to haunt them? Not at all. Regulation led to an intensification of factory labor that was incompatible with the earlier conditions in any case. Children ceased to be workers and were redefined socially as learners and consumers. Consequently, they entered the labor market with higher levels of skill and discipline that were soon presupposed by technological design. As a result no one is nostalgic for a return to the good old days when inflation was held down by child labor. That is simply not an option (at least not in the developed capitalist world).

This example shows the tremendous flexibility of the technical system. It is not rigidly constraining but, on the contrary, can adapt to a variety of social demands. This conclusion should not be surprising given the responsiveness of technology to social redefinition discussed previously. It means that technology is just another dependent social variable, albeit an increasingly important one, and not the key to the riddle of history.

Determinism, I have argued, is characterized by the principles of unilinear progress and determination by the base; if determinism is wrong, then technology research must be guided by the following two contrary principles. In the first place, technological development is not unilinear but branches in many directions, and could reach generally higher levels along more than one different track. And, secondly, technological development is not determining for society but is overdetermined by both technical and social factors.

The political significance of this position should also be clear by now. In a society where determinism stands guard on the frontiers of democracy, indeterminism cannot but be political. If technology has many unexplored potentialities, no technological imperatives dictate the current social hierarchy. Rather, technology is a scene of social struggle, a “parliament of things,” on which civilizational alternatives contend.

VI Interpreting Technology

In the next sections of this essay, I would like to present several major themes of a non-determinist approach to technology. The picture sketched so far implies a significant change in our definition of technology. It can no longer be considered as a collection of devices, nor, more generally, as the sum of rational means. These are tendentious definitions that make technology seem more functional and less social than in fact it is.

As a social object, technology ought to be subject to interpretation like any other cultural artifact, but it is generally excluded from humanistic study. We are assured that its essence lies in a technically explainable function rather than a hermeneutically interpretable meaning. At most humanistic methods might illuminate extrinsic aspects of technology, such as packaging and advertising, or popular reactions to controversial innovations such as nuclear power or surrogate motherhood. Technological determinism draws its force from this attitude. If one ignores most of the connections between technology and society, it is no wonder that technology then appears to be self-generating.

Technical objects have two hermeneutic dimensions that I call their *social meaning* and their *cultural horizon*.¹⁰ The role of social meaning is clear in the case of the bicycle introduced above. We have seen that the construction of the bicycle was controlled in the first instance by a contest of interpretations: was it to be a

sportsman's toy or a means of transportation? Design features such as wheel size also served to signify it as one or another type of object.¹¹

It might be objected that this is merely an initial disagreement over goals with no hermeneutic significance. Once the object is stabilized, the engineer has the last word on its nature, and the humanist interpreter is out of luck. This is the view of most engineers and managers; they readily grasp the concept of “goal” but they have no place for “meaning.”

In fact the dichotomy of goal and meaning is a product of functionalist professional culture, which is itself rooted in the structure of the modern economy. The concept of “goal” strips technology bare of social contexts, focusing engineers and managers on just what they need to know to do their job.

A fuller picture is conveyed, however, by studying the social role of the technical object and the lifestyles it makes possible. That picture places the abstract notion of “goal” in its concrete social context. It makes technology's contextual causes and consequences visible rather than obscuring them behind an impoverished functionalism.

The functionalist point of view yields a decontextualized temporal cross-section in the life of the object. As we have seen, determinism claims implausibly to be able to get from one such momentary configuration of the object to the next on purely technical terms. But in the real world all sorts of unpredictable attitudes crystallize around technical objects and influence later design changes. The engineer may think these are extrinsic to the device he or she is working on, but they are its very substance as a historically evolving phenomenon.

These facts are recognized to a certain extent in the technical fields themselves, especially in computers. Here we have a contemporary version of the dilemma of the bicycle discussed above. Progress of a generalized sort in speed, power, and memory goes on apace while corporate planners struggle with the question of what it is all for.

Technical development does not point definitively toward any particular path. Instead, it opens branches, and the final determination of the “right” branch is not within the competence of engineering because it is simply not inscribed in the nature of the technology.

I have studied a particularly clear example of the complexity of the relation between the technical function and meaning of the computer in the case of French videotex.¹² Called *Téletel*, this system was designed to bring France into the Information Age by giving telephone subscribers access to databases. Fearing that consumers

would reject anything resembling office equipment, the telephone company attempted to redefine the computer's social image; it was no longer to appear as a calculating device for professionals but was to become an informational network for all.

