V. Dusek

Introduction

As philosophy goes, philosophy of technology is a relatively young field. Courses called "History of Modern Philosophy" cover philosophers of the Renaissance and the seventeenth and the eighteenth centuries. Philosophy of the early twentieth century is covered in "Contemporary Philosophy." The main branches of philosophy go back over 2200 years. Philosophy of science was pursued, in fact if not in name, by most of the early modern philosophers in the seventeenth and eighteenth centuries. By the mid-nineteenth century several physicists and philosophers were producing works that focused solely on the philosophy of science. Only sporadically were there major philosophers who had much to say about technology, such as Bacon around 1600 and Marx in the mid-nineteenth century. Most of the "great philosophers" of this period, although they had a great deal to say about science, said little about technology. On the assumption that technology is the simple application of science, and that technology is all for the good, most philosophers thought that there was little of interest. The "action" in early modern philosophy was around the issue of scientific knowledge, not technology. The romantic tradition from the late eighteenth century was pessimistic about science and technology. Romantics emphasized their problematic and harmful aspects, and only a handful of academic philosophers concerned themselves with evaluation and critique of technology itself. Particularly in Germany, there was a pessimistic literature on the evils of modern society in general and technological society in particular. We shall examine at length several of the twentieth-century inheritors of this tradition. In the English-speaking countries, with the exception of romantic poets such as Wordsworth and mid-nineteenth-century culture critics such as Carlyle, Matthew Arnold, and Ruskin, or the socialist artist William

Morris, few had much to say about the evaluation of technology. Only with Hiroshima and Nagasaki, and the realization that atom and hydrogen bombs could literally cause humanity to go extinct, did widespread, popular, critical evaluation of technology occur in the English-speaking world. With the widespread popular awareness that industrial pollution and its degradation of the environment was a major problem, perhaps dated from the publication of Rachel Carson's *Silent Spring* in 1962, or from Earth Day of 1970, a further wave of concern for the understanding of the negative side-effects of technology arose. With the advent of genetic engineering and the specter of human cloning in the late 1970s, with the possibility of technologically manipulating human heredity and even human nature, there was yet another set of issues and impulses for the critical evaluation of technology.

The Society for the Philosophy of Technology was founded in 1976, thousands of years after the birth of philosophy, over three centuries after the beginning of intensive examination of the nature of scientific knowledge, and about a century after the beginnings of systematic philosophy of science.

Not only was the philosophy of technology late in coming of age, but the field itself is hardly consolidated even now. One of the problems is that the philosophy of technology involves the intimate interaction of a number of different fields of knowledge: philosophy of science, political and social philosophy, ethics, and some aesthetics and philosophy of religion. Specialists in ethics and political philosophy have rarely been deeply involved in the philosophy of science and vice versa. Furthermore, the philosophy of technology ideally involves knowledge of science, technology, society, politics, history, and anthropology. One philosopher of technology, Jacques Ellul, even claims that since no one can master all of the relevant fields, no one can direct or deflect technology (see chapter 6).

The topics of the philosophy of technology are varied. In this book there is discussion of the relation of philosophy of science and its recent developments to the philosophy of technology (chapter 1). There is a brief discussion of the nature of definition and various proposed definitions of technology (chapter 2). The theme of technocracy, or rule by an elite of scientists and technologists, is presented in chapter 3, and also used as a means to discuss some of the historical philosophies of technology (such as those of Plato, Bacon, Marx, St Simon, and Comte). The issue of technological rationality and rationality in general is discussed in chapter 4. A variety of characterizations of and approaches to rationality are considered: formal rationality, instrumental (or means–end) rationality, economic rationality, transcendental

rationality, and dialectical rationality, among others. Risk/benefit analysis, a form of formal rationality, closely related to mathematical economics, and often used to evaluate technological projects, is presented and evaluated.

Next, approaches to philosophy of technology very different from the logical, formal economic, and analytical approaches are examined. Phenomenology, involving qualitative description of concrete experience, and hermeneutics, involving interpretation of texts in general, are presented in chapter 5. Several philosophers of technology who have applied phenomenology and hermeneutics to fields such as technical instrumentation and computers are discussed.

A complex of issues involving the influence of technology on society and culture are treated in chapters 6 and 7. Technological determinism, the view that technological changes cause changes in the rest of society and culture, and autonomous technology, the view that technology grows with a logic of its own out of human control, are discussed and evaluated.

Chapter 8 describes the debates concerning whether technology is what distinguishes humans from other animals, and whether language or technology is most characteristic of humans.

Chapters 9 and 10 discuss groups of people who have often been excluded from mainstream accounts of the nature and development of technology. Women, despite their use of household technology and their widespread employment in factories and in the telecommunications industry, were often omitted from general accounts of technology. These accounts often focus on the male inventors and builders of large technological projects. This is true even of some of the best and most dramatic contemporary accounts (Thompson, 2004). Women inventors, women in manufacturing, and the burden of household work are often downplayed. Similarly, non-Western technology is often shunted aside in mainstream Western surveys of technology. The contributions of the Arabs, Chinese, South Asians, and Native Americans to the development of Western technology are often ignored. The power and value of the local knowledge of non-literate, indigenous peoples of the Americas, Africa, and the South Pacific is also often ignored. However, ethno-science and technology raise issues about the role of rationality in technology and the nature of technology itself.

There is also a powerful traditional critical of technology, at least since the romantic era of the late 1700s. In contrast to the dominant beliefs about progress and the unalloyed benefits of technology, the Romantic Movement celebrated wild nature and criticized the ugliness and pollution of the industrial cities. With the growth of scientific ecology in the late nineteenth and early twentieth centuries, a new dimension of scientifically based criticism of pollution was added to the general preference for wild nature over technology. After 1970 the political ecology movement, especially in Germany and the USA, became a mass movement of criticism and even rejection of technology. Even the early nineteenth-century Luddite notion of machine smashing was revived.

Finally, in the late twentieth century the social construction of technology became a major component of the sociology and philosophy of technology. This approach opposes and criticizes technological determinism and autonomous technology theories that claimed to show that technology was following a predetermined course with a logic of its own. Instead, it is claimed that there is a great deal of contingency in the development of technology. Many interest groups have input into the final form of a given technology, and the apparent necessity of the paths of technological development is an illusion.

Because of this late beginning and the overlapping knowledge requirements of the field of philosophy of technology, it is one in which it is difficult to get initial orientation. On the one hand, there is a large, but largely superficial, literature of after-dinner speeches about "Technology and Man," written mainly by technologists and policy-makers. On the other hand, there is a highly convoluted and obscure European literature presupposing some of the most difficult and obscure philosophers (such as Hegel, Marx, and Heidegger). This continental European philosophy of technology does attempt to grapple with the place of technology in history. It is grand and ambitious, but often obscure and obtuse. Certainly the German Martin Heidegger and his students such as Arendt and Marcuse, the critical theorists of the Frankfurt school, and the French theorist of technology out of control, Jacques Ellul, are all notorious for the difficulty and obscurity of their prose. That obscurity is not solely the province of European writers is shown by the stimulating but often hopelessly muddled prose of the Canadian theorist of the media, Marshall McLuhan. Lewis Mumford, the American freelance architecture and city planning critic and theorist of technology, is readable, but at times long-winded.

Not only are major European figures (such as Heidegger, Arendt, and Ellul), whom Don Ihde has called the "grandfathers" of the field, difficult to read, there is a further complication in that many other schools of twentieth-century philosophy have contributed to the philosophy of technology. Anglo-American linguistic and analytic philosophy of science has contributed. Besides the various European schools of philosophy (neo-Marxism,

European phenomenology and existentialism, and hermeneutics), American pragmatism and Anglo-American process philosophy have also supplied frameworks for writers on technology. (Early twentieth-century process philosophy, widely rejected by mainstream analytical philosophers, has undergone a revival among those often dubbed "postmodern" philosophers of technology, such as Bruno Latour and Paul Virilio, via the French postmodernist Deleuze. Anglo-American social constructivist sociologist of science Andrew Pickering, for instance, has become interested in Whitehead via this French revival.)

One of the goals of this book is to introduce to the beginning student the various philosophical approaches that lie behind different takes on the philosophy of technology. Analytic philosophy of science and ethics, phenomenology, existentialism, hermeneutics, process philosophy, pragmatism, and social constructivism and postmodernism are some of the philosophical approaches that we shall examine. There are chapters on phenomenology and hermeneutics, on social constructionism and actor-network theory, and on Anglo-American philosophy of science. There are also boxes inset in various chapters about aspects of the philosophy of Martin Heidegger, about process philosophy, and about postmodernism. It is hoped these will help to orient the student in a field in which such a variety of approaches and philosophical vocabularies have been deployed.

Despite the variety and difficulty of the literature of the field, there is also promise of further research in the philosophy of technology. Various often compartmentalized branches of philosophy, such as philosophy of science and political philosophy, as well as competing and often non-communicating schools of philosophy, such as those mentioned above, may become combined and synthesized through their use in the philosophy of technology.

I hope that the reader will find this work a guide to the many fascinating topics and approaches that this field encompasses.

Note: throughout the book, technical terms and names of persons that I think are particularly important for readers to know are presented in **bold** type.

2

V. Durek

What Is Technology? Defining or Characterizing Technology

Why Bother with Definitions?

Many students, in my experience, especially in the natural sciences, are impatient with disputes about definitions. They are often called "merely semantic" and may seem hairsplitting. Indeed, they are semantic, in that they deal with meaning, but they are hardly trivial. Many apparently substantive disagreements really stem from the disputants having two different definitions of what is being discussed, say religion, but not being aware of it. Often people think that definitions are purely arbitrary; it means that effort need not be wasted on choosing among opposing or alternative definitions. This is itself based on one view of definition, but it is not the only one. We shall learn something about philosophy by seeing the different sorts of definitions that people have used and their connection to differing philosophical views.

Looking at the alternative definitions of technology shows something about the alternative kinds of definition and also about the characterization of technology. Even if one doesn't find a final definition on which everyone can agree, an investigation of the definition of technology shows us the range of things that can count as technology and some of the borderline cases where people differ on whether something should be counted as technology or not. Even an unsuccessful search for a best definition helps us to explore the layout of the area we are investigating.

Kinds of Definitions

Let us look at a few different sorts of definitions. At one extreme is the ancient notion of a **real definition**. The ancient Greek philosophers Socrates

(470–399 BCE), his student Plato (428–347 BCE), and his student, in turn, Aristotle (384–322 BCE) held to this notion of definition. This view assumes that there is a real structure to the world that corresponds to our words and that a correct definition will match the real nature of things. Socrates went about questioning people about the definition of notions such as justice, courage, or piety and showed the people he questioned how their definitions failed to fit with their notions. Socrates appeared to assume and Plato argued that there is a real nature or structure of justice, of courage, and of piety and that the real definition will fit this. Aristotle claimed that objects have essences and that real definitions will match these. Real definitions of the sort that Plato and Aristotle sought are supposed to "cut nature at the joints"; that is, correspond to the "natural kinds" of things. Some contemporary thinkers view scientific definitions, such as definitions of the chemical elements in terms of atomic weight and number, as true definitions in this sense. Some recent writers in technology studies claim that leading writers on technology in the twentieth century, such as Martin Heidegger (1889–1976) and Jacques Ellul (1912–94), are mistakenly searching for an "essence" of technology. Heidegger, in fact, rejected the traditional account of forms and categories of Plato and Aristotle. Nevertheless, it is true that Heidegger and Ellul do present what they claim is a single, real, core notion of technology.

A different, nearly opposite, view of definitions is that of **stipulative definitions**. This conception is closer to the view of definitions held by many people today. It is claimed that definitions are arbitrary choices or stipulations. Definitions are about words and not things. Opponents of the notion of real definitions deny that there are natural classes or real natures of things to be captured by definitions.

Definitions, on the nominalist view, arbitrarily carve up the world of individuals into classes of things. One can define anything as anything one wishes. Lewis Carroll (1832–1898), who was a logician as well as a writer of children's books, had Humpty Dumpty hold this view of definitions. Humpty claimed it was a matter of who was master, he or the words. But as some of Humpty's definitions showed, we cannot sensibly define things in absolutely any way we want. We cannot define religion as a coffee pot and expect to make progress investigating the features of religion. In purely formal systems of abstract math or logic, stipulative definitions make more sense than in common sense or everyday discussions. In an abstract system of math one can lay down a definition and carry it through the system by exact rules of inference. One can use stipulative definitions for the purposes of argument or for a very limited investigation of everyday concepts, but one problem

Box 2.1

Nominalism in British philosophy

Nominalists in the late Middle Ages, such as William of Ockham (1285–1347), denied the reality of essences or universals and claimed that only individuals are real. British philosophers of the seventeenth and eighteenth centuries, in the early days of experimental science, held that there were no real definitions. Thomas Hobbes (1588–1679) claimed that definitions are stipulative, even though he thought he could base science on them. In the seventeenth century, Hobbes successfully described the definitional or postulational side of science, but he failed to explain how he tied his definitional and deductive notion of science to observation. For Hobbes, definitions are introduced at the start of an investigation, they are not, as they were for Aristotle, the final result of investigation. John Locke (1632–1704) claimed that we cannot know the real essences of substances. Definitions do not describe essential properties of things or even whether the things defined exist. We can know only nominal essences of substances. In the early eighteenth century David Hume (1711–76) totally denied the existence of real essences, and his position was highly influential upon later empiricism.

with using stipulative definitions in everyday reasoning is that the ordinary meaning of commonly used words sneaks back into the discussion without the author noticing. She slides from her stipulative definition to the ordinary meaning unaware. Writers on technology are, of course, free to define it any way they wish, but they then need to be careful they do not slip back into using other definitions or understandings of technology common in the culture without realizing they have strayed from their original definition.

This leads us to another sort of definition different from both the above, the **reportative definition**. This sort of definition is a report of how people ordinarily use words. It doesn't claim to find the true structure of reality, but it also doesn't simply make up an arbitrary definition by fiat. Dictionary definitions are close to reportative definitions. However, a purely reportative definition would simply describe how people use the word, without legislating "proper" usage. Dictionary definitions contain some normative content. A pure reportative definition could be quite complicated, describing how people in different regions or of different social status use the word. Reportative definitions often have fuzzy boundaries or vagueness of application. Ordinary

language is frequently imprecise as to exactly what objects count as falling under the definition. The problem with using reportative definitions of technology is that there are so many different uses of the term around. For instance, some educators associate the word "technology" solely with computers in the classroom, while the school building itself, as well as such older aids to teaching as the blackboard, are part of technology in the broadest sense.

A kind of definition used in philosophy and in other academic areas is a **précising definition**. This sort of definition retains the core ordinary meaning of the word. It is not stipulative or arbitrary. However, unlike a reportative definition it does not simply describe how people actually use the word. It attempts to sharpen up the boundaries of application of the word by describing the range of application and cut-off points. (How big is "big" for a certain kind of thing? How few hairs can one have and still be counted as bald?) Any philosophical attempt at a general definition of technology will be a précising definition.

British empiricist philosophers rejected the existence of essences as real natures of things, but the notion of definition by single defining characteristic continued in general use. In the second half of the twentieth century a number of philosophers concluded that kinds of entities couldn't be characterized by an essence. One view (of Ludwig Wittgenstein, 1889–1951) is that objects classified under a single name do not share any one single characteristic but share a "family resemblance." One can often recognize similarities between members of the same human family but cannot find any single feature that they all share. Any pair of things in the class shares some characteristics but no one characteristic is shared by all of them. Wittgenstein gave the example of the notion of "game." The usual characteristics used to define a game are not shared by every game. Not all games have competing players. Not all games have hard and fast rules, involve equipment or game pieces, and so forth. A game is best defined according to the family resemblance approach by giving paradigmatic examples and suggesting that similar things should also be included. Some contemporary philosophers present views that would make technology an example of a family resemblance concept. Current philosophers of technology such as Don Ihde, Donna Haraway, Andrew Feenberg, and others have ceased searching for an "essence of technology" of the sort propounded by early or mid-twentieth-century thinkers such as Martin Heidegger (see chapter 5) or Jacques Ellul (see below in this chapter, and chapter 7). It is suggested that the things that are included under technology are too varied and diverse to share a single essence.

As mentioned above, the major theorists of technology of the first two-thirds of the twentieth century believed that a universal, essential definition of technology could be given. A number of recent theorists, such as Don Ihde, Andrew Feenberg, and others, believe, in contrast, that there is not an essence or single defining characteristic of technology, and that searching for an essential definition is unproductive.

Guidelines for Definitions

Some general guidelines for definition are the following:

1 A definition should not be too broad or narrow. (That is, the definition should not include things we would not designate by the word we are defining, and the definition should not be so restricted as to exclude things that should fall under the term defined.)
2 A definition should not be circular. (For instance, we shouldn't define "technology" as "anything technological" and then define "technological" as "anything pertaining to technology.")
3 A definition should not use figurative language or metaphors.
4 A definition should not be solely negative but should be in positive terms. (A purely negative definition in most cases would not sufficiently limit the range of application of the term. A definition by contrast has to assume that the hearer knows the contrasting or opposite term.)

Box 2.2

Philosophical exceptions to the standard rules for definition

The rough guidelines for definitions will have exceptions if one holds certain non-commonsensical philosophical views. For example, some mystics believe God can be characterized only negatively, and hold to so-called "negative theology." Although a simply circular definition is completely unhelpful, it has been pointed out that if one follows out the definitions in a dictionary, looking up the words in the definition, one eventually goes in a circle, although it is a big circle. Some philosophers, such as Hegel, have suggested that the point is not to avoid circularity but to make the circle big enough to encompass everything!

An example of defining technology in a too narrow manner is the common contemporary tendency to mean by "technology" solely computers and cell phones, leaving out all of machine technology, let alone other technology. A case of defining technology in a manner that may be too broad is B. F. Skinner's inclusion of all human activity in technology. Skinner understands human activity as being conditioned and self-conditioning. For Skinner conditioning is considered to be behavioral technology. A related move is the general inclusion of "psychological technology" as part of the motivational apparatus of technological activities, such as chanting in hunter-gatherer societies, or various political beliefs in industrial societies (propagated by propaganda, understood as a kind of technology by Ellul), thereby erasing the distinction between technology and culture by including *all* of culture within technology (see below on Jarvie).

Definitions of Technology

Three definitions or characterizations of technology are: (a) technology as hardware; (b) technology as rules; and (c) technology as system.

Technology as hardware

Probably the most obvious definition of technology is as tools and machines. Generally the imagery used to illustrate a brochure or flier on technology is that of things such as rockets, power plants, computers, and factories. The understanding of technology as tools or machines is concrete and easily graspable. It lies behind much discussion of technology even when not made explicit. (Lewis Mumford (1895–1990) made a distinction between tools and machines in which the user directly manipulates tools, while machines are more independent of the skill of the user.)