The telephone company designed a new type of terminal, the *Minitel*, to look and feel like an adjunct to the domestic telephone. The telephonic disguise suggested to some users that they ought to be able to talk to each other on the network. Soon the *Minitel* underwent a further redefinition at the hands of these users, many of whom employed it primarily for anonymous on-line chatting with other users in the search for amusement, companionship, and sex.

Thus the design of the *Minitel* invited communications applications which the company's engineers had not intended when they set about improving the flow of information in French society. Those applications, in turn, connoted the *Minitel* as a means of personal encounter, the very opposite of the rationalistic project for which it was originally created. The "cold" computer became a "hot" new medium.

At issue in the transformation is not only the computer's narrowly conceived technical function, but the very nature of the advanced society it makes possible. Does networking open the doors to the Information Age where, as rational consumers hungry for data, we pursue strategies of optimization? Or is it a postmodern technology that emerges from the breakdown of institutional and sentimental stability, reflecting, in Lyotard's words, the "atomisation of society into flexible networks of language games?"¹³ In this case technology is not merely the servant of some predefined social purpose; it is an environment within which a way of life is elaborated.

In sum, differences in the way social groups interpret and use technical objects are not merely extrinsic but make a difference in the nature of the objects themselves. *What* the object *is* for the groups that ultimately decide its fate determines what it *becomes* as it is redesigned and improved over time. If this is true, then we can only understand technological development by studying the sociopolitical situation of the various groups involved in it.

VII Technological Hegemony

In addition to the sort of assumptions about individual technical objects we have been discussing so far, that situation also includes broader assumptions about social

values. This is where the study of the cultural horizon of technology comes in. This second hermeneutic dimension of technology is the basis of modern forms of social hegemony; it is particularly relevant to our original question concerning the inevitability of hierarchy in technological society.

As I will use the term, hegemony is a form of domination so deeply rooted in social life that it seems natural to those it dominates. One might also define it as that aspect of the distribution of social power which has the force of culture behind it.

The term "horizon" refers to culturally general assumptions that form the unquestioned background to every aspect of life.¹⁴ Some of these support the prevailing hegemony. For example, in feudal societies, the "chain of being" established hierarchy in the fabric of God's universe and protected the caste relations of the society from challenge. Under this horizon, peasants revolted in the name of the king, the only imaginable source of power. Rationalization is our modern horizon, and technological design is the key to its effectiveness as the basis of modern hegemonies.

Technological development is constrained by cultural norms originating in economics, ideology, religion, and tradition. We discussed earlier how assumptions about the age composition of the labor force entered into the design of nineteenth-century production technology. Such assumptions seem so natural and obvious they often lie below the threshold of conscious awareness.

This is the point of Herbert Marcuse's important critique of Weber.¹⁵ Marcuse shows that the concept of rationalization confounds the control of labor by management with control of nature by technology. The search for control of nature is generic, but management only arises against a specific social background, the capitalist wage system. Workers have no immediate interest in output in this system, unlike earlier forms of farm and craft labor, since their wage is not essentially linked to the income of the firm. Control of human beings becomes all-important in this context.

Through mechanization, some of the control functions are eventually transferred from human overseers and parcellized work practices to machines. Machine design is thus socially relative in a way that Weber never recognized, and the "technological rationality" it embodies is not universal but particular to capitalism. In fact, it is the horizon of all the existing industrial societies, communist as well as capitalist, insofar as they are managed from above. (In section X, I discuss a

generalized application of this approach in terms of what I call the “technical code.”)

If Marcuse is right, it ought to be possible to trace the impress of class relations in the very design of production technology, as has indeed been shown by such Marxist students of the labor process as Harry Braverman and David Noble.¹⁶ The assembly line offers a particularly clear instance because it achieves traditional management goals, such as deskilling and pacing work, through technical design. Its technologically enforced labor discipline increases productivity and profits by increasing control. However, the assembly line only appears as technical progress in a specific social context. It would not be perceived as an advance in an economy based on workers’ cooperatives in which labor discipline was more self-imposed than imposed from above. In such a society, a different technological rationality would dictate different ways of increasing productivity.¹⁷

This example shows that technological rationality is not merely a belief, an ideology, but is effectively incorporated into the structure of machines. Machine design mirrors back the social factors operative in the prevailing rationality. The fact that the argument for the social relativity of modern technology originated in a Marxist context has obscured its most radical implications. We are not dealing here with a mere critique of the property system, but have extended the force of that critique down into the technical “base.” This approach goes well beyond the old economic distinction between capitalism and socialism, market and plan. Instead, one arrives at a very different distinction between societies in which power rests on the technical mediation of social activities and those that democratize technical control and, correspondingly, technological design.

VIII Double Aspect Theory

The argument to this point might be summarized as a claim that social meaning and functional rationality are inextricably intertwined dimensions of technology. They are not ontologically distinct, for example, with meaning in the observer’s mind and rationality in the technology proper. Rather they are “double aspects” of the same underlying technical object, each aspect revealed by a specific contextualization.

Functional rationality, like scientific–technical rationality in general, isolates objects from their original context in order to incorporate them into theoretical or

functional systems. The institutions that support this procedure, such as laboratories and research centers, themselves form a special context with their own practices and links to various social agencies and powers. The notion of “pure” rationality arises when the work of decontextualization is not itself grasped as a social activity reflecting social interests.

Technologies are selected by these interests from among many possible configurations. Guiding the selection process are social codes established by the cultural and political struggles that define the horizon under which the technology will fall. Once introduced, technology offers a material validation of the cultural horizon to which it has been pre-formed. I call this the “bias” of technology: apparently neutral, functional rationality is enlisted in support of a hegemony. The more technology society employs, the more significant is this support.

As Foucault argues in his theory of “power/knowledge,” modern forms of oppression are not so much based on false ideologies as on the specific technical “truths” which form the basis of the dominant hegemony and which reproduce it.¹⁸ So long as the contingency of the choice of “truth” remains hidden, the deterministic image of a technically justified social order is projected.

The legitimating effectiveness of technology depends on unconsciousness of the cultural–political horizon under which it was designed. A recontextualizing critique of technology can uncover that horizon, demystify the illusion of technical necessity, and expose the relativity of the prevailing technical choices.

IX The Social Relativity of Efficiency

These issues appear with particular force in the environmental movement today. Many environmentalists argue for technical changes that would protect nature and, in the process, improve human life as well. Such changes would enhance efficiency in broad terms by reducing harmful and costly side effects of technology. However, this program is very difficult to impose in a capitalist society. There is a tendency to deflect criticism from technological processes to products and people, from a priori prevention to a posteriori clean-up. These preferred strategies are generally costly and reduce efficiency under the horizon of the given technology. This situation has political consequences.

Restoring the environment after it has been damaged is a form of collective consumption, financed by taxes or

higher prices. These approaches dominate public awareness. This is why environmentalism is generally perceived as a cost involving trade-offs, and not as a rationalization increasing overall efficiency. But in a modern society, obsessed by economic well-being, that perception is damning. Economists and businessmen are fond of explaining the price we must pay in inflation and unemployment for worshipping at Nature's shrine instead of Mammon's. Poverty awaits those who will not adjust their social and political expectations to technology.

This trade-off model has environmentalists grasping at straws for a strategy. Some hold out the pious hope that people will turn from economic to spiritual values in the face of the mounting problems of industrial society. Others expect enlightened dictators to impose technological reform even if a greedy populace shirks its duty. It is difficult to decide which of these solutions is more improbable, but both are incompatible with basic democratic values.¹⁹

The trade-off model confronts us with dilemmas – environmentally sound technology vs. prosperity, workers' satisfaction and control vs. productivity, etc. – where what we need are syntheses. Unless the problems of modern industrialism can be solved in ways that both enhance public welfare and win public support, there is little reason to hope that they will ever be solved. But how can technological reform be reconciled with prosperity when it places a variety of new limits on the economy?

The child labor case shows how apparent dilemmas arise on the boundaries of cultural change, specifically, where the social definition of major technologies is in transition. In such situations, social groups excluded from the original design network articulate their unrepresented interests politically. New values the outsiders believe would enhance their welfare appear as mere ideology to insiders who are adequately represented by the existing designs.

This is a difference of perspective, not of nature. Yet the illusion of essential conflict is renewed whenever major social changes affect technology. At first, satisfying the demands of new groups after the fact has visible costs and, if it is done clumsily, will indeed reduce efficiency until better designs are found. But usually, better designs can be found, and what appeared to be an insuperable barrier to growth dissolves in the face of technological change.

This situation indicates the essential difference between economic exchange and technique. Exchange

is all about trade-offs: more of A means less of B. But the aim of technical advance is precisely to avoid such dilemmas by elegant designs that optimize several variables at once. A single cleverly conceived mechanism may correspond to many different social demands, one structure to many functions.²⁰ Design is not a zero-sum economic game, but an ambivalent cultural process that serves a multiplicity of values and social groups without necessarily sacrificing efficiency.