One problem for the definition of technology as tools or machines is cases where technology is claimed not to use either tools or machines. One such non-hardware technology is the behavioral technology of the psychologist B. F. Skinner (1904–90). If one considers verbal or interpersonal manipulation or direction of the behavior of another as technology then it appears we have technology without tools. Mumford claims that the earliest "machine" in human history was the organization of large numbers of people for manual labor in moving earth for dams or irrigation projects in the earliest civilizations, such as Egypt, ancient Sumer in Iraq, or ancient China. Mumford calls this mass organized labor "the megamachine" (Mumford, 1966). Jacques Ellul considers patterns of rule-following behavior or "technique" to be the essence of technology. Thus, propaganda and sex manuals will be technology involving rules, and can, but need not always, involve use of tools or hardware.

Technology as rules

Ellul's "technique" mentioned above is a prime example of another definition of technology. This treats technology as rules rather than tools. "Software" versus "hardware" would be another way to characterize the difference in emphasis. Technology involves patterns of means–end relationships. The psychological technology of Skinner, the tool-less megamachine of Mumford, or the "techniques" of Ellul are not problems for this approach to technology. The sociologist Max Weber (1864–1920), with his emphasis on "rationalization," resembles Ellul on this, characterizing the rise of the West in terms of rule-governed systems, whether in science, law, or bureaucracy. Physical tools or machinery are not what is central; instead it is the means–end patterns systematically developed.

Technology as system

It is not clear that hardware outside of human context of use and understanding really functions as technology. Here are some examples:

1 An airplane (perhaps crashed or abandoned) sitting deserted in the rain forest will not function as technology. It might be treated as a religious object by members of a "cargo cult" in the Pacific. The cargo cults arose when US planes during the Second World War dropped huge amounts of goods on Pacific islands and cults awaited the return of the big "birds."
2 The Shah of Iran during the 1960s attempted to forcibly modernize the country. He used the oil wealth to import high technology such as jet planes and computers, but lacked sufficient numbers of operators and service personnel. It has been claimed that airplanes and mainframe computers sat outside, accumulating sand and dust or rusting, as housing for storage and the operating and repair staffs for them were not made available. The machinery did not *function* as technology.
3 Technological hardware not functioning as technology is not solely the province of indigenous societies or developing nations, but can also be

present in a milieu of high tech, urban sophisticates. Non-Western technology was displayed in an exhibit of "Primitive [*sic*] and Modern Art" at the Museum of Modern Art as purely aesthetic or artistic phenomena. Indigenous implements and twentieth-century Western abstract art objects were exhibited side by side to emphasize similarity of shape and design. The labels of the primitive implements often did not explain their use, only their place and date. (The use of these devices for cooking, navigation, and other purposes was not explained in the captions.) In some cases neither the museum visitors nor even the curators knew the technological function of the objects. Therefore, although the artifacts were simultaneously both technology and art for their original users, they were not technology, but solely art, for the curators and viewers of the museum exhibit.

These examples suggest that for an artifact or piece of hardware to be technology, it needs to be set in the context of people who use it, maintain it, and repair it. This gives rise to the notion of a **technological system** that includes hardware as well as the human skills and organization that are needed to operate and maintain it (see consensus definition below).

Technology as Applied Science

Much of *contemporary* technology is applied science. However, to *define* technology simply as **applied science** is misleading both historically and systematically. If one understands science in the sense of the combination of controlled experiment with mathematical laws of nature, then science is only some four hundred years old. Even the ancient Greeks who had mathematical descriptions of nature and observation did not have controlled experiment. The medieval Chinese had highly developed technology (see chapter 10) and a rich fund of observation and theory about nature, but had neither the notion of laws of nature nor controlled experiment. Technology in some form or other goes back to the stone tools of the earliest humans millions of years ago. Clearly, with this understanding of science and technology, through most of human history, technology was not applied science. Part of the issue is how broadly one defines science. If one means by science simply trial and error (as some pragmatists and generalizers of Popper's notion of conjecture and refutation have claimed; Campbell, 1974), then prehistoric technology could be treated as applied science. However, now the notion of science has been tremendously broadened to include virtually all human learning, indeed all animal learning, if one holds a trial and error theory of learning. Perhaps this is an example of a definition of science that is too broad.

Even after the rise of early modern experimental science and the notion of scientific laws in the seventeenth century, and the development of the technology that contributed to the industrial revolution, most technological development did not arise from the direct application of the science of Galileo (1564–1642) and Newton (1642–1727). The inventors of the seventeenth and eighteenth centuries usually did not know the theories of mathematical physics of their day, but were tinkerers and practical people who found solutions to practical problems without using the science of their day. Even as late as Thomas Edison (1847–1931) we find a tremendously productive inventor in the field of electricity who did not know the electromagnetic theory of James Clerk Maxwell (1831–79) and his followers, but who produced far more inventions than those scientists who did know the most advanced electrical field theories. Edison initially even disparaged the need for a physicist as part of his First World War team, thinking one needed a physicist only to do complicated numerical computations, but that a physicist would have nothing much to contribute to technology. By this time Edison's view of the role of theory was getting somewhat dated.

Even in the contemporary situation, in which scientific training is essential for most technological invention, the notion of technology as applied science, if taken in too simple and straightforward a way, is misleading. Modern technology is pursued primarily by those with a scientific background and within the framework of modern science, but many of the specific inventions are products of chance or of trial and error, not a direct application of scientific theory to achieve a pre-assumed goal. Many chemical discoveries have been results of accidents. Safety glass was discovered when a chemical solution was spilled on a piece of glass laboratory apparatus, the glass was accidentally dropped, and it did not break. Penicillin was discovered when a bacterial culture was accidentally contaminated by a mold. Paper chromatography was discovered when a scientist accidentally spilled some chemical on a filter paper, and the chemical separated into two components as it seeped up the paper. The Post-it was discovered when a technologist, Art Fry, using little bookmarks in his hymnal, remembered a temporary glue that a colleague, Spencer Silver, had developed back in 1968 that was too weak to permanently stick two pieces of paper together. In 1977–9 3M began to market the invention, and by 1980 it was sold throughout the USA. Charles Goodyear's development of vulcanization of rubber

involved numerous trials and experiments, but one crucial event involved him accidentally leaving his treated "gum elastic" on a hot stove, and noticing that it charred like leather. He then experimented to find a lesser, but optimum, heat of exposure (Goodyear, 1855). Louis Pasteur (1822–95) famously said that chance favors the prepared mind. The development of these accidental discoveries made much use of the scientific knowledge of the people who made them. But the discoveries were hardly the straightforward application of scientific theory to a preset problem.

For these reasons, although technology involves knowledge, particularly know-how, a definition of technology that characterizes it simply as applied science is too narrow.

Systems Definition as a Consensus Definition of Technology

A number of writers have formulated a somewhat complex definition of technology to incorporate the notion of a technological system. The economist John Kenneth Galbraith (1908–2004) defined technology as "the systematic application of scientific or other knowledge to practical tasks" (Galbraith, 1967, chapter 2). Galbraith describes this as incorporating social organizations and value systems. Others have extended this definition to mention the organizational aspect of technology, characterizing technology as "any systematized practical knowledge, based on experimentation and/or scientific theory, which enhances the capacity of society to produce goods and services, and which is embodied in productive skills, organization and machinery" (Gendron, 1977, p. 23), or "the application of scientific or other knowledge to practical tasks by ordered systems that involve people and organizations, living things, and machines" (Pacey, 1983, p. 6). We can combine these definitions into "the application of scientific or other knowledge to practical tasks by ordered systems that involve people and organizations, productive skills, living things, and machines."

This consensus definition is sometimes characterized as the "**technological systems**" approach to technology. The technological system is the complex of hardware (possibly plants and animals), knowledge, inventors, operators, repair people, consumers, marketers, advertisers, government administrators, and others involved in a technology. The technological systems approach is more comprehensive than either the tools/hardware or the rules/software approach, as it encompasses both (Kline, 1985).

The tool approach to technology tends to make technology appear **neutral**. It is neither good nor bad. It can be used, misused, or refused. The hammer can be used to drive a nail or smash a skull. The tool user is outside of the tool (as in the case of carpenters' tools) and controls it. The systems approach to technology makes technology encompass the humans, whether consumers, workers, or others. The individual is not outside the system, but inside the system. When one includes advertising, propaganda, government administration, and all the rest, it is easier to see how the technological system can control the individual, rather than the other way round, as in the case of simple tools.

The notion (known as autonomous technology) that technology is out of human control and has a life of its own (see chapter 7) makes much more sense with technological systems than it does with tools. Technological systems that include advertising, propaganda, and government enforcement can persuade, seduce, or force users to accept them.

As noted above, not all students of technology wish to develop a definition or general characterization of technology. Some, particularly among the "postmodern" devotees of science and technology studies, claim not only that there is no "essence" of technology of the sort that mid-twentieth-century thinkers such as Martin Heidegger, Jacques Ellul and others claimed or sought, but that no general definition of technology is possible.

Despite the validity of the doubts of postmodern students of technology studies concerning an essence of technology, the "consensus definition" delineated above will help to keep the reader roughly focused on the kinds of things under discussion. For instance, the recent advocates of "actor-network theory" (see chapter 12) developed an approach to technology that has many affinities to the consensus definition in the technological systems approach. Advocates of the technological systems approach have recently begun to ally with or even fuse with the social construction of technology approach. Understanding technology as a network fits well with the European sociology of actor-network theory (see box 12.2). Thomas P. Hughes, the person who is perhaps the leading American historian of technological systems, has moved toward the social construction view, and combined it with his own approach (Bijker et al., 1987; Hughes, 2004).

Study questions

1 Do you think we can have successful discussions of controversial topics without bothering at all about definitions of major terms?

2 Can we make words mean anything we wish? In what sense is this true and in what sense is this false?

3 Are there any areas of knowledge or subject matters in which there are "real definitions"? Are there any areas in which there are essential definitions?

4 What sorts of classes of things might have only "family resemblances" and no essential definitions? (Give examples other than the two given in the chapter and explain your answer.)

5 The philosopher Arne Naess (decades later to be the founder of "deep ecology") in his earliest work surveyed people on the street as to their definitions of various philosophical terms. What sort of definitions was he collecting? Do you think this is a fruitful way to clarify philosophical issues?

6 Do you think that the characterization of technology as applied science is correct? Give examples that support this characterization and examples that go against it (other than ones given in the chapter).

7 Does the notion of technology without tools make sense? If not, why not? If so, try to give some examples not mentioned in the chapter.

1

V. Dusek

Philosophy of Science and Technology

Much of the philosophy of technology in the nineteenth and twentieth centuries was done without consideration of or involvement with the philosophy of science. There were theoretical reasons for this, tacitly assumed by most writers. If science is simply a direct, uninterpreted description of things as they are, untainted by cultural and social biases and constraints, then science is simply a mirror of reality. Furthermore, if technology is simply applied science, and technology is, fundamentally, a good thing, then there are no special philosophical problems concerning technology itself. That is, the frameworks for the development of technology and its reception are not of interest. There are only after-the-fact ethical problems about technology's misapplication. However, recent approaches to the philosophy of science have shown that science is laden with philosophical presuppositions, and many feminists, ecologists, and other social critics of science have claimed that science also is laden with social presuppositions. Many recent approaches to philosophy of technology claim that technology is not primarily, or even is not at all, applied science.

First we shall survey the major mainstream philosophies of science from the early modern period to the mid-twentieth century, and then look at some more recent philosophies of science, and how they impact our understanding of technology.

The most widely known and accepted philosophy of science (often presented in introductory sections of science texts) has been **inductivism**. Francis Bacon (1561–1626) was not only one of the earliest advocates of the values of science for society (see chapter 3) but also the major advocate of the inductive method. According to inductivism, one starts with observations of individual cases, and uses these to predict future cases. Bacon enumerated

what he called "idols," or sources of pervasive bias, both individual and social, that prevented unbiased, pure observation and logical theorizing. One of these groups of "idols," the idols of the theater, he claimed, was philosophy.

Inductivism generalizes from individual cases to laws. The more individual cases that fit a generalization, the more probable the generalization. British philosophy from the seventeenth to the twentieth centuries has been primarily inductivist. The inductivist view spread widely to other nations during the eighteenth and nineteenth centuries. By the nineteenth century the sway of inductivism was such that even philosophers who did not really follow the inductive method were claimed to have done so. The theorist of electromagnetic fields, Michael Faraday (1791–1867), is an example. In the 1800s he was widely portrayed as what Joseph Agassi (1971) has called "the Cinderella of science," a poor boy who, through careful, neutral observation, arrived inductively at major discoveries. Twentieth-century studies show that he used romantic philosophical ideas, and in his own notebooks made numerous metaphysical speculations as frameworks for his electrical conjectures (Williams, 1966; Agassi, 1971). The evolutionist Charles Darwin (1809–82) even claimed he worked "on true Baconian principles, without any theory," though his real method is one of conjecturing hypotheses and deducing their consequences (Ghiselin, 1969). Although inductivism is probably still the most widely believed account of science among the public (although not as dominant as previously), inductivism has a number of logical problems. The most fundamental is called **Hume's Problem** or the **problem of the justification of induction**. These are technical and may appear nit picking to the non-philosopher, but they are significant enough problems to cause many philosophers of science (and scientists who have thought about these issues) to move away from straightforward inductivism (see box 1.1).

Logical positivism was a philosophy that developed in central Europe in the 1930s (primarily Vienna, where the group of philosophers and scientists calling itself the "**Vienna Circle**" arose) and spread to the USA with the emigration of many of its leaders after the rise of Nazism. The logical positivists took over much of the spirit of Comte's earlier positive philosophy without its explicit social theory and quasi-religious aspect (see discussion of Comte in chapter 3). The logical positivists, like the older positivists, saw science as the highest, indeed the only, genuine form of knowledge. They saw statements other than empirically supportable ones as meaningless. This was the **verification theory of meaning**: for a statement to be meaningful it had to be possible to verify it (show it true by empirical evidence). This

Box 1.1

The problem(s) of induction

In the early eighteenth century the Scottish philosopher David Hume (1711–76) raised what is called the problem of induction. It is really the problem of the justification of induction. Hume granted that we use induction, though he thought that it turns out to be a matter of custom and habit. A later philosopher, George Santayana (1863–1952), called it "animal faith." We expect the future to be like the past. Hume raised the question of the justification or rational reason for our belief in induction. The usual answer one gives is that "induction works." Hume doesn't deny that it works. However, Hume notes that what we really mean is that induction (or science in general) "has worked in the past and therefore we expect it to work in the future." Hume pointed out that this reasoning from past success to future success is *itself* an inductive inference and it depends on the principle of induction! Thus appeal to success or "it works" is circular. It implicitly applies the principle of induction to induction itself. It attempts to use the principle of induction to justify the principle of induction. Hume showed how other attempted justifications (such as an appeal to probability rather than certainty) also fail or beg the question. Most of Hume's contemporaries didn't see the problem and dismissed Hume's claims. However, one philosopher, Immanuel Kant (1724–1804), recognized the importance of Hume's problem and called it "the scandal of philosophy" (he could have called it the scandal of science, given its implications, though most working scientists were unaware of it). Kant's solution was that principles built into the human mind, such as causality and necessity, allow us to organize our experience in ways that allow regularity and induction. The cost of Kant's solution is that the regularity of nature is no longer known in things in themselves, separate and outside of us, but is the way we structure our experience and knowledge of nature. That is, we can't know that "things in themselves" follow lawful regularities, but only that our mind is structured to seek such regularities and structure our experience in terms of such laws. Karl Popper (1902–94) accepted the insolubility of Hume's problem. However, Popper's solution involves giving up the claim that science uses induction. Thus the proposed solutions to Hume's problem lead to views of science far from the usually accepted ones. Either we structure our experience in terms of induction, but cannot know if nature really follows laws, or we do not really ever use induction, but deceive ourselves into thinking that we do.

criterion of meaning was meant to exclude theology and metaphysics from the realm of the cognitively meaningful. The logical positivists were guilty of the fallacy of persuasive definition, in that they defined "meaningless" in a technical manner, but then used the term in a pejorative, dismissive manner, equivalent to "worthless" or "garbage."

Although the logical positivists did see the spread of the scientific approach as a boon to humankind and most of them held politically reformist and often social democratic views, they did not consider political philosophy as part of genuine, "scientific" philosophy, and with a few exceptions did not explicitly discuss their broader social views within their analyses of science. The sociologist and philosopher Otto Neurath (1882–1945) was a notable exception, who explicitly referred to Marxism in a positive manner (Uebel, 1991). (Neurath also contributed to highway and airport technology by inventing the non-verbal, pictorial schemas and symbols that caution the driver about approaching curves or deer crossings, and guide the passenger or customer to the restroom today; Stadler, 1982.) However, even the implicit support of social democracy by the positivists and their American followers was suppressed during the McCarthy Era of the early 1950s in the USA (Reisch, 2005).

The "logical" part of logical positivism consisted of the reconstruction of scientific theories using formal, mathematical logic. The apparent success of Bertrand Russell (1872–1970) in reducing mathematics to logic inspired logical posivitists to systematize scientific theories in terms of assumptions (axioms) and rigorous logical deductions. For the most part they analyzed science as a body of statements or propositions. Scientific theories were treated as primarily conceptual entities. In this the logical positivists were similar to many earlier philosophers in their treatment of science. The positivists simply analyzed the structure and connection of statements with more precision and rigor than their predecessors. The inspiration of Russell's logical foundation for mathematics inspired some positivists, notably Rudolf Carnap (1891–1970), to attempt to develop a formal inductive logic. The failure of this program, carried out over decades, has convinced almost all philosophers of science that a formal logic of induction of the sort Carnap envisioned is impossible. Induction involves informal assumptions and judgment calls. (See chapter 4.)

The quest for precision and rigor led the positivists to self-criticism of their own empirical or observational criterion of meaningfulness. Though this led to the demise of the criterion (the verificationist criterion of meaning), it is a tribute to the honesty and rigor of the positivists that they criticized their own original program and admitted when it had failed. The somewhat more tolerant resulting position that gave up the strict verification criterion called itself **logical empiricism**. Verification was weakened to confirmation or partial support by the logical empiricists. Empirical criteria of meaning tended to be either too narrow, and exclude the more theoretical parts of science, or so broad as to succeed in allowing the more theoretical parts of science, but only to readmit metaphysics and theology to the realm of the meaningful. The original version of the verification principle excluded theoretical terms in physics, such as "electron," as meaningless, while the principle would allow "Either this object is red or God is lazy" to be verified by a red object and hence allow "God is lazy" to be meaningful.