X The Technical Code

That these conflicts over social control of technology are not new can be seen from the interesting case of the "bursting boilers."²¹ Steamboat boilers were the first technology regulated in the United States. In the early nineteenth century the steamboat was a major form of transportation similar to the automobile or airplane today. Steamboats were necessary in a big country without paved roads and lots of rivers and canals. But steamboats frequently blew up when the boilers weakened with age or were pushed too hard. After several particularly devastating accidents in 1816, the city of Philadelphia consulted with experts on how to design safer boilers, the first time an American governmental institution interested itself in the problem. In 1837, at the request of Congress, the Franklin Institute issued a detailed report and recommendations based on rigorous study of boiler construction. Congress was tempted to impose a safe boiler code on the industry, but boilermakers and steamboat owners resisted and government hesitated to interfere with private property.

It took from that first inquiry in 1816 to 1852 for Congress to pass effective laws regulating the construction of boilers. In that time 5,000 people were killed in accidents on steamboats. Is this many casualties or few? Consumers evidently were not too alarmed to continue traveling by riverboat in ever-increasing numbers. Understandably, the shipowners interpreted this as a vote of confidence and protested the excessive cost of safer designs. Yet politicians also won votes demanding safety.

The accident rate fell dramatically once technical changes such as thicker walls and safety valves were mandated. Legislation would hardly have been necessary to achieve this outcome had it been technically determined. But in fact boiler design was relative to a social judgment about safety. That judgment could have been made on

strictly market grounds, as the shippers wished, or politically, with differing technical results. In either case, those results *constitute* a proper boiler. What a boiler “is” was thus defined through a long process of political struggle culminating finally in uniform codes issued by the American Society of Mechanical Engineers.

This example shows just how technology adapts to social change. What I call the “technical code” of the object mediates the process. That code responds to the cultural horizon of the society at the level of technical design. Quite down-to-earth technical parameters such as the choice and processing of materials are *socially* specified by the code. The illusion of technical necessity arises from the fact that the code is thus literally “cast in iron,” at least in the case of boilers.²²

Conservative anti-regulatory social philosophies are based on this illusion. They forget that the design process always already incorporates standards of safety and environmental compatibility; similarly, all technologies support some basic level of user or worker initiative. A properly made technical object simply *must* meet these standards to be recognized as such. We do not treat conformity as an expensive add-on, but regard it as an intrinsic production cost. Raising the standards means altering the definition of the object, not paying a price for an alternative good or ideological value as the trade-off model holds.

But what of the much discussed cost/benefit ratio of design changes such as those mandated by environmental or other similar legislation? These calculations have some application to transitional situations, before technological advances responding to new values fundamentally alter the terms of the problem. But all too often, the results depend on economists’ very rough estimates of the monetary value of such things as a day of trout fishing or an asthma attack. If made without prejudice, these estimates may well help to prioritize policy alternatives. But one cannot legitimately generalize from such policy applications to a universal theory of the costs of regulation.

Such fetishism of efficiency ignores our ordinary understanding of the concept which alone is relevant to social decision-making. In that everyday sense, efficiency concerns the narrow range of values that economic actors routinely affect by their decisions. Unproblematic aspects of technology are not included. In theory one can decompose any technical object and account for each of its elements in terms of the goals it meets, whether it be safety, speed, reliability, etc., but in practice no one is interested in opening the “black box” to see what is inside.

For example, once the boiler code is established, such things as the thickness of a wall or the design of a safety valve appear as essential to the object. The cost of these features is not broken out as the specific “price” of safety and compared unfavorably with a more efficient but less secure version of the technology. Violating the code in order to lower costs is a crime, not a trade-off. And since all further progress takes place on the basis of the new safety standard, soon no one looks back to the good old days of cheaper, insecure designs.

Design standards are only controversial while they are in flux. Resolved conflicts over technology are quickly forgotten. Their outcomes, a welter of taken-for-granted technical and legal standards, are embodied in a stable code, and form the background against which economic actors manipulate the unstable portions of the environment in the pursuit of efficiency. The code is not varied in real-world economic calculations but treated as a fixed input.

Anticipating the stabilization of a new code, one can often ignore contemporary arguments that will soon be silenced by the emergence of a new horizon of efficiency calculations. This is what happened with boiler design and child labor; presumably, the current debates on environmentalism will have a similar history, and we will someday mock those who object to cleaner air as a “false principle of humanity” that violates technological imperatives.