Karl Popper (1902–94) was another Viennese philosopher of science who knew the logical positivists personally and debated with them, but whose views differ from theirs in some important ways. Popper claimed that falsifiability, the possibility of being falsified or refuted, not verifiability, is the criterion that separates science from non-science. This is Popper's **falsifiability criterion** of demarcation of science from non-science. Popper also claimed that the more falsifiable a theory is the more scientific it is. This leads to the view that scientific laws rather than statements of particular facts are the most scientific statements. (For the positivists statements of particular facts are the fully verifiable ones, hence the most scientific.) Particular facts can be verified, and, hence, achieve the highest probability, while laws cover an indefinite range of cases and can never be verified. In fact laws are always infinitely improbable according to Popper, because their range of application is infinite, but only a small part of their consequences is tested. The positivists' view of science fits with the view of science as primarily a collection of facts, organized and helpfully summarized by laws, while Popper's view of science makes science primarily a collection of laws. For Popper the role of particular facts lies solely in testing or attempting to falsify the laws. According to him science consists of bold conjectures or guesses and decisive refutations or negative tests. This is his **falsificationist method** of science. Popper accepts Hume's claim that there is no justification of induction, so Popper throws out induction as a "myth" (see box 1.1). Hypotheses are guessed at, conjectured, and do not arise logically from observations of individual cases. As long as a hypothesis survives testing it is scientifically retained. It doesn't matter whether it was preceded by observations or arose from a dream or a religious belief as long as it survives tests. The famous story of how the chemist F. A. Kekulé's (1829–96) dream of a snake swallowing its own tail led him to hypothesize the ring structure of

the benzene molecule (Beveridge, 1957, 56, 76) is an example of how highly non-rational sources can nonetheless yield testable results.

Popper, unlike the positivists, did not equate non-scientific or non-testable with meaningless. For Popper metaphysics can be meaningful and can play a positive role in guiding the formation of scientific theories. Popper's views are counterintuitive at first, but their consequences fit well with the role of testing and criticism in science and the notion of the centrality of universal laws in science.

Popper's approach also has political implications. The critical approach (a generalization of the method of refutation) is central to free thought and democracy, the "open society" (Popper, 1945). The holding of positions as tentative avoids dogmatism. The welcoming of criticism encourages open-mindedness and free speech. Popper understood "reified dogmatism" as a closed system of thought that has mechanisms to discount or dismiss over possible objection or criticism. For Popper both religious fundamentalism and dogmatic Marxist totalitarianism are examples of such closed systems. However, Popper believes that schools of science themselves can develop strategies to shield themselves from all criticism, and thereby it too can become non-scientific in a logical sense, while mistakenly being held to be "science" by educational and funding institutions.

To take an extreme example, the psychologist of intelligence Sir Cyril Burt (1883–1971) was a leading **scientist in the institutional sense**. He edited the leading and most rigorous *Journal of Statistical Psychology*. He advised the London Council on educational tracking policy. He started Mensa, the society for people with high IQ, and even received a knighthood for his work on the inheritance of IQ. However, shortly after his death, most psychologists became convinced that the data he presented in his later years was fraudulent. He apparently invented non-existent research assistants. He composed letters and articles under pseudonyms incompetently criticizing his work, to give himself the opportunity to respond brilliantly to them (Hearnshaw, 1979). If this is true, he certainly failed in being a **scientist in the normative sense** of Popper; that is, someone who was intellectually honest, open to criticism, and willing to reject his theories.

The interesting aspects of Popper's contrary to common sense approach to science were only widely recognized after logical positivism ran into conceptual difficulties. Popper's views have exciting implications for both social criticism and evaluation of programs in science, but the downside of Popper's views for the philosophy of technology is the sharp wedge he drives between science and technology. Science involves daring and improbable conjectures and their refutation, but technology demands reliable and workable devices. The collapse of a bridge has human costs different from those of intellectual rejection of a theory in particle physics. Popper students and followers, such as Joseph Agassi (1985) and Mario Bunge (1967, chapter 11, 1979), have made important contributions to the philosophy of technology, but Popper's own theory of science, interesting as it is, is separate from pragmatic considerations of technology. Nevertheless, the Popperian approach to science opens the way to investigation of the way that philosophical worldviews or metaphysical theories may influence the formation of scientific theories. This in turn shows how cultural views can be at least as important as observational data as a source of scientific theory, and through applications can in turn affect technology.

One of the major debates in the philosophy of science is that between **realism** and **anti-realism**, particularly, as Popper (1962, chapter 3) formulated it, between essentialism and **instrumentalism** with respect to theoretical terms in science. Some parts of science are particularly close to observation and experiment. Other parts of scientific theory are only indirectly connected with observation and experiment through long chains of logical deduction. The term "electron" in physics is an example. Scientific realists claim that the theoretical terms in science represent or refer to objectively real entities, even if we cannot observe them. Anti-realists claim that the theoretical terms are not to be taken to literally refer to objects or entities.

Instrumentalists treat theories merely as instruments for prediction. The theories do not describe real, unobserved, structures, but are more or less useful for prediction of things we can directly observe.

The metaphors used by realists and instrumentalists, respectively, are at the basis of the theoretical and technological approaches that were historical components of the Renaissance birth of modern science. Realists often describe scientific theories as "pictures" of the world. Instrumentalists describe theories as "tools" for prediction. The birth of early modern science may have been the fusion of literate scholars, knowledgeable of the Greek classics and philosophical "world pictures," but ignorant of practical crafts, with the illiterate but technologically skilled artisans with their tools. Economic hard times in the Renaissance threw together impoverished wandering scholars with wandering artisans, yielding the "marriage of metaphysics and technology" (Agassi, 1981) that is science. The claim that the breakdown of class barriers led to communication between humanists and artisans (Zilsel, 2000) is called "the Zilsel thesis." While Zilsel (1891–1944) located this process in the 1600s, it is more plausible to trace it to the Renaissance in the 1400s

(Rossi, 1970). The "Renaissance Men," such as Leon Battista Alberti (1404–72), theorist of geometrical perspective, architect, and social philosopher of the family, and Leonardo da Vinci (1452–1519), the artist, philosopher, scientist, and engineer, were artists who combined technical virtuosity in mechanics and architecture with philosophy and scientific theory. The "tools" in the form of painter's brush or sculptor's chisel were a means to the "picture" in the form of Renaissance painting or sculpture. These components of the birth of modern science and technology show up today in the preferred metaphors of instrumentalism and realism as philosophies of the relation of science to reality.

The interesting aspects of Popper's non-commonsensical approach to science were only widely recognized after logical positivism ran into conceptual difficulties. During the 1950s and 1960s there were many criticisms of logical empiricism. The logical empiricists were rigorous and honest enough to qualify and limit many of their own claims. The history of logical empiricism is one of successive retreat from the original, simple, and provocative theses of the Vienna Circle. This whittling down of logical empiricism greatly increased interest in and allegiance to Popper's alternative approach.

However, the most well known and influential alternative was Thomas Kuhn's *The Structure of Scientific Revolutions* (1962). Kuhn (1922–96) approached science from the standpoint of history. Kuhn, with a doctorate in physics, taught an undergraduate course in science for humanists, reading original texts. Kuhn was puzzled by Aristotle's *Physics*, which seemed totally nonsense to someone trained in modern physics. One afternoon, while he was gazing from his dorm window out on the trees of Harvard Yard, the scales fell from his eyes, and he realized that Aristotle's claims made perfect sense within a framework totally different from the modern one.

The logical positivists had treated scientific theories as static structures. They made their own formal reconstructions of scientific theories, rather than describing the theories as their creators and contemporaries viewed them. Kuhn claimed to present scientific theories in terms of the frameworks in which they were originally understood, not as contemporary textbooks or logical empiricist formal reconstructions presented them. Kuhn centered his account of science on the notion of a "**paradigm**." The paradigm is not solely an explicit formal structure. Paradigms are not only explicit theories but ways of viewing the world. Kuhn's paradigms include not only (a) theories, but also (b) tacit skills of laboratory practice that are not recorded and are taught by imitation of an expert practitioner. Further, paradigms encompass

(c) ideals of what a good scientific theory should be, and (d) a metaphysics of what basic entities exist. Kuhn also tied the paradigm to the structure of the scientific community. The paradigm binds the researchers in a scientific specialty, channeling their experimental and theoretical practice in certain directions and defining good scientific theory and practice. Later Kuhn distinguished between paradigms as **exemplars**, models for good scientific theory and practice, such as the works of Galileo, Newton, or Einstein, and the paradigm as **disciplinary matrix**, or belief system shared by members of the scientific community.

Kuhn's view of the development of scientific paradigms differs from the positivists' and Popper's account of theories. Kuhn denies that either induction or Popper's falsification describes the rise and fall of paradigms. Generally a new paradigm arises without a strong inductive base. Particular refutations can be sidestepped by modifying one or more hypotheses in the theory refuted. The scope of the original theory can be limited or auxiliary assumptions can be added. Thus "refutations" are not decisive or fatal. A slightly modified version of the "refuted" theory can survive under the paradigm. The logic of this situation is called the **Duhem thesis** or **Duhemian argument** (see box 1.2).

Paradigms collapse because of an accumulation of what Kuhn calls **anomalies**. Anomalies are not strict counter-instances or refutations. They are phenomena that seem not to fit with the categories of the paradigm or that are simply left as exceptions. A paradigm is rejected only after a new paradigm has arisen and there is a shift of allegiance of scientists. (At one point Kuhn quotes the physicist Max Planck as saying that it is a matter of the older generation dying off; Kuhn, 1962, p. 151.)

Kuhn's approach opened the way for widespread appreciation of the role of philosophical worldviews and social ideologies in the creation and acceptance of scientific theories. Kuhn himself did not emphasize either the philosophical frameworks of theories as such or the external, social influences on the acceptance of new paradigms, though he hinted at both in passing. However, after Kuhn, numerous philosophers, historians, and sociologists of science took up the issue of how philosophical views, religious beliefs, and social ideologies have played a role in the birth and spread of scientific theories. This in turn strengthens the case for cultural influences on technology. If the scientific paradigms at the basis of various technologies have religious or political components, then religion and politics can influence technology, not just in social acceptance, but also in terms of the structure of the very theories used in the technology. This approach, taking its

Box 1.2

The Duhem thesis

The Duhem thesis is the logic behind much of Kuhn's claim that paradigms in normal science do not get rejected because they are refuted. The physicist, philosopher, and historian of science Pierre Duhem (1861–1916) presented arguments against crucial refutation of theories in the early twentieth century. He wrote decades before Popper but his arguments are the most challenging objection to Popper's theory of falsification. Duhem noted that if a theory consists of several hypotheses or assumptions, the refutation of the theory as a whole does not tell us which hypothesis is a fault, only that the theory as a whole made an incorrect prediction. Duhem also argued and gave examples, in which one of the lesser hypotheses or auxiliary hypotheses was changed in the light of a supposed refutation of the theory, yielding a modified theory that correctly described the situation that refuted the original version. For instance, Boyle's law of gases appeared to be refuted by the behavior of iodine. However, chemists and physicists modified Boyle's law to claim that it applied only to ideal gases, and then claimed that iodine was not an ideal gas. (In an ideal gas all molecules are the same. Iodine gas is a mixture of molecules with different numbers of iodine atoms.)

The American philosopher W. V. O. Quine (1908–2000) generalized Duhem's claim, noting that if one allows drastic enough modifications and redefinitions *any* theory can be saved from any counter-evidence (Quine, 1951). Quine allows such extreme strategies as changing the formal logic of the theory and "pleading hallucination" (the extreme Quinean strategy could also, more reasonably, involve shifts in the meaning of terms in the theory to avoid refutation). This is known as the *Duhem–Quine thesis* and has influenced constructivist sociologists of scientific knowledge and science and technology studies postmodernists. The latter claim that, because no evidence can decisively refute any theory, the reason why theories are rejected involves non-evidential issues, not part of the logic of science, such as political, social, or religious interests and worldviews, and these views in turn can influence the technology based on the theory.

Philosophers have disagreed about the legitimacy of various stronger and weaker versions of the Duhemian argument (Harding, 1976). Analytical philosophers of science generally defend the weaker, original, Duhem version of the thesis. Science and technology studies people generally opt for the strong, Quine, version, as it appears to make evidence almost irrelevant to science (see box 6.3 and the discussion of the sociology of scientific knowledge in chapter 12).

inspiration from Kuhn, has been used to counter technological determinism (see chapter 6).

Two topics raised by the post-positivist philosophy of science are the **theory-laden nature of observation** and the **underdetermination** of theories by evidence. Kuhn, as well as several other philosophers of science of the late 1950s and 1960s, such as Norwood Russell Hanson (1958), emphasized how sensory observations depend on contexts of theory and interpretation. They appealed to psychological studies of perception and visual illusion. They followed the claim that beliefs and expectations influence perception. Michael Polanyi (1958) emphasized how skills of interpretation are developed though apprenticeship and practice. The interpretation of medical X-ray pictures or the identification of cell organelles through a microscope is not obvious. It involves training. (James Thurber recounts how, after a long bout with a school microscope, he realized he was studying not a microscopic creature, but the reflection of his own eyelash.)

Another form of theory dependence of observation includes the role of theories of our measuring and observing instruments in our construal of the readings and observations our instruments produce. Theory also plays a role in the selection of what to observe and in the language in which observations are described and interpreted. Even when perceptual observation has been replaced by machine observation these latter influences of theory on the nature and structure of observation reports remain.

Closely related to the problem of induction (box 1.1) and to the Duhem thesis (box 1.2) is the **underdetermination thesis**. Many different theories, such as both the new theory and the appropriately modified version of the old, supposedly refuted theory, can explain the same set of data. The same set of data points can be predicted or accounted for by many different equations. Many different continuous curves can be drawn through any set of points, and thus the many different equations of those curves can be said to describe those points. Thus the logic of confirmation or inductive support does not lead to one unique theory. Considerations other than empirical evidence are used in making the choice of theory. It is true that most of the mathematically possible theories that account for a given set of data are excessively complicated and most could be eliminated as unreasonable. Nevertheless, where more than one reasonably manageable theory accounts for the data, there is a turn to considerations of simplicity or elegance. But what is considered simple depends on ideals of what a good theory is and aesthetic considerations of the scientist or scientific community. Consistency with other theories held also counts as a non-empirical constraint on theory choice.

Many sociologists of scientific knowledge and science and technology studies postmodernists appeal to the underdetermination thesis as well as the Quine–Duhem thesis.

Sociology of Scientific Knowledge

The work of Kuhn (and a number of other philosophers of science of the period) opened thinking about science to a number of issues and considerations that the positivist approach to science as a body of statements had overlooked or not considered worthy of investigation. Kuhn's paradigmatic approach opened science to the kinds of examination that humanists had traditionally used in examining art and culture. It also opened up the social examination, not just of the institutions and networks of science, but also of the content of scientific theories (sociology of scientific knowledge or SSK) (see chapter 12). A number of sociologists of science, particularly in the United Kingdom, took up this investigation.

Earlier sociology of knowledge, initiated by Karl Mannheim (1893–1947) in 1936, had investigated political and religious beliefs but exempted the claims of science from sociological explanation (Mannheim, 1936, p. 79). A majority of sociologists consider themselves to be scientists and to share at least a diluted version of Comte's (1798–1857) positivistic ideal of objective, lawful sociological knowledge (see the discussion of Comte in chapter 3). Most sociological studies of science prior to the 1970s concerned networks of journal citations or patterns of funding and professionalization, assuming the content of science to be beyond social explanation. Robert K. Merton's (1910–2003) influential sociology of science concentrated on the norms of science. These are the values professed by the scientific community. These norms include: (a) universalism; (b) disinterestedness (lack of interest-based bias in investigation); (c) "communism" (the free sharing of data and results); and (d) organized skepticism (the tendency to doubt and question results and theories). These values resemble Karl Popper's norms of science, although the later Popper emphasizes that these are ideals of science, not a description of actual scientists' behavior. (In contrast to Popper, Kuhn claims to be giving an account of the actual behavior of scientists.) Philosophically trained sociologist of science Steve Fuller (1997, p. 63) has noted that Merton takes the professed ideals of scientists at face value as accounts of actual scientific behavior, while sociologists of politics and religion often doubt or even debunk explicitly professed ideals and contrast them with the actual doings of politicians and religious people. It is significant that Merton first discussed the norms of science in an article concerning totalitarian restraints on science in Nazi Germany (Merton, 1938). His use of the term "communism" for sharing of data shows a residue of his earlier leftist political views. Later, Merton contrasted these norms of science primarily with those of the USSR.

SSK claims that the statements, laws, and experiments of science are themselves legitimate objects of scientific investigation. Earlier philosophers and sociologists of science thought (and many still think) that scientific errors could be explained by social or psychological causes, but scientific truths could not. David Bloor (1976), who initiated what he called the "Strong Programme," proposed (a) a Principle of Symmetry, that the same sort of causal explanations ought to be given of both truth and error in science and of both rational and irrational behavior; (b) a Causality Principle, that all explanations of scientific knowledge should be causal; (c) the Impartiality Principle, that SSK should be impartial with respect to truth and falsity, rationality and irrationality; and (d) the Reflexivity Principle, that these principles should apply to sociology itself.

Other sociologists of scientific knowledge such as Harry Collins (1985) bracketed or set aside the truth or falsehood of scientific statements, studying gravitational waves and parapsychology with the same methods and approaches. Many in SSK followed the social construction of scientific knowledge approach (see chapter 12). The social construction approach can mean a number of things. The weakest version of the thesis is that social interaction of humans is the basis for the formation of scientific theories and experiments. This claim is reasonable. Science differs from introspective knowledge in that it is supposed to be public and replicable. Science is a social enterprise. Another reasonable claim is that technological, instrumental apparatus is physically constructed in a literal sense. An issue arises, however, as to whether the construction of concepts and the construction of apparatus ought to be considered with a unitary conception of "construction" or whether two different sorts of activities are being illicitly run together.

A stronger thesis of the social construction position is that the objects of science or scientific truths are socially constructed. If the latter claim means that what we take to be scientific truths or what we believe to be scientific truths are socially constructed then it collapses into the first position. Many of the defenders of social construction would claim that there is no difference between a truth and what we take to be a truth. This is a version of the

consensus theory of truth, that what is true is what the community believes. Opponents of the extreme social construction view claim that the objects that we think exist may not be the same as the objects that genuinely exist and that what our community holds to be true may not be true.

Among the contributions of the social constructivist and related approaches are case studies showing how consensus is formed in scientific communities. Political negotiation, appeals to authority of eminent scientists, recruitment of allies, and rhetorical persuasion of the undecided all play a role. Extra-scientific factors often play a role. Pasteur's experiments in the mid-nineteenth century rejecting the spontaneous generation of life from non-living material were welcome to the Catholic Church in their defense of the necessity of divine creation. Although Pasteur himself did not really reject an origin of life in the distant past due to natural causes, he was happy to play to the conservative atmosphere in France in his day (Farley and Geison, 1974; Geison, 1995). Often the consensus is formed without some major objections being accounted for. Some conflicting experiments and studies are rejected because of the reputation or lack of prestige of the experimenters. Data that don't fit the expected result are ignored. Once the conclusion is reached it seems in retrospect to be inevitable. It is difficult to remember or imagine the state of uncertainty and disagreement that preceded it.

Social Epistemology

In Anglo-American analytical philosophy a field of **social epistemology** (social theory of knowledge) developed in the last two decades of the twentieth century (Fuller, 1988; Kitcher, 1993). Social epistemology, like traditional epistemology, but unlike sociology of scientific knowledge, is normative. That is, it is concerned with evaluation of the knowledge claims made by scientists. On the one hand, social epistemology differs from traditional philosophical epistemology in treating knowledge, especially scientific knowledge, as a social rather than an individual achievement. On the other hand, social epistemology contrasts with Kuhn's and other "historicist" (history-oriented rather than logic-oriented) post-positivistic philosophy of science in claiming to take a descriptive approach. It also contrasts with the evaluatively neutral stance taken by most social constructivist sociology of science, such as in the bracketing of truth-claims by Collins noted above. Some "historicist" philosophers of science, such as Feyerabend, do take evaluative stances, in judging and rejecting certain scientific theories, and social constructivists, while professing a neutral stance, often implicitly debunk the traditional "naive" truth claims made by scientists. That constructivists are not as totally normatively neutral as they profess to be is suggested by the fact that though they treat occultism or parapsychology neutrally, none so far has treated racist science or Nazi science in an evaluatively neutral manner.

Feminist, Ecological, and Multicultural Science and Technology Studies

Accepting Kuhn's views, if cultural considerations of worldview and attitude toward nature were significant for the nature of scientific theories, then theorists of science with critical approaches to dominant social attitudes could criticize the theories and methods of various sciences and technologies themselves. Feminists and ecological critics of contemporary society have been prominent in taking this approach (see chapters 9 and 11). Similarly, anthropology and some cultural studies approaches to science and technology have criticized the assumption of universality of Western science and technology. These responses note earlier, but often fruitful, approaches to science and technology in Egyptian, Babylonian, Chinese, Indian, and Muslim civilizations of ancient and medieval times. These cultures contributed a great deal of technology and science to the West, but often based their investigations on worldviews and metaphysics very different from that of modern Western science. From this multicultural critics raise questions about the supposed "universality" of Western science (Harding, 1998).

Likewise, the "local" knowledge in non-literate societies has often contained considerable knowledge of medicinal and other values of local plants, agricultural techniques, survival skills in harsh climates, and navigational skills. Contemporary ethno-botanists investigate indigenous cures and the chemistry of plants used by local healers. Western Arctic explorers borrowed the design of their clothing and many survival techniques from the Inuits and other inhabitants of the Arctic, usually without crediting them. Apparently local religiously based seasonal cycles of planting, such as those in Bali, have sometimes proven more agriculturally effective than the recommendations of Western "experts." Social constructivist and postmodernist

defenders of ethno-science sometimes claim that it is simply an alternative knowledge to Western science, which is itself a "local knowledge," whose locality is the laboratory. (See chapter 10.)

The "Science Wars"

With the post-Kuhnian development of politically critical studies of science by feminists, activists in indigenous cultures, ecologists and others, as well as the development of sociological studies of scientific knowledge and literary studies of scientific texts a backlash has arisen. A number of disparate groups are involved. There are scientists and technologists who believe the objectivity of their field is being wrongly denied by social, political and literary studies of science. There are also political conservatives, opponents of feminism and ethnic movements, and opponents of the ecology movement. There are also traditional literary and humanist opponents of postmodernist movements in the humanities (see box 6.3). These groups have formed an unstable alliance to attack the new science studies in the so-called **Science Wars** (Ross, 1996; Dusek, 1998). A great many articles, both scholarly and polemical, were written for and against the new science studies (Koertge, 1997; Ashman and Baringer, 2001). The most famous, or notorious, incident in the science wars was the **Sokal hoax**. Alan Sokal, a physicist, wrote an article titled "Transgressing the boundaries: toward a transformative hermeneutics of quantum gravity" (1995), which contained within its implicit satire the most ridiculous and exaggerated claims to be found in science studies and the political criticisms of science. He was able to publish it in a cultural studies journal, and then revealed his hoax. In the wake of this revelation both sides in the dispute issued hundreds of news stories, editorials, and articles both pro and con, ranging from conservative political commentators Rush Limbaugh and George Will to angry letters to editors of various eminent scientists and humanists (Editors of *Lingua Franca*, 2000). At least two science studies people were denied prestigious positions, and an editor nudged into earlier retirement, because of letter writing campaigns by the scientist science warriors. The fires of the science wars in the form that gained mass media attention died down by the beginning of the new century, but they continue to smolder in less public and explicit forms.

Instrumental Realism

A later development in the philosophy of science with the greatest relevance to philosophy of technology was what Don Ihde (1991, p. 150 n1) called the **instrumental realist** approach to science. The positivists, the followers and descendents of Kuhn in the new philosophy of science, and even the sociology of scientific knowledge concentrated on science as primarily a *theoretical* enterprise. Empirical testing was definitive of positivism's definition of scientific knowledge, but the model of testing was generally direct sense observation.

Philosophers and historians such as Ian Hacking (1983), Robert Ackermann (1985), and Peter Galison (1987) emphasize the mediating role of observational instruments and the manipulative nature of scientific knowledge. The American pragmatists, such as John Dewey, early emphasized physical manipulation of nature as central to knowledge. However, later academic pragmatism became strongly influenced by the positivists. Emphasis on practice and manipulation declined in later "pragmatic" accounts of science.

Kuhn had included tacit laboratory skills in his account of science, but later discussions of Kuhn in philosophy of science debates focused primarily on the conceptual aspects of the paradigm. Jerome Ravetz developed Kuhn's emphasis on the craft nature of science and Michael Polanyi's notion of tacit skills into a thoroughgoing treatment of science as craft, but it was not influential, perhaps because it was neither fully within philosophy of science nor within the developing sociology of scientific knowledge (Ravetz, 1971). The instrumental realists of the 1980s developed a strong focus on the embodied, active aspects of science that became a significant movement within the philosophy of science. For the instrumental realists scientific instrumentation is central to science. The active, manipulative aspect of instrumental observation takes priority over passive observation and contemplation. Today most scientific observations are far from the naked eye observations of older astronomy and natural history. The "Baconian" ideal of induction from pure, unbiased perceptions is modified by the technology-laden nature of contemporary scientific observation. French physicists call the tendency to look where our instruments allow us to look "the logic of the lamp post," after the old joke about the drunk who looked for his keys under the lamp post because there was better light, even though he had dropped his keys down the block where it was pitch black.

Since contemporary science is so involved with and dependent upon sophisticated technological instrumentation, insofar as scientific discovery is based on observation, technology is prior to science as well as driving science. This is the opposite of the account of technology as "applied science," in which science is prior to and drives technology. In the "technoscience" view of Bruno Latour (1947–) and others, technology and science are today inextricably interwoven. The notion that modern science is dependent on technology has some similarity to Heidegger's later views (see box 5.1). For Heidegger, technology is the fundamental fact or force in the modern condition, and technology is philosophically prior to science.

Instrumental realism shifts the dividing line between theory and observation in such a way as to make the realm of pure theory minimal. Where the ability to manipulate the situation is a criterion of the reality of the entity manipulated, much that was formerly treated as "purely theoretical" in the philosophy of science becomes real. Hacking's famous example is that on hearing that elementary particles (often treated as theoretical entities by philosophers) can be sprayed, he concluded if they can be sprayed they are real (Hacking, 1983). The realist/instrumentalist dispute mentioned earlier in this chapter treated theoretical entities as objects of contemplation, not of manipulation. By rejecting this contemplative stance instrumental realists not only make clearer the close connection of modern science with technology (thereby implicitly justifying the running together of the two as "technoscience" by postmodern science studies), but also eliminate the break between ordinary experience and the objects of science.

Approaching and integrating the work of the instrumental realists from a phenomenological point of view (see chapter 5), Don Ihde has drawn the implication of this approach that even the most esoteric scientific research involving advanced, abstract theories is highly perceptual, given that testing via instrumentation is an extension of perception. Ihde also points out that instruments as an extension of (or, better, literally incorporated into) bodily perception incorporate human embodiment into even the most arcane, advanced science.

One irony of the development of the instrumental realist approach from post-positivist philosophy of science is that in its application to the history of science the emphasis on experiment has reintroduced the characterization of scientific method as inductive. Yet it is precisely the problem of induction and responses to it such as Popper's that led to the emphasis on the theory-driven account of science and on the theory-laden character of observation.

Historians and sociologists of science who use the instrumental realist approach may not be bothered by these problems (though at least one sociologist of scientific knowledge, Collins, uses the problem of induction to undermine empirical accounts of scientific change). Instrumental realism brings us full circle to the original inductivism, if not that of the simplest variety. Philosophers, however, may need to re-examine their approaches to the logical problem of induction in relation to the defense of the instrumental realist approach.

Conclusion

Inductivism supported the view that science grows directly out of perceptual observations unbiased by theory. The logical positivist or logical empiricist philosophy of science has often been used to reinforce the notion of science as neutral and technology as applied science. Popper's falsificationism or critical approach, belatedly appreciated, allowed for the role of theory as prior to observation and the role of philosophical theories as background frameworks for scientific theories. Kuhn and post-positivist, historicist philosophy of science opened the door to considering the role of philosophical, religious, and political influences on the creation and acceptance of scientific theories. Feminist, ecological, and multiculturalist critics use Kuhn's notion of a paradigm to expose what they claim to be pervasive bias in the methods and results of mainstream Western science and technology. Sociologists of scientific knowledge emphasize that the logic of evidence and refutation of theories does not determine the course of theory change. Instead, the prestige of established scientists, recruitment of allies, and negotiation between competing teams leads to a closure of scientific disputes that is later attributed to the facts of nature. Instrumental realists emphasize that, in contemporary science, observation itself is mediated through the technology of scientific instrumentation. Rather than technology being applied science, technology is prior to scientific observation.

Study questions

1 Do you think that inductivism is adequate as a theory of scientific method? If it is not, why do so many working scientists hold to it?
2 Are scientific theories decisively refuted by counter-evidence or do they "roll with the punches," so to speak, being readjusted to fit what was

counter-evidence for the old version? Give an example not in the chapter if possible.
3 Are scientific theories direct outgrowths of observation or are they influenced as well by assumptions and worldviews of their creators?
4 Do you think that the scientists involved in the "science wars" who dismiss and ridicule sociological and literary accounts of the success of scientific theories are justified in dismissing the social, political, and rhetorical aspects of science as irrelevant to scientific truth and validity?
5 Does the instrumental realist approach do away with the problems raised by earlier accounts of science, such as the inductive, Popperian falsificationist, and Kuhnian approaches?

"The Manifesto"
from: Otto Neurath
Empiricism and Sociology
ed. by Marie Neurath
and Robert S. Cohen

Reidel, 1973

CHAPTER 9

WISSENSCHAFTLICHE WELTAUFFASSUNG: DER WIENER KREIS

[The Scientific Conception of the World: The Vienna Circle][1]

Dedicated to Moritz Schlick[2]

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 ties 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 theologising thought is again on the increase today, not only in life but also in science. Is this a general phenomenon or merely a change 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 *privatdozent* (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 fore-runner 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 re-shaping 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 Weltauffassung*] in which members of the Vienna Circle preponderate.

2. The scientific world conception

The scientific world conception is characterised not so much by theses 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 harmonise 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."[3]

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 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 recognisable 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 emphasised 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 formalised through further development of logical analysis. First it was arithmetised, that is, interpreted as the theory of a certain number system. Next it was axiomatised, 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 logicised, 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; thereby 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.*

APPENDIX

1. *Members of the Vienna Circle*

Gustav Bergmann
Rudolf Carnap
Herbert Feigl
Philipp Frank
Kurt Gödel
Hans Hahn
Viktor Kraft
Karl Menger
Marcel Natkin
Otto Neurath
Olga Hahn-Neurath
Theodor Radakovic
Moritz Schlick
Friedrich Waismann

2. *Those sympathetic to the Vienna Circle*

Walter Dubislav
Josef Frank
Kurt Grelling
Hasso Härlen
E. Kaila
Heinrich Loewy
F. P. Ramsey
Hans Reichenbach
Kurt Reidemeister
Edgar Zilsel

3. *Leading representatives of the scientific world-conception*

Albert Einstein
Bertrand Russell
Ludwig Wittgenstein

REFERENCES

[1] [1929, Bibl. No. 179 – Ed.].

[2] [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 contributions. (H. Feigl mentions F. Waismann and himself, see: 'Wiener Kreis in America' in *Perspectives in American History, II,* 1968.) See also H. Neider's remarks in his contribution to our first chapter; he was a witness, as I was myself. (The publisher, Artur Wolf, also published the first colour book of the Social and Economic Museum in Vienna.) Carnap and Hahn's widow gave us their permission to include the pamphlet among Otto Neurath's writings. In fact, the name Wiener Kreis (Vienna Circle) was invented and suggested by Neurath. (See the Neurath-Carnap correspondence in a later volume in this series.) – M. N.]

[3] [Note: In his text, Russell wrote about 'logical atomism', not specifically of 'logical analysis' – Trans.].

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1 Co., 1931), pp. 126–

p. 50.

Science and Society

From *Philosophy and Civilization* (1931)

The significant outward forms of the civilization of the western world are the product of the machine and its technology. Indirectly, they are the product of the scientific revolution which took place in the seventeenth century. In its effect upon men's external habits, dominant interests, the conditions under which they work and associate, whether in the family, the factory, the state, or internationally, science is by far the most potent social factor in the modern world. It operates, however, through its undesigned effects rather than as a transforming influence of men's thoughts and purposes. This contrast between outer and inner operation is the great contradiction in our lives. Habits of thought and desire remain in substance what they were before the rise of science, while the conditions under which they take effect have been radically altered by science.

When we look at the external social consequences of science, we find it impossible to apprehend the extent or gauge the rapidity of their occurrence. Alfred North Whitehead has recently called attention to the progressive shortening of the time-span of social change. That due to basic conditions seems to be of the order of half a million years; that due to lesser physical conditions, like alterations in climate, to be of the order of five thousand years. Until almost our own day the time-span of sporadic technological changes was of the order of five hundred years; according to him, no great technological changes took place between, say, 100 A.D. and 1400 A.D. With the introduction of steam-power, the fifty years from 1780 to 1830 were marked by more changes than are found in any previous thousand years. The advance of chemical techniques and in use of electricity and radio-energy in the last forty years makes even this last change seem slow and awkward.

Domestic life, political institutions, international relations and personal contacts are shifting with kaleidoscopic rapidity before our eyes. We cannot appreciate and weigh the changes; they occur too swiftly. We do not have time to take them in. No sooner do we begin to understand the meaning of one such change than another comes and displaces the former. Our minds are dulled by the sudden and repeated impacts. Externally, science through its applications is manufacturing the conditions of our institutions at such a speed that we are too bewildered to know what sort of civilization is in process of making.

Because of this confusion, we cannot even draw up a ledger account of social gains and losses due to the operation of science. But at least we know that the earlier optimism which thought that the advance of natural science was to dispel superstition, ignorance, and oppression, by placing reason on the throne, was unjustified. Some superstitions have given way, but the mechanical devices due to science have made it possible to spread new kinds of error and delusion among a larger multitude. The fact is that it is foolish to try to draw up a debit and credit account for science. To do so is to mythologize; it is to personify science and impute to it a will and an energy on its own account. In truth science is strictly impersonal; a method and a body of knowledge. It owes its operation and its consequences to the human beings who use it. It adapts itself passively to the purposes and desires which animate these human beings. It lends itself with equal impartiality to the kindly offices of medicine and hygiene and the destructive deeds of war. It elevates some through opening new horizons; it depresses others by making them slaves of machines operated for the pecuniary gain of owners.

The neutrality of science to the uses made of it renders it silly to talk about its bankruptcy, or to worship it as the usherer in of a new age. In the degree in which we realize this fact, we shall devote our attention to the human purposes and motives which control its application. Science is an instrument, a method, a body of technique. While it is an end for those inquirers who are engaged in its pursuit, in the large human sense it is a means, a tool. For what ends shall it be used? Shall it be used deliberately, systematically, for the promotion of social well-being, or shall it be employed primarily for private aggrandizement, leaving its larger social results to chance? Shall the scientific attitude be used to create new mental and moral attitudes, or shall it continue to be subordinated to service of desires, purposes and institutions which were formed before science came into existence? Can the attitudes which control the use of science be themselves so influenced by scientific technique that they will harmonize with its spirit?

The beginning of wisdom is, I repeat, the realization that science itself is an instrument which is indifferent to the external uses to which it is put. Steam and electricity remain natural forces when they operate through mechanisms; the only problem is the purposes for which men set the mechanisms to work. The essential technique of gunpowder is the same whether it be used to blast rocks from the quarry to build better human habitations, or to hurl death upon men at war with one another. The airplane binds men at a distance in closer bonds of intercourse and understanding, or it rains missiles of death upon hapless populations. We are forced to consider the relation of human ideas and ideals to the social consequences which are produced by science as an instrument.

The problem involved is the greatest which civilization has ever had to face. It is, without exaggeration, the most serious issue of contemporary life. Here is the instrumentality, the most powerful, for good and evil, the world has ever known. What are we going to do with it? Shall we leave our underlying aims unaffected by it, treating it merely as a means by which uncooperative individuals may advance their own fortunes? Shall we try to improve the hearts of men without regard to the new methods which science puts at our disposal? There are those, men in high position in church and state, who urge this course. They trust to a transforming influence of a morals and religion which have not been affected by science to change human desire and purpose, so that they will employ science and machine technology for beneficent social ends. The recent Encyclical of the Pope is a classic document in expression of a point of view which would rely wholly upon inner regeneration to protect society from the injurious uses to which science may be put. Quite apart from any ecclesiastical connection, there are many "intellectuals" who appeal to inner "spiritual" concepts, totally divorced from scientific intelligence, to effect the needed work. But there is another alternative: to take the method of science home into our own controlling attitudes and dispositions, to employ the new techniques as means of directing our thoughts and efforts to a planned control of social forces.