Non-economic values intersect the economy in the technical code. The examples we are dealing with illustrate this point clearly. The legal standards that regulate workers’ economic activity have a significant impact on every aspect of their lives. In the child labor case, regulation helped to widen educational opportunities with consequences that are not primarily economic in character. In the riverboat case, Americans gradually chose high levels of security and boiler design came to reflect that choice. Ultimately, this was no trade-off of one good for another, but a non-economic decision about the value of human life and the responsibilities of government.

Technology is thus not merely a means to an end; technical design standards define major portions of the social environment, such as urban and built spaces, workplaces, medical activities and expectations, life patterns, and so on. The economic significance of technical change often pales beside its wider human implications in framing a way of life. In such cases, regulation defines the cultural framework *of the* economy; it is not an act *in* the economy.

XI Heidegger's "Essence" of Technology

The theory sketched here suggests the possibility of a general reform of technology. But dystopian critics object that the mere fact of pursuing efficiency or technical effectiveness already does inadmissible violence to human beings and nature. Universal functionalization destroys the integrity of all that is. As Heidegger argues, an "objectless" world of mere resources replaces a world of "things" treated with respect for their own sake as the gathering places of our manifold engagements with "being."²³

This critique gains force from the actual perils with which modern technology threatens the world today. But my suspicions are aroused by Heidegger's famous contrast between a dam on the Rhine and a Greek chalice. It would be difficult to find a more tendentious comparison. No doubt modern technology is immensely more destructive than any other. And Heidegger is right to argue that means are not truly neutral, that their substantive content affects society independent of the goals they serve.

But I have argued here that this content is not *essentially* destructive; rather, it is a matter of design and social insertion.

However, Heidegger rejects any merely social diagnosis of the ills of technological societies and claims that the source of their problems dates back at least to Plato, that modern societies merely realize a *telos* immanent in Western metaphysics from the beginning. His originality consists in pointing out that the ambition to control being is itself a way of being and hence subordinate at some deeper level to an ontological dispensation beyond human control. But the overall effect of his critique is to condemn human agency, at least in modern times, and to confuse essential differences between types of technological development.

Heidegger distinguishes between the *ontological* problem of technology, which can only be addressed by achieving what he calls "a free relation" to technology, and the merely *ontic* solutions proposed by reformers who wish to change technology itself. This distinction may have seemed more interesting in years gone by than it does today. In effect, Heidegger is asking for nothing more than a change in attitude toward the selfsame technical world. But that is an idealistic solution in the bad sense, and one which a generation of environmental action would seem decisively to refute.

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

Unfortunately, Heidegger's argument is developed at such a high level of abstraction he literally cannot discriminate between electricity and atom bombs, agricultural techniques and the Holocaust. In a 1949 lecture, he asserted: "Agriculture is now the mechanized food industry, in essence the same as the manufacturing of corpses in gas chambers and extermination camps, the same as the blockade and starvation of nations, the same as the production of hydrogen bombs."²⁴ All are merely different expressions of the identical enframing which we are called to transcend through the recovery of a deeper relation to being. And since Heidegger rejects technical regression while leaving no room for a better technological future, it is difficult to see in what that relation would consist beyond a mere change of attitude.

XII History or Metaphysics

Heidegger is perfectly aware that technical activity was not "metaphysical" in his sense until recently. He must therefore sharply distinguish modern technology from all earlier forms of technique, obscuring the many real connections and continuities. I would argue, on the contrary, that what is new about modern technology can only be understood against the background of the traditional technical world from which it developed. Furthermore, the saving potential of modern technology can only be realized by recapturing certain traditional features of technique. Perhaps this is why theories that treat modern technology as a unique phenomenon lead to such pessimistic conclusions.

Modern technology differs from earlier technical practices through significant shifts in emphasis rather than generically. There is nothing unprecedented in its chief features, such as the reduction of objects to raw materials, the use of precise measurement and plans, the technical control of some human beings by others, and large scales of operation. It is the centrality of these features that is new, and of course the consequences of that are truly without precedent.

What does a broader historical picture of technology show? The privileged dimensions of modern technology appear in a larger context that includes many currently subordinated features that were defining for it in former times. For example, until the generalization of Taylorism, technical life was essentially about the choice of a vocation. Technology was associated with a way of life, with specific forms of personal development, virtues, etc. Only the success of capitalist deskilling finally reduced these human dimensions of technique to marginal phenomena.

Similarly, modern management has replaced the traditional collegiality of the guilds with new forms of technical control. Just as vocational investment in work continues in certain exceptional settings, so collegiality survives in a few professional or cooperative workplaces. Numerous historical studies show that these older forms are not so much incompatible with the "essence" of technology as with capitalist economics. Given a different social context and a different path of technical development, it might be possible to recover these traditional technical values and organizational forms in new ways in a future evolution of modern technological society.