Science and machine technology are young from the standpoint of human history. Though vast in stature, they are infants in age. Three hundred years are but a moment in comparison with thousands of centuries man has lived on the earth. In view of the inertia of institutions and of the mental habits they breed, it is not surprising that the new technique of apparatus and calculation, which is the essence of science, has made so little impression on underlying human attitudes. The momentum of traditions and purposes that preceded its rise took possession of the new instrument and turned it to their ends. Moreover, science had to struggle for existence. It had powerful enemies in church and state. It needed friends and it welcomed alliance with the rising capitalism which it so effectively promoted. If it tended to foster secularism and to create predominantly material interests, it could still be argued that it was in essential harmony with traditional morals and religion. But there were lacking the conditions which are indispensable to the serious application of scientific method in reconstruction of fundamental beliefs and attitudes. In addition, the development of the new science was attended with so many internal difficulties that energy had to go to perfecting the instrument just as an instrument. Because of all these circumstances the fact that science was used in behalf of old interests is nothing to be wondered at.

The conditions have now changed, radically so. The claims of natural science in the physical field are undisputed. Indeed, its prestige is so great that an almost superstitious aura gathers about its name and work. Its progress is no longer dependent upon the adventurous inquiry of a few untrammeled souls. Not only are universities organized to promote scientific research and learning, but one may almost imagine the university laboratories abolished and still feel confident of the continued advance of science. The development of industry has compelled the inclusion of scientific inquiry within the processes of production and distribution. We find in the public prints as many demonstrations of the benefits of science from a business point of view as there are proofs of its harmony with religion.

It is not possible that, under such conditions, the subordination of scientific techniques to purposes and institutions that flourished before its rise can indefinitely continue. In all affairs there comes a time when a cycle of growth reaches maturity. When this stage is reached, the period of protective nursing comes to an end. The problem of securing proper use succeeds to that of securing conditions of growth. Now that science has established itself and has created a new social environment, it has (if I may for the moment personify it) to face the issue of its social responsibilities. Speaking without personification, we who have a powerful and perfected instrument in our hands, one which is determining the quality of social changes, must ask what changes we want to see achieved and what we want to see averted. We must, in short, plan its social effects with the same care with which in the past we have planned its physical operation and consequences. Till now we have employed science absent-mindedly as far as its effects upon human beings are concerned. The present situation with its extraordinary control of natural energies and its totally unplanned and haphazard social economy is a dire demonstration of the folly of continuing this course.

The social effects of the application of science have been accidental, even though they are intrinsic to the private and unorganized motives which we have permitted to control that application. It would be hard to find a better proof that such is the fact than the vogue of the theory that such unregulated use of science is in accord with "natural law," and that all effort at planned control of its social effects is an interference with nature. The use which has been made of a peculiar idea of personal liberty to justify the dominion of accident in social affairs is another convincing proof. The doctrine that the most potent instrument of widespread, enduring, and objective social changes must be left at the mercy of purely private desires for purely personal gain is a doctrine of anarchy. Our present insecurity of life is the fruit of the adoption in practice of this anarchic doctrine.

The technologies of industry have flowed from the intrinsic nature of science. For that is itself essentially a technology of apparatus, materials and numbers. But the pecuniary aims which have decided the social results of the use of these technologies have not flowed from the inherent nature of science. They have been derived from institutions and attendant mental and moral habits which were entrenched before there was any such thing as science and the machine. In consequence, science has operated as a means for extending the influence of the institution of private property and connected legal relations far beyond their former limits. It has operated as a device to carry an enormous load of stocks and bonds and to make the reward of investment in the way of profit and power one out of all proportion to that accruing from actual work and service.

Here lies the heart of our present social problem. Science has hardly been used to modify men's fundamental acts and attitudes in social matters. It has been used to extend enormously the scope and power of interests and values which anteceded its rise. Here is the contradiction in our civilization. The potentiality of science as the most powerful instrument of control which has ever existed puts to mankind its one outstanding present challenge.

There is one field in which science has been somewhat systematically employed as an agent of social control. Condorcet, writing during the French Revolution in the prison from which he went to the guillotine, hailed the invention of the calculus of probabilities as the opening of a new era. He saw in this new mathematical technique the promise of methods of insurance which should distribute evenly and widely the impact of the disasters to which humanity is subject. Insurance against death, fire, hurricanes and so on have in a measure confirmed his prediction. Nevertheless, in large and important social areas, we have only made the merest beginning of the method of insurance against the hazards of life and death. Insurance against the risks of maternity, of sickness, old age, unemployment, is still rudimentary; its idea is fought by all reactionary forces. Witness the obstacles against which social insurance with respect to accidents incurred in industrial employment had to contend. The anarchy called natural law and personal liberty still operates with success against a planned social use of the resources of scientific knowledge.

Yet insurance against perils and hazards is the place where the application of science has gone the furthest, not the least, distance in present society. The fact that motor cars kill and maim more persons yearly than all factories, shops, and farms is a fair symbol of how backward we are in that province where we have done most. Here, however, is one field in which at least the idea of planned use of scientific knowledge for social welfare has received recognition. We no longer regard plagues, famine and disease as visitations of necessary "natural law" or of a power beyond nature. By preventive means of medicine and public hygiene as well as by various remedial measures we have in idea, if not in fact, placed technique in the stead of magic and chance and uncontrollable necessity in this one area of life. And yet, as I have said, here is where the socially planned use of science has made the most, not least, progress. Were it not for the youth of science and the historically demonstrated slowness of all basic mental and moral change, we could hardly find language to express astonishment at the situation in which we have an extensive and precise control of physical energies and conditions, and in which we leave the social consequences of their operation to chance, *laissez-faire*, privileged pecuniary status, and the inertia of tradition and old institutions.

Condorcet thought and worked in the Baconian strain. But the Baconian ideal of the systematic organization of all knowledge, the planned control of discovery and invention, for the relief and advancement of the human estate, remains almost as purely an ideal as when Francis Bacon put it forward centuries ago. And this is true in spite of the fact that the physical and mathematical technique upon which a planned control of social results depends has made in the meantime incalculable progress. The conclusion is inevitable. The outer arena of life has been transformed by science. The effectively working mind and character of man have hardly been touched.

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taken effect most rapidly, namely, education. In dealing with the young, it would seem as if scientific methods might at once take effect in transformation of mental attitudes, without meeting the obstacles which have to be overcome in dealing with adults. In higher education, in universities and technical schools, a great amount of research is done and much scientific knowledge is imparted. But it is a principle of modern psychology that the basic attitudes of mind are formed in the earlier years. And I venture the assertion that for the most part the formation of intellectual habits in elementary education, in the home and school, is hardly affected by scientific method. Even in our so-called progressive schools, science is usually treated as a side line, an ornamental extra, not as the chief means of developing the right mental attitudes. It is treated generally as one more body of ready-made information to be acquired by traditional methods, or else as an occasional diversion. That it is the method of all effective mental approach and attack in all subjects has not gained even a foothold. Yet if scientific method is not something esoteric but is a realization of the most effective operation of intelligence, it should be axiomatic that the development of scientific attitudes of thought, observation, and inquiry is the chief business of study and learning.

Two phases of the contradiction inhering in our civilization may be especially mentioned. We have long been committed in theory and words to the principle of democracy. But criticism of democracy, assertions that it is failing to work and even to exist are everywhere rife. In the last few months we have become accustomed to similar assertions regarding our economic and industrial system. Mr. Ivy Lee, for example, in a recent commencement address, entitled "This Hour of Bewilderment," quoted from a representative clergyman, a railway president, and a publicist, to the effect that our capitalistic system is on trial. And yet the statements had to do with only one feature of that system: the prevalence of unemployment and attendant insecurity. It is not necessary for me to invade the territory of economics and politics. The essential fact is that if both democracy and capitalism are on trial, it is in reality our collective intelligence which is on trial. 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.

The first lesson which the use of scientific method teaches is that control is coordinate with knowledge and understanding. Where there is technique there is the possibility of administering forces and conditions in the region where the technique applies. Our lack of control in the sphere of human relations, national, domestic, international, requires no emphasis of notice. It is proof that we have not begun to operate scientifically in such matters. The public press is full of discussion of the five-year plan and the ten-year plan in Russia. But the fact that the plan is being tried by a country which has a dictatorship foreign to all our beliefs tends to divert attention from the fundamental consideration. The point for us is not this political setting nor its communistic context. It is that by the use of all available resources of knowledge and experts an attempt is being made at organized social planning and control. Were we to forget for the moment the special Russian political setting, we should see here an effort to use coordinated knowledge and technical skill to direct economic resources toward social order and stability.

To hold that such organized planning is possible only in a communistic society is to surrender the case to communism. Upon any other basis, the effort of Russia is a challenge and a warning to those who live under another political and economic regime. It is a call to use our more advanced knowledge and technology in scientific thinking about our own needs, problems, evils, and possibilities so as to achieve some degree of control of the social consequences which the application of science is, willy-nilly, bringing about. What stands in the way is a lot of outworn traditions, moth-eaten slogans and catchwords, that do substitute duty for thought, as well as our entrenched predatory self-interest. We shall only make a real beginning in intelligent thought when we cease mouthing platitudes; stop confining our idea to antitheses of individualism and socialism, capitalism and communism, and realize that the issue is between chaos and order, chance and control: the haphazard use and the planned use of scientific techniques.

Thus the statement with which we began, namely, that we are living in a world of change extraordinary in range and speed, is only half true. It holds of the outward applications of science. It does not hold of our intellectual and moral attitudes. About physical conditions and energies we think scientifically; at least, some men do, and the results of their thinking enter into the experiences of all of us. But the entrenched and stubborn institutions of the past stand in the way of our thinking scientifically about human relations and social issues. Our mental habits in these respects are dominated by institutions of family, state, church, and business that were formed long before men had an effective technique of inquiry and validation. It is this contradiction from which we suffer to-day.

Disaster follows in its wake. It is impossible to overstate the mental confusion and the practical disorder which are bound to result when external and physical effects are planned and regulated, while the attitudes of mind upon which the direction of external results depends are left to the medley of chance, tradition, and dogma. It is a common saying that our physical science has far outrun our social knowledge; that our physical skill has become exact and comprehensive while our humane arts are vague, opinionated, and narrow. The fundamental trouble, however, is not lack of sufficient information about social facts, but unwillingness to adopt the scientific attitude in what we do know. Men floundered in a morass of opinion about physical matters for thousands of years. It was when they began to use their ideas experimentally and to create a technique or direction of experimentation that physical science advanced with system and surety. No amount of mere fact-finding develops science nor the scientific attitude in either physics or social affairs. Facts merely amassed and piled up are dead; a burden which only adds to confusion. When ideas, hypotheses, begin to play upon facts, when they are methods for experimental use in action, then light dawns; then it becomes possible to discriminate significant from trivial facts, and relations take the place of isolated scraps. Just as soon as we begin to use the knowledge and skills we have to control social consequences in the interest of shared abundant and secured life, we shall cease to complain of the backwardness of our social knowledge. We shall take the road which leads to the assured building up of social science just as men built up physical science when they actively used the techniques of tools and numbers in physical experimentation.

In spite, then, of all the record of the past, the great scientific revolution is still to come. It will ensue when men collectively and cooperatively organize their knowledge for application to achieve and make secure social values; when they systematically use scientific procedures for the control of human relationships and the direction of the social effects of our vast technological machinery. Great as have been the social changes of the last century, they are not to be compared with those which will emerge when our faith in scientific method is made manifest in social works. We are living in a period of depression. The intellectual function of trouble is to lead men to think. The depression is a small price to pay if it induces us to think about the cause of the disorder, confusion, and insecurity which are the outstanding traits of our social life. If we do not go back to their cause, namely our half-way and accidental use of science, mankind will pass through depressions, for they are the graphic record of our unplanned social life. The story of the achievement of science in physical control is evidence of the possibility of control in social affairs. It is our human intelligence and human courage which are on trial; it is incredible that men who have brought the technique of physical discovery, invention, and use to such a pitch of perfection will abdicate in the face of the infinitely more important human problem.

NOTES

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By Nature and by Art

(1944)

I

Current philosophical theories of knowledge are strangely neglectful of the implications and consequences of the revolution that has taken place in the actual subject-matter and methods of scientific knowledge. In substance, this revolution may be said to be one from knowledge that is such "by nature" to scientific subject-matter which is what it is because it is "by art." The classic scheme, following Aristotle, held that the subject-matter of science, as the highest grade of knowledge, is what it is because of certain inherent forms, essences, or natures. These indwelling and constitutive natures are eternal, immutable, and necessary. It followed that in the Greek-medieval system all *sciences*, from astronomy to biology, were concerned with species or kinds, which are immutably the same and eternally separated from one another by the fixed natures forming their inherent essences or Being.

Other forms of knowledge, such as were called sense-perception and opinion, were also what they were by the nature of their inherent Beings; or, more strictly, by the unchangeable and incorrigible partiality or defect of Being which marked them. For over against fixed and eternal species constituted by inherent essential forms were the things that change; things that are generated and perish. Alteration, modifiability, mutability, are *ipso facto* proof of instability and inconstancy. These in turn are proof of lack of Being in its full sense. It is because of lack, or privation, of self-contained and self-sufficient Being that some things are variable and transient, now one thing and now another. The lack of inherent natures or essences is equivalent to dependence upon circumstances that are external, this dependence upon what is outside being manifested in their variability. In classic terminology, science is concerned with "formal causes," that is, with inherent natures which "cause" things to be *what* they are. Sense-knowledge and opinion are inferior forms of knowledge concerned with things which by their natures are so mutable that knowledge of them is itself unstable and shifting—as in the case of things touched, heard, seen.

It should not be necessary to dwell upon the fact that according to what is now science what the ancient scheme relegated to an inferior position, namely, efficient and material "causes," constitutes the only legitimate subject-matter of natural science, acceptance of the view that essential forms or natures are its subject-matter accounting for the sterility of science during the period before the scientific revolution occurred. According to the ancient doctrine, the subject-matter of sense-knowledge and opinion on one side, and of science on the other, are forever separated by a gulf that is impassable for the reason that it is cosmological and ontological—that is, due to the very "being" of the subjects involved. In what now constitutes science, the difference is methodological. For it is due to *methods of inquiry*, not to inherent natures. Potentially the subject-matters of sense and opinion are science in the making; they are its raw material. Increased maturity of the procedures and techniques of inquiry will transform their material into scientific knowledge. On the other side, there is no subject-matter of the scientific kind which is eternally the same and not subject to improvement with further development of efficacy in inquiry-procedures.

The scientific revolution, which put science upon the road of steady advance and ever increasing fertility, is connected with substitution of knowledge "by art" for that said to be "by nature." The connection is not remote nor recondite. The arts are concerned with production, with generation, with doing and making. They fall, therefore, within the domain of things which in the classic scheme are mutable, and of which, according to that scheme, scientific knowledge is impossible. According to the present conduct of science and according to its conclusions, science consists of knowledge of *orders of change*. While this fact marks a complete departure from the classic view, it does not suffice of itself to justify calling scientific knowledge an art, though it provides a condition without which that designation is not warranted; for it completely breaks down the grounds upon which a fixed and impassable line was originally drawn between the subject-matters of science and of art. For it connects science with change. The consideration that completes the ground for assimilating science to art is the fact that assignment of scientific status in any given case rests upon facts which are experimentally produced. Science is now the product of operations deliberately undertaken in conformity with a plan or project that has the properties of a working hypothesis. The value or validity of the latter is tested, as in the case of any art, by what happens in consequence of the operations it instigates and directs. Moreover, science is assimilated to the conditions defining an art by the fact that, as in the case of any industrial art, production of relevant and effective consequences depends upon use of artificially designed appliances and apparatus as means of execution of the plan that directs the operations which are undertaken.

II

It is an old and familiar story that "nature" is a word of many senses. One of its senses has been mentioned. According to it, the nature of that which is undergoing investigation, say combustion, electricity, or whatever, is the subject-matter of scientific generalizations. We still use the expression "the nature" of something or other in this sense, though, I imagine, with decreasing frequency. But when we do use it in this sense, its meaning is radically different from that possessed by the same expression in the classic scheme. For it no longer designates a fixed and inherent essence, or Being, that makes facts to *be* what they are. Instead, it signifies an order of connected changes, an order which is found to be fruitfully effective in understanding and dealing with particular changes. The difference is radical.[1]

Another meaning of "nature" is *cosmological*. The word is used to stand for the world, for the universe, for the sum total of facts which actually and potentially are the subject of inquiry and knowledge. With respect to this sense of "nature," ancient philosophy has an important advantage over the general tenor of modern philosophy. For while modern philosophy is conformable to actual scientific practice in eliminating an ontological difference, or a difference in kinds of Being, between the eternal and the changing, it has, unfortunately, tended to substitute for this difference one equally fixed between supposed subjective and objective orders of Being.[2] "Unfortunately" is in fact too mild and neutral a word. For the net effect has been to set up a seat and agency of knowing over against Nature as that known. Hence the "knower" becomes in effect extra-natural. Historically, the facts of the case are easily explainable. For while in the Greek version mind in both its sensible and its rational operations was a culminating manifestation or terminal "end," of natural facts, in the medieval version (out of which modern theory grew without outgrowing some of its major tenets) soul and mind took on definitely supernatural traits. These traits, in a more or less attenuated form, reappear in the extra-natural knowing "subject" of modern philosophy as that is set over against the natural world as "object."

To complete the statement of the terms of the question under discussion, it is necessary to note explicitly the sense of "nature" and "natural" in which they contrast with "art" and "artificial." For in the cosmological sense of nature, the saying of Shakespeare holds to the effect that nature is made better by no mean but nature makes that mean; in the third sense of natural (that just mentioned), science is definitely and conclusively a matter of art, not of nature.

We most readily lay hold of the meaning of this statement by presenting to ourselves a picture of an astronomical observatory or a physical laboratory. And we have to include as part of the picture the role of collections of books and periodicals, which operate in the most intimate and vital working connection with the other means by which science is carried on. For the body of printed matter is what enables the otherwise highly restricted material of immediate perception to be linked with subject-matters having an indefinitely wide spatial and temporal range. For only in fusion with book-material does what is immediately present take on scientific status, and only in fusion with the latter does the former cease to be "theoretical" in the hypothetical sense of that word. For only as culturally transmitted material with its deep and wide scope is anchored, refreshed, and tested continually through *here-and-now* materials provided by direct experimental observations does it become a warranted part of authentic science.

A further qualification has to be added to complete the statement that science with respect to both method and conclusions is an art. For there is a sense in which every form of knowledge is an affair of art. For all knowledge, even the most rudimentary such as is attributable to low-grade organisms, is an expression of skill in selection and arrangement of materials so as to contribute to maintenance of the processes and operations constituting life. It is not a metaphorical expression to say that at the very least all animals know *how*, in virtue of organic structure and physiological processes in connection with trans-cuticular conditions, to do things of this sort. When, then, it is said that science, as distinct from other modes of knowledge, is an art, the word "art" is used with a differential property. The operations of *search* that constitute the art or skill marking other modes of knowledge develop into re-search.

A more concrete qualification of the art which constitutes scientific knowledge is its dependence upon *extra-organic* appliances and instrumentalities, themselves artificially devised. The scientific revolution may be said to have been initiated when investigators borrowed apparatus and processes from the industrial arts and used them as means of obtaining dependable scientific data. The use of the lens was of itself almost enough to revolutionize the science of astronomy. As we look back, we note that the bulk of early knowledge was in fact built up through the pursuit of industrial and mechanical arts. The low social status of artisans (in which class were included sculptors, architects, painters of pictures, musicians, in fact all producers save those working with words) was "rationalized" in the doctrine of the inherently inferior state of all knowledge of this kind. At best, it was "empirical" in the disparaging sense of that word. Fundamentally, the scientific revolution consisted of transformation of "empirical" into *experimental*. The transformation was effected, historically, by adoption, as means of obtaining scientific knowledge, of devices and processes previously employed in industry to obtain "material" ends—in that sense of "material" which identifies "matter" with the menial and servile. After a period in which natural knowledge progressed by *borrowing* from the industrial crafts, science entered upon a period of steady and ever-accelerated growth by means of deliberate invention of such appliances on its own account. In order to mark this differential feature of the art which is science, I shall now use the word "technology."[3]

Because of technologies, a circular relationship between the arts of production and science has been established. I have already spoken of the dependence of science as now conducted upon the use of appliances and processes such as were once confined to the "utilitarian" and "practical" ends to which a subordinate and "base" status was attributed socially and morally. On the other hand, before the application in a return movement of science in the industrial arts, production was a routine affair. It was marked by imitation and by following established models and precedents. Innovation and invention were accidental rather than systematic. Application of scientific conclusions and methods liberated production from this state—a state justifying use of the adjective "empirical" in its disparaging sense. Through incorporation into the arts of production of the methods and conclusions of science, they are capable of becoming "rational" in the honorific sense of that word. The phrase "rationalization of production" states a fact. Indeed, it may be said that the distinction between science and other technologies is not intrinsic. It is dependent upon cultural conditions that are extrinsic to both science and industry. Were it not for the influence exerted by these conditions, the difference between them would be conventional to the point of being verbal. But as long as some technologies are carried on for personal profit at the expense of promotion of the common welfare, the stigma of "materialism" will continue to be attached to industrial technologies, and the honorific adjective "idealistic" will be monopolized by the technology which yields knowledge—especially if that knowledge is "pure"—that is, in the classic view, uncontaminated by being put to "practical" use.

III

Valuable instruction concerning a number of mooted problems in the theory of knowledge may be derived from the underlying principles of the prior discussion. One of them, perhaps the most obvious on the surface, is the fact that many classifications and distinctions which have been supposed to be inherent or intrinsic to knowing and knowledge are in fact due to socio-cultural conditions of a historical, and therefore temporal and local, sort. There is the fact (upon which I have dwelt at length in previous writings) of the arbitrary and irrelevant nature of the sharp line drawn in the classic philosophical tradition between "theoretical" and "practical" knowledge. The gulf that was supposed to separate them is in fact merely a logical corollary of the view that the proper subject of scientific knowledge is eternal and immutable. The connection of science with change and the connection of the methods of science with experimental production of change have completely vitiated this doctrine. The infertility of natural knowledge before adoption of the experimental method is attributable, in large measure, to the fact that ancient and medieval science took the material of ordinary observation "as is"; that is, in lumps and chunks as given "naturally" in a ready-made state. In consequence, the only treatment to which it could be subjected was dialectical.

What is not so obvious upon the surface is that a theory of knowledge based upon the conduct and conclusions of science does away, once and for all, with the fixed difference supposed to exist between sense-knowledge and rational-knowledge. The sensory aspect of knowledge is strictly an *aspect*. It is distinguishable in intellectual analyses that are undertaken for special purposes. But it is not, as it was long taken to be, a special kind of knowledge nor yet a separate component in knowledge. It is that aspect of the system of knowledge in and by which knowledge extending across an indefinitely extensive spatial and temporal range of facts is anchored and focalized in that which is *here-and-now*. Without demonstrated anchorage of this sort, any system, no matter how well organized with respect to internal consistency, is "theoretical" in the sense of being hypothetical. On the other hand, the "rational" aspect of knowledge is constituted by the corpus of extant knowledge which has been constituted by prior inquiries and which is so organized as to be communicable—and hence applicable to results of further inquiry by which the old system is corrected and extended.

The principle underlying these special matters is that the legitimate subject-matter of a *theory* of knowledge consists of *facts* that are known at a given time, with, of course, the proviso that the procedures by which this body of knowledge has been built up are an integral part of it. This view of the grounds of a competent theory of knowledge stands in open opposition to that which underlies the *epistemological* theory: the postulate, namely, that no subject-matter is entitled to be called knowledge until it has been shown to satisfy conditions that are laid down prior to any case of actual knowledge and independently of any conclusion reached in the course of the inquiries by which knowledge in the concrete is arrived at. The completeness of the opposition between the two postulates may be judged from the following consideration. Upon the ground of the first postulate subject-matter is entitled to the name of knowledge when it is determined by the methods of inquiry, test, verification, and systematic arrangement, or organization, which are factually employed in the sciences. Upon the other basis, the antecedent conditions apply to any and every case, good, bad, and indifferent. Hence they are of an entirely different order from the facts of actual investigation, test, and verification, which warrant use of the name "knowledge" in its honorific sense in actual instances.

It was then inevitable, from the standpoint of logic, that the epistemological approach culminated in the Kantian question: How is knowledge possible anyway (*ueberhaupt*)? If the question were put with reference to the "possibility" of any other subject under investigation, the *existence* of the subject-matter under inquiry would be the starting point. It suffices, for example, to show that cancer exists for the question as to its possibility to be simply the question of the specific conditions of an *actuality*. Only in the case of knowledge is it supposed that the question of its "possibility" is one which puts actuality into total doubt until certain universal antecedent conditions have been laid down and shown to be satisfied.

In the case of cancer, for example, the question of possibility means that our knowledge is still in a doubtful and indeterminate state, so that research is going on to discover the characteristic properties, conditions, and consequences of facts whose actual existence sets the problem. Yet strangely enough (strangely, provided, that is, historical-cultural facts are left out of account) the dogmatic and contradictory assumption that there exists knowledge of the conditions of knowledge prior to and conditioning every specific instance of knowledge arrogated to itself the name of a *critical* theory of knowledge!

IV

I do not propose to discuss further this contradiction, beyond saying that the contradiction will be obvious to anyone who views the matter in terms of the facts of knowledge, instead of in terms supplied by the history of philosophical systems viewed in isolation from other cultural events. I propose rather to set forth some of the historical-cultural conditions which generated in general the epistemological assumption of prior conditions to be satisfied; and which, in particular, led to the "subject-object" formula about these conditions. One of the influential factors consists of the conditions existing when the scientific revolution took place. It is hardly possible to over-emphasize the fact that these conditions were those of revolt not merely against long accepted intellectual doctrines but also against customs and institutions which were the carriers of these doctrines, and which gave them a support extraneous to their own constituents. Because of causes which are psychologically adequate, if not factually so, the word "social" has come to be regarded as applicable to that which is institutionally established and which exerts authority because of this fact. The adjective "individual" is identified on this basis with that which marks a departure from the traditionally and institutionally established, especially if the departure is of a quality involving revolt and a challenge to the rightful authority of tradition and custom.

These conditions were fully and strikingly present at the time of the rise of modern science. Every book on the history of philosophy mentions the fact that the philosophical literature of the fifteenth and subsequent centuries is marked by treatises, essays, tractates, that deal with the methods to be adopted and pursued if scientific knowledge is to be actually obtained. The negative aspect of these new ventures is assault, overt or implicit, upon all that had long been accepted as science. There was in effect, if not openly, an assertion that currently accepted subject-matter was hardly more than a systematized collection of errors and falsities. The necessity of radically new procedures of assault upon existing "science" was uniformly treated as an affair of *method*. It was because of the *methods* habitually used and sanctioned that existing "science" was stagnant, and so far removed from its proper mark—understanding of nature. Other documents upon right methods may not have used the words of Francis Bacon's *Novum Organum*, much less endorsed its precepts. But they were at one with him in proclaiming the necessity of a complete break with traditional methods and in stark opposition to the tenets of the *Organon* of Aristotle.

If the movement of protest, revolt, and innovation that was expressed in these documents and put in practice in the new astronomy and "natural philosophy" had been confined to "science" in its technical and isolated aspect, there would not have been the crisis that actually occurred. The facts constituting what is called "the conflict of science with religion"—or theology—clearly and convincingly prove that the movement of innovation, protest, and revolt was not so confined. The new science was treated as morally heretical and as a dangerous menace to the very foundations of a stable and just social order. Upon the Continent, especially, it was treated as rebellion against divinely established authority. In a more fundamental way than in the ecclesiastic movement named Protestantism, it was a protest against established foundations in morals and religion. Its opponents made this point clear when its proponents failed to do so.

Stated in slightly different terms, the subject-object formulation of the conditions to be satisfied before any subject-matter has a right to the honorable title of "knowledge" has to be viewed in vitally intimate connection with those movements in political and economic institutions which popularly bear the name "individualism." For, as has been already remarked, any departure from traditions and customs that are incorporated in and backed by institutions having firmly established authority is regarded as "individual" in a non-social and *anti*-social sense by the guardians of old forms in church and state. Only at a later time, when it is possible to place events in a long historic perspective instead of in the short-time crowded and broken perspective of what is immediately contemporary, can so-called "individualism" be seen to be as "social" in origin, content, and consequences as are the customs and institutions which are in process of modification.

In this cultural situation, the fact that philosophers as unlike as Descartes and Berkeley both refer to the seat and agent of knowledge as "I" or an "ego," a personal self, has more than casual significance. This reference is especially significant as evidence of the new climate of opinion just because no attempt at justification accompanied it. It was taken to be such an evident matter that no argument in its behalf was called for. References and allusions of this kind are the forerunners of the allegedly "critical" attempt of Kant to frame an account of the conditions of knowledge in terms of a "transcendental ego," after Hume had demonstrated the shaky character of the "empirical" self as the source and agent of authentic knowledge.

If we adopt the customary course of isolating philosophies in their historical appearance which is their actuality from other socio-cultural facts, if we treat the history of philosophy as something capable of being understood in the exclusive terms of documents labeled philosophical, we shall look at the outstanding feature of modern philosophy as one of a conflict between doctrines appealing to "sense-experience" as ultimate authority and theories appealing to intuition and reason, a conflict reaching a supposed solution in the Kantian reconciliation of the *a priori* and the *a posteriori*. When these philosophies are placed in their cultural context, they are seen to be partners in a common movement, both schools being in revolt against traditional science in its methods, premises, and conclusions, while both schools are engaged in search for a new and different seat of intellectual and moral authority. There are indeed significant differences between the two schools. But when these are historically viewed, they appear as differences of emphasis, one school inclining to the "conservative" phase of cultural institutions, and the other school to the "progressive" or radical phase.

While those aspects of the new science which express initiative, invention, enterprise, and independence of custom (on the ground that customs are more likely to be distorting and misleading than helpful in attaining scientific knowledge) are necessary conditions for generation of the subject-object formulation, they are far from being its sufficient condition. Unquestioned persistence of fundamental tradition controlled protest against other customs. Medieval institutions centered in belief in an immaterial soul or spirit. This belief was no separate item. It permeated every aspect of life. The drama of the fall, the redemption, and the eternal destiny for weal or woe, of the soul was all-controlling in the accepted view of the creation and history of the universe and of man. Belief in the soul was so far from being just an intellectual tenet that poignant emotion and the deepest and most vivid images of which man is capable centered about it. The church that administered the concerns of the soul was in effect the dominant educational and political institution of the period.

Secularizing movements gradually undermined the monopoly of authority possessed by the church. Although interests of a natural type did not supersede supernatural interests, they tended to push them out of a central into a peripheral position. But supernatural concerns retained such force in moral and religious matters that the theory of knowledge was routed through the channels they had worn after the *facts* of science were wearing a natural channel. This roundabout channel seemed, because of the force of habit, more "natural" than any indicated by the facts of science. The enormous gap between knowledge-facts and epistemological theory which marks modern philosophy was instituted.

In spite of revolt and innovation, the hold of the belief in the soul as knowing subject upon the attitudes which controlled the formation of the theory of knowledge was so firm that it could not be broken until the institutions, upon which the belief in its concrete validity depended had undergone definite degeneration.

Revolt and innovation were sufficient, however, to bring to explicit and emphatic statement one aspect of the Christian doctrine of the soul, an aspect which was kept covert and hidden in the dominant institutionalism of the Middle Ages. This aspect was the *individual* or singular nature of the subject of sin, redemption, punishment, and reward. Protestantism insisted upon making this aspect of the Christian position overt and central in religious matters. The writers who were concerned with the new science performed a similar task in the theories of knowledge they promulgated. The hold of the old doctrine, even upon those most indifferent to its theological phases, is shown in the persistence of belief in an immaterial mind, consciousness, or whatever, as being the seat and agent of knowledge. The influence of the belief upon the new science, even with its fundamental revolt and innovation, is exhibited in identification of the subject and agent of sound knowledge with "individuals" who had freed themselves from the perverting and deadening effect of custom and tradition. Even today those who deny in words that mind and consciousness are organs of knowledge, replacing them with an organic body or with the nervous system of the organism, attribute to the latter an isolation from the rest of nature (including transmitted and communicated culture) which is much more than reminiscent of the lonely isolation of the medieval soul.

It took more than the undeniable but negative fact of the gradual attenuation and decay of the importance once attached to the soul as seat of knowledge to effect an adequate elimination. The new movement of science had to achieve, on the ground of its own methods and conclusions, a positive conquest of those aspects of natural fact that deal with life and human history before complete elimination could occur. Only during the last hundred years (less than that in fact) have the sciences of biology, cultural anthropology, and history, especially of "origins," reached a stage of development which places man and his works squarely within nature. In so doing they have supplied the concrete and verified positive facts that make possible and imperatively demand formation of a systematic theory of knowledge in which the facts of knowledge are specified or described and organized exactly as are the facts of the sciences which are the relevant subject-matter of a theory of knowledge. Only in this way will the facts of our knowledge-systems and those of the theory of knowledge be brought into harmony with one another, and the present glaring discrepancy between them be done away with.

NOTES

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1. It may be remarked in passing that the *old* sense of the "nature" of a thing still prevails in discussion of moral and social subjects; and this fact may explain the continued stagnation and infertility of inquiry in these fields.

2. Virtual synonyms are "mental" and "physical" orders, and "personal" and "impersonal," taken as separate and opposed with reference to their inherent stuffs or subject-matters.

3. While a number of writers have brought forward the facts which are involved in this view, Dr. Clarence Ayres, as far as I am aware, was the first one explicitly to call science a mode of technology. It is probable that I might have avoided a considerable amount of misunderstanding if I had systematically used "technology" instead of "instrumentalism" in connection with the view I put forth regarding the distinctive quality of science as knowledge.

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Don Ihde, general editor

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Larry A. Hickman

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Chapter One: Locating Dewey's Critique of Technology

> When the instrumental and final functions of communication live together in experience, there exists an intelligence which is the method and reward of the common life, and a society worthy to command affection, admiration, and loyalty. (LW1:160;EN:169)

I

John Dewey's concern with technology pervades his published work. From his early days at the University of Michigan in the late 1880s until his last published work in the 1950s, Dewey formed his fundamental philosophical insights in response to the problems and opportunities of the developing technological society in which he lived as an active participant. While still at Michigan he came to view the problems of technology and the problems of philosophy as inseparable. Throughout his career his philosophical arguments were illuminated by means of a rich inventory of tools, machines, and hardware. Late in his life, "technology" became a synonym for his very method of inquiry.

It is the central thesis of this book that inquiry within technological fields—among which he included science as well as the fine and the vernacular arts—formed the basis of and provided the models for Dewey's larger project: his analysis and critique of the meanings of human experience.[1] And it is no overstatement to say that his critique of technology was the warp on which the weft of that larger project was strung.

It is therefore remarkable that Dewey is not generally known for his critique of technology. It is true that it was only after Dewey's death in 1952 that professional philosophers in America and Europe began to think systematically about technology and to organize themselves into societies to promote such research. But standard anthologies of the philosophy of technology[2] still do not include Dewey's essays, nor has his work on the subject yet been the focus of more than a few isolated interpretive essays.[3] A survey of publications in American studies and

American philosophy reveals a similar situation: Dewey has not generally been read as having set out a philosophy of technology.[4]

Some of the responsibility for this situation may have been Dewey's own, for he concentrated his critique of technology in no single work. His books on ethics, logic, aesthetics, education, religion, and political philosophy are clearly marked as such, and there is at least a healthy debate concerning whether *Experience and Nature* is a book about metaphysics.[5] But there is no *locus classicus* for Dewey's account of technology.[6]

Fault may also lie with Dewey's students and disciples. Almost without exception they failed to see that the version of pragmatism he called "instrumentalism" was his lifelong critique of tools and media of all sorts. Of that group, apparently only Sidney Hook and C. E. Ayres grasped this basic feature of instrumentalism. Hook's neglected Ph.D. dissertation, *The Metaphysics of Pragmatism* (published in 1927, the year the fifteen millionth Model "T" Ford rolled off the assembly line) caught Dewey's work in midstride. It nevertheless remains one of the best sources of insight into what Dewey meant by "instrumentalism." Few of Dewey's other colleagues or disciples seem to have understood that term as Dewey himself understood it, namely as a cognate of "technology."

No less overlooked and underrated than Hook's dissertation are the works of C. E. Ayres. *Science: The False Messiah* (which appeared in 1927, the same year as Hook's dissertation and Dewey's *The Public and Its Problems*), *The Industrial Economy* (1952), and *Toward a Reasonable Society* (1961) represent Ayres's attempts to construct along instrumentalist lines a theory of political economy appropriate to technologically based democracies. Taken together, these works of Hook and Ayres constitute the only sustained treatments of this fecund area of Dewey's thought.

It is to some extent possible to account for Dewey's preoccupation with technology in terms of the milieu in which he lived and worked. He came to prominence as "America's philosopher"[7] during a period that Charles Beard termed "the machine age." "In his hands," wrote Beard, "a branch of wisdom once deemed esoteric acquired a practical ring; in fact it conformed very closely to the requirements of an age committed to machine production, science, and progressive endeavor."[8]

The innovations of the machine age, the cultural changes through which Dewey lived and that influenced his thinking, shed light on Beard's assessment. His first essay was published in 1882, the year that Thomas A. Edison designed his first hydroelectric plant in Appleton, Wisconsin; his last appeared some seventy-two years later, shortly after his death in 1952, a year also visited by the explosion of the first hydrogen bomb and the first mass production of the birth-control pill.