Technology is an elaborate complex of related activities that crystallizes around tool making and using in every society. Matters such as the transmission of techniques or the management of its natural consequences are not extrinsic to technology per se but are dimensions of it. When, in modern societies, it becomes advantageous to minimize these aspects of technology, that too is a way of accommodating it to a certain social demand, not the revelation of its pre-existing "essence." In so far as it makes sense to talk about an essence of technology at all, it must embrace the whole field revealed by historical study, and not only a few traits ethnocentrically privileged by our society.

There is an interesting text in which Heidegger shows us a jug "gathering" the contexts in which it was created

and functions. This image could be applied to technology as well, and in fact there is one brief passage in which Heidegger so interprets a highway bridge. Indeed, there is no reason why modern technology cannot also "gather" its multiple contexts, albeit with less romantic pathos than jugs and chalices. This is in fact one way of interpreting contemporary demands for such things as environmentally sound technology, applications of medical technology that respect human freedom and dignity, urban designs that create humane living spaces, production methods that protect workers' health and offer scope for their intelligence, and so on. What are these demands if not a call to reconstruct modern technology so that it gathers a wider range of contexts to itself rather than reducing its natural, human, and social environment to mere resources?

Heidegger would not take these alternatives very seriously because he reifies modern technology as something separate from society, as an inherently contextless force aiming at pure power. If this is the "essence" of technology, reform would be merely extrinsic. But at this point Heidegger's position converges with the very Prometheanism he rejects. Both depend on the narrow definition of technology that, at least since Bacon and Descartes, has emphasized its destiny to control the world to the exclusion of its equally essential contextual embeddedness. I believe that this definition reflects the capitalist environment in which modern technology first developed.

The exemplary modern master of technology is the entrepreneur, singlemindedly focused on production and profit. The enterprise is a radically decontextualized platform for action, without the traditional responsibilities for persons and places that went with technical power in the past. It is the autonomy of the enterprise that makes it possible to distinguish so sharply between intended and unintended consequences, between goals and contextual effects, and to ignore the latter.

The narrow focus of modern technology meets the needs of a particular hegemony; it is not a metaphysical condition. Under that hegemony technological design is unusually decontextualized and destructive. It is that hegemony that is called to account, not technology per se, when we point out that today technical means form an increasingly threatening life environment. It is that hegemony, as it has embodied itself in technology, that must be challenged in the struggle for technological reform.

XIII Democratic Rationalization

For generations faith in progress was supported by two widely held beliefs: that technical necessity dictates the path of development, and that the pursuit of efficiency provides a basis for identifying that path. I have argued here that both these beliefs are false, and that furthermore, they are ideologies employed to justify restrictions on opportunities to participate in the institutions of industrial society. I conclude that we can achieve a new type of technological society that can support a broader range of values. Democracy is one of the chief values a redesigned industrialism could better serve.

What does it mean to democratize technology? The problem is not primarily one of legal rights but of initiative and participation. Legal forms may eventually routinize claims that are asserted informally at first, but the forms will remain hollow unless they emerge from the experience and needs of individuals resisting a specifically technological hegemony.

That resistance takes many forms, from union struggles over health and safety in nuclear power plants to community struggles over toxic waste disposal, to political demands for regulation of reproductive technologies. These movements alert us to the need to take technological externalities into account and demand design changes responsive to the enlarged context revealed in that accounting.

Such technological controversies have become an inescapable feature of contemporary political life, laying out the parameters for official "technology assessment."²⁵ They prefigure the creation of a new public sphere embracing the technical background of social life, and a new style of rationalization that internalizes unaccounted costs borne by "nature," i.e., something or-body exploitable in the pursuit of profit. Here respect for nature is not antagonistic to technology but enhances efficiency in broad terms.

As these controversies become commonplace, surprising new forms of resistance and new types of demands emerge alongside them. Networking has given rise to one among many such innovative public reactions to technology. Individuals who are incorporated into new types of technical networks have learned to resist through the Net itself in order to influence the powers that control it. This is not a contest for wealth or administrative power, but a struggle to subvert the technical practices, procedures, and designs structuring everyday life.

The example of the Minitel can serve as a model of this new approach. In France, the computer was politicized as soon as the government attempted to introduce a highly rationalistic information system to the general public. Users "hacked" the network in which they were inserted and altered its functioning, introducing human communication on a vast scale where only the centralized distribution of information had been planned.