At the time of Dewey's birth in 1859 the United States was in the

last stages of what Lewis Mumford has called the "eotechnic" period of technology. Wind, water, and animals were still the primary sources of power. Wood, in addition to powering steamships and railway locomotives, was the principal material of construction. The year of Dewey's birth was also the year that the first oil well was drilled in Titusville, Pennsylvania.

By 1900, however, when Dewey was in the middle of his ten-year term at the University of Chicago, Americans had moved firmly into Mumford's "paleotechnic" phase of coal and steel. They had "mastered the mechanical equivalent of 65,000,000 horses. Four million units of this new power eased the farmers' burdens. Railroads accounted for 24,000,000 horsepower as contrasted with less than 2,000,000 in 1860, and the stage had been set for automotive power to become . . . dominant . . . by 1910."[9]

By the time of Dewey's death in 1952, America was the undisputed leader in what Mumford called the "neotechnic" age of electricity and synthetic materials. America had moved, and had helped move the world, into the age of nuclear fission.

But the fact that Dewey's milieu was a technologically active one fails to provide a sufficient reason for his abiding interest in the subject. There were other philosophers with whom Dewey shared the places and times of the American machine age, but who exhibited scant interest in its public objects and events. Of the major figures of the classical period of American philosophy, for example, Dewey was the only one to engage actively in the cultural events of his lifetime. Both C. S. Peirce and William James were in their twenties during the American Civil War of 1861–65. But Peirce wrote nothing at all about that national trauma, and James's remarks were confined to an oration in 1897 on the occasion of the dedication of a monument.[10] The conceptual origins of the machine age in America have been traced by Swiss historian of technology Siegfried Giedion to Oliver Evans's mechanized grain mill built in Redclay Creek, Pennsylvania, in 1784.[11] But neither Peirce (1839–1914) nor James (1841–1910)—nor, for that matter, Royce (1855–1916) or Santayana (1863–1952)—seems to have regarded such matters as bearers of philosophical import.

For Dewey, however, philosophical inquiry, like any other form of inquiry, takes place as part of, and is directed toward, specific times and places. No major American philosopher, with the possible exception of Dewey's student Sidney Hook, has been more diligently committed to this ideal. As Dewey wrote in 1938, "We always live at the time we live and not at some other time, and only by extracting at each present time the full meaning of each present experience are we prepared for doing the same thing in the future. This is the only preparation which in the long run amounts to anything" (LW13:29–30;EE:51).

The machine age of which Beard wrote, and through much of which

Dewey lived, gave birth to two highly mechanized world wars concerning which Dewey was anything but silent. But it also gave rise to the locomotives, power plants, microscopes, radios, automobiles, agricultural implements, and even the humble pedals and skates that Dewey's readers find around every turn. These and hundreds of other technological artifacts concentrated his attention and furnished him with illustrative materials. He was concerned with how tools and instruments come to be, how they change human experience, and what they portend. But even more fundamentally, he sought to demonstrate that the methods and means by which technological inquiry takes place *are* the methods and means by which all knowing, in its "honorific" sense, is generated (see LW12:73;LTI:67).

In this area of his work as well as others, Dewey demonstrated outstanding tenacity with respect to the development, refinement, and recasting of his ideas over time so as to render them intelligible for the diverse audiences that constituted his reading publics.[12] His theory of inquiry, for example, which I shall argue was from first to last an account of technological method, was for the most part developed in essays and books published between 1903 and 1938. But it is adumbrated in his essay on "Moral Theory and Practice," published in January 1891 (EW3:93–109), and in his syllabus for "Introduction to Philosophy," offered at the University of Michigan in 1892 (EW3:230). Its development continued to occupy him until his death some sixty years later.

In his 1891 essay Dewey posed ethics as a type of problem in engineering. In his syllabus of 1892 he characterized the theory of inquiry, or logic, as "the general theory of science" (EW3:230), by which he meant experimentation that progresses only as it develops and utilizes ever more precise instrumentation. He argued in the 1892 syllabus that it is the task of logic to look backward at already complete experiments, by which he meant the manipulation of experience by means of instrumentation of all appropriate types, in order to resolve such experiments into their constituent factors. In his last letter to Arthur F. Bentley, dated 9 April 1951, he wrote that if he got the needed strength, he would like to write "on *knowing* as the way of behaving in which linguistic artifacts transact business with physical artifacts, tools, implements, apparatus, both kinds being planned for the purpose and rendering *inquiry* of necessity an *experimental transaction* . . . ."[13]

Some of Dewey's work was directed toward the interests of other professional philosophers, some to educators working in primary and secondary schools, some to students of philosophy, some to the "intellectual" community in general, and some to the general public. But his prodigious ambition with respect to creating and sustaining these diverse constituencies led not just to his national prominence; it may also be responsible for the formidable difficulties confronted by those who attempt to get an overview of his massive published work.

II

Dewey's ambition with respect to creating and maintaining diverse audiences may also account for his somewhat controversial style. Dewey's style (or, as one of his students remarked, "his lack of it"[14]) has at times been a stumbling block to recognition of the revolutionary character of his insights and proposals.

In *The Golden Day*, Lewis Mumford characterized Dewey's style as "fuzzy and formless as lint."[15] One of the anonymous authors of the file on Dewey compiled by the Federal Bureau of Investigation during the 1940s remarked, somewhat less generously, that "[r]eading him is a task."[16] Perhaps least generous of all was H. L. Mencken, who called Dewey "the most dreadful writer ever heard of."[17]

More sympathetic was the assessment of Stephen Toulmin that Dewey's style was "loose limbed and colloquial."[18] And John J. McDermott, with even greater sympathy, suggested that "Dewey was very wary of the seductive character of language and strove to avoid the use of the flamboyant phrase, choosing rather to make his point in the 'plain style.' "[19]

But whereas Mumford was so offended by Dewey's style that he was almost invariably oblivious to his insights, Toulmin and McDermott saw that form and content were for Dewey parts of a single fabric. Even though most of Dewey's work on his theory of inquiry, for example, was done during a time when philosophy was becoming increasingly formal and symbolic, the fact that his own presentations continued to be discursive was not due just to happenstance or force of habit, but to what he took to be the nature of the material he had chosen to treat.

Dewey's remarks in the preface to his 1938 *Logic: The Theory of Inquiry* are typical of his justifications of this predilection. There, he suggested that adequate symbolization of logic must follow a "general theory of language in which form and matter are not separated," that logic "depends upon prior institution of valid ideas of the conceptions and relations that are symbolized," and that without such discursive preparation, "formal symbolization will (as so often happens at present) merely perpetuate existing mistakes while strengthening them by seeming to give them scientific standing" (LW12:4;LTI:iv).

True to his distaste for dualisms and his penchant for avoiding extreme positions, Dewey's style exhibits neither the ornateness characteristic of most of the philosophical literature of his early and middle periods nor the bare-boned, low-content formalism that came to be the fashion in philosophical circles during his later period. It is reminiscent instead of what was characteristic of American-made tools of the machine age: functional simplicity designed for tasks at hand.

As I have already indicated, however, Dewey's design strategy was not without its difficulties. Novice or unsophisticated tool users tend at times to mistake simplicity for commonness or lack of adequacy.

Perhaps that is why tools that are poorly designed and constructed often sport superfluous frills and come in brightly colored packages. It is also true that the designer of a new tool that does the work traditionally done by an old and familiar one (but in a radically novel and more efficient fashion) had better be chary of calling the new device by the name of the old one.

Regardless of how one assesses his style, however, one thing is quite clear: Dewey steadfastly refused to obey the rules of the philosophical games played during the several periods of his long professional life. Early, when building systems was the norm, he refused to be a builder of systems. Later, when finding logical fallacies and "category mistakes" in the arguments of one's critics and opponents became stylish, he was still out of step. What in fact characterized his philosophical style from first to last was a plainspokenness that veiled the extent to which he undercut and then reconstructed the assumptions of his opponents and critics, and this in a way that was so radical that his opponents more often than not missed the point of his critiques of their works.[20]

III

One measure of the extent to which Dewey undercut traditional assumptions about technology is found in the fact that his work has to this day not been adequately addressed, even by the best and most complete taxonomies of the subject. One of the most reliable maps of this rugged and treacherous territory has been constructed by Carl Mitcham in his seminal essay "Types of Technology," published in 1978. In its "narrow" sense, Mitcham suggests, technology is the disposition and manipulation of materials by technically trained experts. To proponents of this view, including many engineers, technology is a realm of tools, machines, and electronic devices overseen by mechanics, engineers, and programmers. Typical questions within this domain are: "What is the best material with which to construct some artifact? What is the most efficient procedure for producing a particular product or bringing about a desired effect? How can materials and energy be combined to create new inventions?"[21]

As used by historians and social scientists, however, "technology" normally has a much broader meaning. It includes the narrow sense, to be sure, but is extended to include "all making of material artifacts, the objects made, their use, together with their intellectual and social contexts."[22] In this usage, for example, premodern pot making is counted as a form of technology because of its obvious connections to modern forms of technology such as industrial ceramics, and because the social conditions associated with earlier pot making are continuous with the production and use of such artifacts today. Mitcham suggests that "in the history of technology, which is the primary social science

study of technology, technology has sometimes been defined so as to refer even to the making of nonmaterial things such as laws and languages—although in practice this definition has not been widely utilized."[23]

Mitcham's own suggestion is that the term "technology" is not univocal, but that there is a certain primacy connected with its use to refer to the making of material artifacts. He even proposes that "the term be stipulated to refer to the human making and using of material artifacts in all forms and aspects."[24] Mitcham correctly sees the history of philosophy as almost exclusively concerned with human *doing*, and he thinks that this fact may be responsible for the somewhat tardy and grudging attention that philosophers have given to technological matters, which are matters of *making*.

Despite his disclaimer regarding the exclusion of nonmaterial things from the realm of technology, however, Mitcham's work exhibits a somewhat hesitant tendency to include such immaterial things as laws and languages within the domain of technological artifacts. This tendency, however ambivalently expressed, aligns Mitcham almost uniquely among contemporary philosophers of technology with the position developed by John Dewey in the initial decades of this century.[25]

Mitcham has argued that properly philosophical accounts of technology operate somewhere between the narrow and broad domains just described. As opposed to the "first-order" questions posed by engineers and historians, however, philosophers of technology concern themselves with "second-order" issues such as the nature and meanings of technology, and its structural and functional aspects.

In the introduction to their now-classic *Philosophy and Technology*, Mitcham and his colleague Robert Mackey isolated three basic groups of philosophical approaches within this middle field: (1) those that analyze technology as a problem of epistemology, (2) those that consider technology from an anthropological standpoint, that is, in relation to the nature of human life, and (3) those that treat technology as "the defining characteristic of thought and action in modern society."[26]

In terms of these distinctions (and by way of preview), Dewey's own position may be characterized as follows. First, he attempted to undercut the epistemological position by arguing that technology has to do with experience in a wider sense than could be contained even in the broadest of epistemological accounts. He argued that one of the principal fallacies in the history of philosophy was the taking of "cognitive knowledge" as paradigmatic for all human experience. He further contended that there are vast areas of human experience, including some in which technological activities take place, with which knowing has no business. As Ralph Sleeper has convincingly argued, inquiry is for Dewey more a matter of logic than of epistemology.[27] In other words, Dewey was not so much interested in a theory of certain knowledge as he was in a method of inquiry by means of which perceived problems could be solved.

Second, Dewey was acutely aware of the place of technology within the larger concerns of human life. In this as well as other matters, Charles Beard's assessment was essentially correct: Dewey "waited assiduously on the new revelations of science, listened to the changing voices of psychology, and gave to his thought the semblance of vitality and motion that accompanied the flow of all things."[28]

Dewey was forever seeking to establish connections and continuities between humble quotidian technological practices and their refined, enriched manifestations.[29] In his account of inquiry he argued for the continuity of inquiry from mundane affairs through science, logic, and metaphysics. In his treatment of the production of art and aesthetic experience his metaphor was that of a mountain peak: "Mountain peaks do not float unsupported; they do not even just rest upon the earth. They *are* the earth in one of its manifest operations. It is the business of those who are concerned with the theory of the earth, geographers and geologists, to make this fact evident in its various implications. The theorist who would deal philosophically with fine art has a like task to accomplish" (LW10:9–10;AE:3–4).

Third, Dewey did not think technology "the defining characteristic of thought and action in modern society." Because of his characterization of the ways in which meanings are generated and in which they function, and because of his appreciation of the complexity of human society, he rejected the view that *any* characteristic of modern society could adequately define it. He was, however, careful to distinguish those activities within modern societies that are productive of expanded meanings and significances from those activities that are "mechanical" in the infelicitous sense of that word; that is, in the sense in which means and ends have been divorced from one another, and meaningfulness has been lost, forfeited, or abandoned. Unfortunately, however, as Dewey well knew, the term "technological" has been utilized for both kinds of activities. This fact served as one of the primary motivations for his attempt to reconstruct the term.

IV

Even attempts by other philosophers to refine Mitcham and Mackey's taxonomy have failed to make a place for Dewey's critique of technology. Utilizing their work as his point of departure, Albert Borgmann discerned what he takes to be three conjointly exhaustive approaches to second order, or philosophical, questions about technology.[30] He terms these views "substantive," "instrumentalist," and "pluralist."

Substantive approaches, such as the one advanced by Jacques Ellul,[31] reify technology by treating it as a force in its own right. They seek "to give a comprehensive elucidation of our world by reducing its perplexing features and changes to one force or principle. That principle, technology, serves to explain everything, but it remains itself entirely unexplained and obscure."[32] I shall deal more fully with Ellul's views in chapter 6; but for now it is correct, even if something of an oversimplification, to say that he views technology as artificial and autonomous, as exhibiting exponential self-augmenting growth, as having complete power of determination over other cultural manifestations such as art and religion, and as rendering human beings increasingly impotent with respect to control over their lives.

Borgmann suggests that "instrumentalist" approaches are both more familiar and offer a more perspicuous view of technology. These views are "historicist" (in one of the many senses of that word) in that they attempt to display a "continuous historical thread that leads from our ensemble of machines back to simple tools and instruments."[33] Borgmann divides instrumentalist views into three further types:

1. "Anthropological" views treat human beings fundamentally as tool users and makers of artifacts.
2. "Epistemological" views are those whose primary focus "is not the development of humans and their tools but . . . the methodology that modern technology embodies as a way of taking up with reality, particularly in distinction to scientific procedure."[34]
3. "Rational value determinism" is the view that the determination of what guides value formulation within technology is itself a rational undertaking. Since Borgmann thinks that instrumentalist views treat technology as "value neutral," it is a matter of some interest that he nevertheless holds that "rational value determinism" is a form of instrumentalism. "If technology is at bottom a mere instrument," he suggests, "the inquiry of *what guides* technology becomes a task in its own right. The determination of the guiding values is sometimes held to be a matter of rational inquiry. 'Rational value determinism' is therefore by implication a species of instrumentalism."[35]

Borgmann's final category comprises what he calls "pluralist" approaches. This is a family of positions which might also be called "sociological," in the sense that each is characterized by its attempts to describe the complex of trends, attitudes, and forces that are termed "technological" even in a loose sense. Borgmann's view is that for pluralists such as Victor Ferkiss[36] there is no overall pattern of technology, but rather a continually shifting network of technological phenomena that comprises numerous countervailing forces.

Though one would have expected to find Dewey listed as an advocate of what Borgmann calls the instrumentalist view (since that was Dewey's name for his own position), Borgmann does not mention him in that (or in any other) connection. In fact, Dewey's account of technology fits comfortably in none of the three categories that Borgmann thinks are conjointly exhaustive.

Dewey's is not a substantive view because he continually and explicitly rejected reification of all sorts. Dewey's well-known antifoundationalism with respect to the traditional problems of metaphysics, his contention that certainty is both illusive and not required for satisfactory knowing, and his constant insistence that nouns such as "mind" and "knowledge" be treated as gerunds rather than substantives all militate against an interpretation of his view as a substantive position.

Nor is his view "pluralist" in Borgmann's sense. Even though Dewey was not unaware of the enormous diversity of cultural manifestations we call technological, his work went beyond the tagging, cataloging, and comparing that often delimit such approaches. Ever the reformer, Dewey did not shy away from working out critical proposals regarding the reconstruction of technological inquiry; he thought that such proposals should be developed for all technical-cultural manifestations that are living and momentous.

Was Dewey, then, an instrumentalist in Borgmann's sense of that term? At first glance, and because Dewey used the term "instrumentalism" as one of the designations for his own philosophical method, this would appear to be the case. But further analysis reveals adequate grounds for locating Dewey's position outside this category as well.

It is true that Dewey thought that there is a historical thread from the simple tools and implements of our ancestors to the complex machines of contemporary life. There is a vestige of a bent stick in the most up-to-date plowing equipment. In contrast to the position taken by Heidegger and to Borgmann's own neo-Heideggerian position, however, Dewey thought that the experimental tools and methods produced by seventeenth-century science and further developed during the first industrial revolution did not so much constitute a radical break in the progress of inquiry as they did a giant step forward for inquiry.

Dewey repeatedly insisted that his account of inquiry was based on a genetic method that took development over time as an essential component. Since human beings are within and part of nature, the development of intelligence with respect to the control of human environments in order to effect increased meaning and significance within those environments is for Dewey emergent within nature. And though he was not reluctant to admit that there have been periods of stagnation and retrogression in the history of intelligent control of environing situations, he also thought that the history of the

development of the tools and artifacts by means of which such control has been effected has generally been cumulative.

Dewey's position also fails to exhibit the other marks that Borgmann thinks characterize instrumentalism. First, human beings are in Dewey's view certainly more than simply tool makers and tool users, although they are that. They engage in myriad activities that may be loosely termed "aesthetic" in the sense that they involve primitive and uncritical delight. Their interests are also directed toward those experiences Dewey calls "consummatory"—that is, experiences in which appreciation has been sharpened and significance has been expanded by means of critical inquiry in order to extend them far beyond anything that might be called a primitive pleasure. Dewey specifically associates tool use in its most important sense with knowing, but he just as specifically indicates that there are portions of experience in which tools are used habitually and transparently, that is, without reflective interaction with them.

This is one of the aspects of Dewey's view that is incompatible with strict versions of the *homo faber* thesis. There are, he emphasized, areas of human experience with which knowing has no business. In Dewey's view, human beings find themselves in situations and exhibit responses that are much richer than would be characteristic of forms of life in which the construction and use of tools was the highest good. Dewey thought that tools are most often developed to solve some specific existential problem. But it was also his view that the construction and use of tools is a part of the richness of human experience, and that tool making and using may be a means of enrichment of those areas of human experience in which knowing is not operative. Tools and machines have their own momentum: they have consequences that were never intended.