It is instructive to compare this case to the movements of AIDS patients.²⁶ Just as a rationalistic conception of the computer tends to occlude its communicative potentialities, so in medicine, caring functions have become mere side effects of treatment, which is itself understood in exclusively technical terms. Patients become objects of this technique, more or less "compliant" to management by physicians. The incorporation of thousands of incurably ill AIDS patients into this system destabilized it and exposed it to new challenges.

The key issue was access to experimental treatment. In effect, clinical research is one way in which a highly technologized medical system can care for those it cannot yet cure. But until quite recently access to medical experiments has been severely restricted by paternalistic concern for patients' welfare. AIDS patients were able to open up access because the networks of contagion in which they were caught were paralleled by social networks that were already mobilized around gay rights at the time the disease was first diagnosed.

Instead of participating in medicine individually as objects of a technical practice, they challenged it collectively and politically. They "hacked" the medical system and turned it to new purposes. Their struggle represents a counter-tendency to the technocratic organization of medicine, an attempt at a recovery of its symbolic dimension and caring functions.

As in the case of the Minitel, it is not obvious how to evaluate this challenge in terms of the customary concept of politics. Nor do these subtle struggles against the growth of silence in technological societies appear significant from the standpoint of the reactionary ideologies that contend noisily with capitalist modernism today. Yet the demand for communication these movements represent is so fundamental that it can serve as a touchstone for the adequacy of our concept of politics to the technological age.

These resistances, like the environmental movement, challenge the horizon of rationality under which technology is currently designed. Rationalization in our society responds to a particular definition of technology

as a means to the goal of profit and power. A broader understanding of technology suggests a very different notion of rationalization based on responsibility for the human and natural contexts of technical action. I call this “democratic rationalization” because it requires technological advances that can only be made in opposition to the dominant hegemony. It represents an alternative to both the ongoing celebration of technocracy triumphant and the gloomy Heideggerian counterclaim that “Only a God can save us” from technocultural disaster.²⁷

Is democratic rationalization in this sense socialist? There is certainly room for discussion of the connection between this new technological agenda and the old idea of socialism. I believe there is significant continuity. In socialist theory, workers’ lives and dignity stood for the larger contexts modern technology ignores. The destruction of their minds and bodies on the workplace was viewed as a contingent consequence of capitalist technical design. The implication that socialist societies might

design a very different technology under a different cultural horizon was perhaps given only lip service, but at least it was formulated as a goal.

We can make a similar argument today over a wider range of contexts in a broader variety of institutional settings with considerably more urgency. I am inclined to call such a position socialist and to hope that in time it can replace the image of socialism projected by the failed communist experiment.

More important than this terminological question is the substantive point I have been trying to make. Why has democracy not been extended to technically mediated domains of social life despite a century of struggles? Is it because technology excludes democracy, or because it has been used to suppress it? The weight of the argument supports the second conclusion. Technology can support more than one type of technological civilization, and may someday be incorporated into a more democratic society than ours.

Notes

This paper expands a presentation of my book, *Critical Theory of Technology* (New York: Oxford University Press, 1991), delivered at the American Philosophical Association, December 28, 1991, and first published in an earlier version in *Inquiry* 35/3–4 (1992).

- 1 See, for example, Joshua Cohen and Joel Rogers, *On Democracy: Toward a Transformation of American Society* (Harmondsworth: Penguin, 1983); Frank Cunningham, *Democratic Theory and Socialism* (Cambridge: Cambridge University Press, 1987).
- 2 Max Weber, *The Protestant Ethic and the Spirit of Capitalism*, T. Parsons, trans. (New York: Scribners, 1958), pp. 181–2.
- 3 Martin Heidegger, *The Question Concerning Technology*, W. Lovitt, trans. (New York: Harper & Row, 1977); Jacques Ellul, *The Technological Society*, J. Wilkinson, trans. (New York: Vintage, 1964).
- 4 Richard W. Miller, *Analyzing Marx: Morality, Power and History* (Princeton: Princeton University Press, 1984), pp. 188–95.
- 5 Karl Marx, *Capital* (New York: Modern Library, 1906), p. 13.
- 6 See, for example, David Bloor, *Knowledge and Social Imagery* (Chicago: University of Chicago Press, 1991), pp. 175–9. For a general presentation of constructivism, see Bruno Latour, *Science in Action* (Cambridge, Mass.: Harvard University Press, 1987).
- 7 Trevor Pinch and Wiebe Bijker, “The Social Construction of Facts and Artefacts: or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other,” *Social Studies of Science* 14 (1984).
- 8 See Langdon Winner’s blistering critique of the characteristic limitations of the position, “Upon Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology,” *The Technology of Discovery and the Discovery of Technology: Proceedings of the Sixth International Conference of the Society for Philosophy and Technology* (Blacksburg, Va.: Society for Philosophy and Technology, 1991).
- 9 *Hansard’s Debates, Third Series: Parliamentary Debates 1830–1891*, vol. LXXIII, 1844 (Feb. 22–Apr. 22). The quoted passages are found between pp. 1088 and 1123.
- 10 A useful starting point for the development of a hermeneutics of technology is offered by Paul Ricoeur, “The Model of the Text: Meaningful Action Considered as a Text,” in P. Rabinow and W. Sullivan, eds., *Interpretive Social Science: A Reader* (Berkeley: University of California Press, 1979).
- 11 Michel de Certeau used the phrase “rhetorics of technology” to refer to the representations and practices that contextualize technologies and assign them a social meaning. De Certeau chose the term “rhetoric” because that meaning is not simply present at hand but communicates a content that can be articulated by studying the connotations technology evokes. See the special issue of *Traverse* 26 (October, 1982), entitled *Les Rhétoriques de la Technologie*, and, in that issue, especially Marc Guillaume’s article, “*Téléspectres*,” pp. 22–3.
- 12 See chapter 7, “From Information to Communication: The French Experience with Videotex,” in Andrew

- Feenberg, *Alternative Modernity* (Berkeley and Los Angeles: University of California Press, 1995).
- 13 Jean-François Lyotard, *La Condition Postmoderne* (Paris: Editions de Minuit, 1979), p. 34.
 - 14 For an approach to social theory based on this notion (called, however, *doxa* by the author), see Pierre Bourdieu, *Outline of a Theory of Practice*, R. Nice, trans. (Cambridge: Cambridge University Press, 1977), pp. 164–70.
 - 15 Herbert Marcuse, “Industrialization and Capitalism in the Work of Marx Weber,” in *Negations*, J. Shapiro, trans. (Boston: Beacon Press, 1968).
 - 16 Harry Braverman, *Labor and Monopoly Capital* (New York: Monthly Review Press, 1974); David Noble, *Forces of Production* (New York: Oxford University Press, 1984).
 - 17 Bernard Gendron and Nancy Holstrom, “Marx, Machinery and Alienation,” *Research in Philosophy and Technology* 2 (1979).
 - 18 Foucault’s most persuasive presentation of this view is *Surveiller et Punir* (Paris: Gallimard, 1975).
 - 19 See, for example, Robert Heilbroner, *An Inquiry into the Human Prospect* (New York: Norton, 1975). For a review of these issues in some of their earliest formulations, see Andrew Feenberg, “Beyond the Politics of Survival,” *Theory and Society* 7 (1979).
 - 20 This aspect of technology, called “concretization,” is explained in Gilbert Simondon, *Du Mode d’Existence des Objets Techniques* (Paris: Aubier, 1958), chap. 1.
 - 21 John G. Burke, “Bursting Boilers and the Federal Power,” in M. Kranzberg and W. Davenport, eds., *Technology and Culture* (New York: New American Library, 1972).
 - 22 The technical code expresses the “standpoint” of the dominant social groups at the level of design and engineering. It is thus relative to a social position without for that matter being a mere ideology or psychological disposition. As I will argue in the last section of this essay, struggle for sociotechnical change can emerge from the subordinated standpoints of those dominated within technological systems. For more on the concept of standpoint epistemology, see Sandra Harding, *Whose Science? Whose Knowledge?* (Ithaca: Cornell University Press, 1991)
 - 23 The texts by Heidegger discussed here are, in order, “The Question Concerning Technology,” *op. cit.*; “The Thing,” and “Building Dwelling Thinking” in *Poetry, Language, Thought*, A. Hofstadter, trans. (New York: Harper & Row, 1971).
 - 24 Quoted in T. Rockmore, *On Heidegger’s Nazism and Philosophy* (Berkeley: University of California Press, 1992 p. 241.
 - 25 Alberto Cambrosio and Camille Limoges, “Controversies as Governing Processes in Technology Assessment,” *Technology Analysis & Strategic Management* 3/4 (1991).
 - 26 For more on the problem of AIDS in this context, see Andrew Feenberg, “On Being a Human Subject: Interest and Obligation in the Experimental Treatment of Incurable Disease,” *The Philosophical Forum* 23/3 (1992).
 - 27 “Only a God Can Save Us Now,” Martin Heidegger interviewed in *Der Spiegel*, D. Schendler, trans. *Graduate Philosophy Journal* 6/1 (1977).