Second, it is true that Dewey held that value determination is rational, but in a sense quite different from Borgmann's use of that phrase. For Borgmann, rationality is apparently something cognitive, and set over and against experimental activities we call technological, setting the goals of more properly technological activities and informing them with meaning. This view provides the basis for his contention that science and technology are fundamentally different enterprises. But Dewey rejected the notion that rationality is purely cognitive, and he viewed science as a type of technology. He reconstructed "rationality" as "intelligence"—the formulation and testing of ends that are proposed in the context of, and grow from, experimental activities.

Intelligence is for Dewey not something over or against technology, but a characteristic of technology in its honorific sense. In other words, when what is commonly called technology fails to be intelligent, it does not, strictly speaking, deserve the name "technology." It should instead be termed repetition of habitual behavior, acquiescence to the temptation of personal gain in economic or political spheres, or perhaps even laziness or stupidity.

Dewey's critique of technology is not instrumentalism in the ordinary sense, in which ends are established, revealed, or inherited, and then means to reach them are sought. Dewey never tired of arguing against acquiesence to fixed and final values or ends, and against default to unconditional or supernaturally transcendent goals. He proposed instead that goals be treated as "ends-in-view"—ends that are alive and active only as they exhibit continuous interplay with the means that are devised and tested in order to secure them. Insofar as he utilized the term at all, transcendence was for Dewey a kind of projection into the future, not something read out of eternity or something given once and for all by the authors of the "classics" (as some writers of best-selling books and champions of "great books" programs would have it).[37]

Analysis of means and ends thus becomes, in Dewey's view, an analytical exercise performed *after* the fact of successful inquiry, for the purpose of separating out elements of a total inquiriential situation in order to produce within it still further meaning and significance. Far from being just given in experience, means and ends in Dewey's view are themselves constructed as tools of analysis from enriched experience once experience becomes the object of reflection.

Third, perhaps the most glaring difference between Dewey's position and the kind of instrumentalism sketched by Borgmann is that Borgmann's instrumentalists, like his substantivists and pluralists (and, for that matter, like Borgmann himself), restrict the domain of technological instruments to tangible artifacts that are extra-organic. They do this by distinguishing as different tangible tools and hardware on one side, and conceptual means or ideas on another. It was Dewey's view, however, that the tools and artifacts we call technological may be found on either side of what he argued was an extremely malleable and permeable membrane that separates the "internal" from the "external" with respect to the organism only in the loosest and most tentative of senses.

In *Experience and Nature* Dewey specifically identified ideas as artifacts. "The idea," he contended, "is, in short, art and a work of art. As a work of art, it directly liberates subsequent action and makes it more fruitful in a creation of more meanings and more perceptions" (LW1:278;EN:301). As I have indicated, he was already in the 1890s treating ethics as a kind of engineering problem. And as early as 1916 he compared the construction of logical entities to the development of agricultural implements, suggesting that instruments, including tools and works of art, provide an alternative to the entities that have traditionally been placed in compartments labeled "physical," "psychical," and "metaphysical."

> Consider the bare possibility that tools and works of art give the key to the question at hand: that works and tools of art are precisely the sought-for alternative to physical, psychical and metaphysical entities. On this possibility, the ignoring of the characteristic features of this kind of thing is responsible for the unsettled and persistent controversy. Manufactured articles do not exist without human intervention; they do not come into being without an end in view. But when they exist and operate, they are just as realistic, just as free from dependence upon psychical states (to say nothing of their not *being* psychical states) as any other physical things . . . . They are simply prior natural things reshaped for the sake of entering effectively into some type of behavior. (MW 10:92)

It was further his view that "logical distinctions and relations may be purely methodological, and yet not 'mental' in the traditional sense of mental. They may well be . . . the tools of a safeguarded research and the results *qua* results of such investigation" (MW 10:93).

Borgmann thinks that the position taken by instrumentalists is "shortsighted"[38] and that it "does not constitute a proper theory of technology"[39] because its treatment of tools and instruments as value-neutral "is congenial to that liberal democratic tradition which holds that it is the task of the state to provide means for the good life but wants to leave to private efforts the establishment and pursuit of ultimate values."[40]

This might be true of what may be called "naive" instrumentalism, or what Langdon Winner has called "straight-line" instrumentalism. But it is not true of Dewey's instrumentalist version of pragmatism. Many of those who have hurled stones at technology from the ivory towers of the humanities have misidentified all or most technology as straight-line instrumentalism. William Barrett's remarks on technology in *The Illusion of Technique* provide a good example. Technology is for Barrett "*embodied technique* . . . and technique reaches its limits precisely at that point beyond which real creativity is called for—in the sciences as well as the arts."[41] Barrett's definition of technique is in fact one that offers a good description of the straight-line instrumentalism of pre-seventeenth-century crafts: "A technique is a standard method that can be taught. It is a recipe that can be fully conveyed from one person to another. A recipe always lays down a certain number of steps which if followed to the letter, ought to lead invariably to the end desired. The logicians call this a *decision procedure*."[42] But as Dewey repeatedly reminded us, technology is much more than the straight-line instrumentalism with which Barrett wished to identify it.

In the chapters that follow, I shall have much more to say about the differences between Dewey's instrumentalism and naive or straight-line instrumentalism. For the present, however, it should be said that Dewey did not treat tools and instruments as value-neutral but rather as teeming with values and potentialities that form the basis for intelligent selection of ends-in-view, or things to be done. Moreover, regarding

Borgmann's criticism that the straight-line instrumentalists tend to want to leave to private interests "the establishment of ultimate values," it should be remembered that Dewey's critics on the political right never tired of attacking him for his call to intelligent planning—the engendering and testing of goals and ends—at the most comprehensive of public levels.

Far from taking the position of the straight-line instrumentalists that Borgmann characterizes so well—that technology constitutes a value-neutral tool that is equally pliable in the hands of political moderates or in those of extremists of the left or right—it was Dewey's contention that the failure of political programs such as those undertaken by the European Fascists of the 1930s was due precisely to their misunderstanding of the values implicit in the situations that gave rise to their tools and in which they utilized them. Political inquiry, because it is one important form of assessing and choosing the most desirable among these values, was for Dewey a form of technological inquiry, though not the highest or primary form of *techne*, as it was for Plato. It is simply one area of human experience, which requires successful instrumental inquiry if it is to generate satisfactory consequences.

V

Carl Mitcham has argued that philosophers are also properly concerned with the "structural" and "functional" aspects of technology. "Structure," for Mitcham, has to do with the search for a "real definition of the essence of technology that can be seen to underlie or be exemplified in its various modes and manifestations."[43] In terms of function, he thinks that an adequate philosophical critique of technology must distinguish between what "goes on internally in man, that which is part of his bodily activity and thus his social involvement, and that which becomes in a sense part of and interacts with the natural world by taking on a life of its own independent of his immediate bodily action. This corresponds to the distinctions between technology-as-knowledge, technology-as-process, and technology-as-product—or thoughts, activities, and objects."[44]

In this definition technological objects include utensils, apparatus, utilities, tools, machines, and electronic devices. Technological activities include invention, design, making, operation, and management. Mitcham suggests that "the functions of planning, teaching, consulting, and systems engineering cut across these various distinctions."[45] Finally, technological "thoughts" include for Mitcham (a) unconscious sensorimotor awareness of how to make or use some artifact; (b) technical maxims or rules of thumb, such as "cookbook recipes" of the form "to get A, do B"; (c) descriptive laws of the form "if A, then B"; and (d) technological theories that relate or provide an explanatory framework for descriptive laws.[46]

It is possible to see in Mitcham's account the vestiges of one that is considerably older. Aristotle, too, distinguished among (inner) theoretical sciences such as mathematics, (social) practical sciences such as ethics, and (artifactual) productive sciences such as poetry. A full account of the very different ways in which Aristotle and Dewey treated these matters will be part of chapter 5. For the present, however, the following should be noted. For Aristotle, the theoretical sciences were regarded as superior to those that are practical and productive (1026a20),[47] and the practical sciences were regarded as superior to those that are productive (1064a10).[48] But because Dewey rejected the Aristotelian view that objects, ends, or principles are fixed and finished, cognitive or theoretical exercises are for him more than mere contemplation of static entities. They become special tools of activities that are practical. And since practice that is intelligent (as opposed to rote or lazy) involves the constant production of new artifacts, including "internal" artifacts such as refined habits, production takes precedence over and becomes a guide to practicality.

Despite the fact that Dewey and Aristotle shared an approach to philosophy that has been termed both naturalist and functionalist, in the matter of the classification of these "sciences" Dewey turns Aristotle on his head. Dewey goes beyond theory and beyond praxis to production: his concern is with the making and testing of new entities including extra-organic tools as well as goals and ideals.

In addition to the "intellectual component" that is most commonly taken as "internal" with respect to technology, Mitcham sees a second internal function, which he calls "technology-as-volition." From this vantage point ". . . technologies seem to be tied up with every imaginable will, motive, love, desire, need, intention, affection, choice, etc."[49]

This post-Aristotelian category may be traced at least as far back as book 5 of Francis Bacon's *The Dignity and Advancement of Learning*. It is there that Bacon asserts that "the doctrine concerning the Intellect . . . and the doctrine concerning the Will of man, are as it were twins by birth. For purity of illumination and freedom of will began and fell together; and nowhere in the universal nature of things is there so intimate a sympathy as between truth and goodness. The more should learned men be ashamed, if in knowledge they be as the winged angels, but in their desires as crawling serpents; carrying about with them minds like a mirror indeed, but a mirror polluted and false."[50]

Whereas much of the philosophical tradition since Bacon posits two things or faculties—namely, intellect and will (sometimes, as in the work of Hume, called reason and passion)—Dewey characterizes the situation quite differently. Human beings operate on the basis of habits that are learned as the result of previous inquiry, whether their own or that of someone else, and they are able to marshal those habits in the pursuit of projected ends, which he calls ideas. Dewey thus rejects attempts to reify intellect and will. He substitutes a functional account for a structural one, eschewing in the process all varieties of faculty psychology.

Dewey treated this matter in his 1922 *Human Nature and Conduct*, where he developed at considerable length his reasons for rejecting those positions, such as Bacon's, that have hypostatized the "will." He argued that what is commonly called "will" is but a complex of habits, which in turn are "demands for certain kinds of activity . . . and . . . constitute the self. In any intelligible sense of the word will, they *are* will. They form our effective desires and they furnish us with our working capacities" (MW14:21;HNC:25).

Habits are in their turn characterized in terms of rich technological metaphors: the toolbox (MW14:22;HNC:25), the flywheel, and the mainspring (see LW2:334–35;PP:159). Dewey contrasted tools passively arrayed in a toolbox to tools in active use. To think of habits as tools in a box is to treat them as objects, not as tools. We can certainly think of habits in this way, as having certain structural features; but in their function as tools, rather than as objects in a box, they have their meaning only in their use, and they are used only in conjunction with concrete situations. Habits are dynamic, supplying inner tension, like mainsprings, and, like flywheels, they also supply the momentum necessary for continued activity even in the absence of stimuli that call for innovative thinking.

If structure gives way to function in Dewey's account of tools, including the tools we call habits, it is also the case that the diremption of inner and outer gives way to attention to a total situation. Eye, arm, and hand may be treated structurally, as objects: in use, however, they function as tools for grasping and handling. But grasping is an activity that when actively engaged resists attempts to separate that which grasps from that which is grasped: " . . . Whenever they are in action they are cooperating with external materials and energies. Without support from beyond themselves the eye stares blankly and the hand moves fumblingly. They are means only when they enter into organization with things which independently accomplish definite results" (MW14:22;HNC:26). What is grasped and what grasps may be analyzed *after* grasping has been attempted or accomplished, and *on the basis of* that functional activity. But Dewey argues that to say (as is common in philosophical treatments of technology) that there exists *before* that activity takes place something essentially grasping and something essentially grasped, is to commit what he terms "the philosophic fallacy": the taking the results of inquiry as prior to it.

Chapter Two: Knowing as a Technological Artifact

> Inference, or the use of things as evidence of other things, is a constant and important function of behavior, as much so as any other in life. This is a minimum statement, suffering from exaggerated over-caution. If such acts as walking, plowing, eating, blacksmithing, etc., need and evolve distinctive instrumentalities, organs, structures, for their prosecution, especially for their *successful* prosecution, the presumption is strongly in favor of the statement that the operation of inference has its own peculiar characteristic tools and results. (MW10:92)

I

Techne, the ancestor of "technology," was used by Greek contemporaries of Plato and Aristotle to designate any productive skill. More specifically, the term was used in a demotic sense as "a kind of professional competence as opposed to instinctive ability (*physis*) or mere chance (*tyche*)."[1] *Techne* was thus used to designate a realm of activity that occupied a place between two extremes: the order of nature (or supernature) and the disorder of chance. For the Greeks, productive skill was said to act with respect to both extremes.

For Aristotle and Plato alike, *techne* was said to imitate nature by modifying and bringing to completion natural events and objects for the sake of human purpose and use. At the same time it was said to perform the quasi-divine function of establishing order where there had been only chance. Although Aristotle found much in Plato's treatment of *techne* with which to disagree, it is clear that both men would have accepted this general characterization of the term.

In addition to its intermediate position between nature and chance, *techne* stood, for the Greeks, between two other extremes. Since it involved knowledge and ability directed toward production and construction, it occupied "a sort of intermediate place between mere experience or know-how, *empeiria*, and theoretical knowledge, *episteme*."[2] Unlike *episteme*, technology did not have to do with the *in Experimental Logic* (Chicago: The University of Chicago Press, 1916), 303–29. Page references are to the Dover reprint (New York: Dover Publications, Inc., n.d.).

"Why I Am Not a Communist," *Modern Monthly* 8 (April 1934), 135–37. LW9:91–95

Notes

1. LOCATING DEWEY'S CRITIQUE OF TECHNOLOGY

1. Webster Hood was correct in his assertion that Dewey had an "abiding interest" in technology and that he was probably the first contemporary philosopher to make technology a central concern and "to see it as posing genuine philosophic problems." See Webster F. Hood, "Dewey and Technology: A Phenomenological Approach," *Research in Philosophy and Technology* V (1982), 190.

2. General anthologies in this field include: Carl Mitcham and Robert Mackey, eds., *Philosophy and Technology: Readings in the Philosophical Problems of Technology* (New York: The Free Press, 1972); Albert H. Teich, ed., *Technology and the Future*, 4th ed. (New York: St. Martin's, 1986); Alex C. Michalos, ed., *Philosophical Problems of Science and Technology* (Boston: Allyn & Bacon, 1974); George Bugliarello and Dean B. Doner, eds., *The History and Philosophy of Technology* (Urbana, Ill.: University of Illinois Press, 1979); Larry Hickman and Azizah al-Hibri, eds., *Technology and Human Affairs* (St. Louis: C. V. Mosby, 1981); and Larry Hickman, ed., *Philosophy, Technology and Human Affairs* (College Station, Texas: Ibis Press, 1985). Only the last two collections include selections from Dewey's work.

3. These rare essays include: Webster F. Hood, "Dewey and Technology: A Phenomenological Approach," *Research in Philosophy and Technology* V (1982), 189–207; and Edith Wyschogrod, "The Logic of Artifactual Existents: John Dewey and Claude Lévi-Strauss," *Man and World* XIV (1982), 235–50.

4. A notable exception to this pattern are the works of John J. McDermott. See especially *The Culture of Experience* (New York: New York University Press, 1976), and *Streams of Experience* (Amherst, Mass.: The University of Massachusetts Press, 1986).

5. See Richard Rorty's essay "Dewey's Metaphysics," in his book *The Consequences of Pragmatism* (Minneapolis: The University of Minnesota Press, 1982).

6. Dewey exhibited a curious lack of interest in keeping his works in print. Systematic research into his work was extremely difficult prior to the availability of the critical edition of his work, undertaken by Jo Ann Boydston and her staff at the Center for Dewey Studies at Southern Illinois University.

7. This is Max Eastman's designation. See Eastman's article "America's Philosopher," *Saturday Review of Literature*, 17 January 1953, 23–24, 38.
8. Charles A. Beard and Mary R. Beard, *The Rise of American Civilization*, rev. ed. 1934, reprinted 1946 (New York: The Macmillan Company, 1946), 789.
9. Robert H. Walker, *Life in the Age of Enterprise* (New York: Capricorn Books, 1971), 44–45.
10. In his introduction to *Essays in Religion and Morality*, the ninth title and the eleventh volume of *The Works of William James* (Cambridge: Harvard University Press, 1982), John J. McDermott gives the following assessment of that occasion:

> The occasion of James' oration was the unveiling of a monument to Robert Gould Shaw, the commander of the Fifty-Fourth Regiment of Massachusetts Volunteers, the first regiment of black soldiers to fight for the Union Army. James was both a likely and an unlikely candidate for the honor of giving this address. It was fitting for James to speak, for his younger brother Garth Wilkinson James had been an adjutant in the Fifty-Fourth Regiment and had been wounded in the assault on Fort Wagner. Yet William James, though of age and surrounded by peers who enlisted, chose not to serve in the Civil War and offered no excuses or explanations (xx).

McDermott characterizes James's stance on the events symbolized by that occasion:

> Missing . . . is any sense of the enormous importance of the abolition movement and of the end of slavery in the United States. Not having participated in that movement in either a military or a political manner, he seems to view the Civil War at too great a distance, a distance that no doubt contributed to his estrangement from his two military brothers (xxi).

11. See Siegfried Giedion, *Mechanization Takes Command* (1948; reprint, New York: W. W. Norton, 1969), 83.
12. A fascinating analysis of Dewey's audiences has been done by C. Wright Mills in his *Sociology and Pragmatism*, Irving Louis Horowitz, ed. (New York: Oxford University Press, 1966).
13. Sidney Ratner *et al.*, eds., *John Dewey and Arthur F. Bentley: A Philosophical Correspondence, 1932–1951* (New Brunswick, NJ: Rutgers University Press, 1964), 646.
14. Irwin Edman, *John Dewey: His Contribution to the American Tradition* (Indianapolis: Bobbs-Merrill, 1955), 11.
15. Lewis Mumford, *The Golden Day* (New York: Dover Publications, 1968), 130.
16. FBI New York File No. 100-25838, New York, New York, 29 April 1943, p. 2. Copy at Center for John Dewey Studies, Carbondale, Ill.
17. H. L. Mencken, *Letters of H. L. Mencken*, Guy J. Forque, ed. (New York: Alfred A. Knopf, 1961), 316. Quoted in Earl James Weaver, "John Dewey: A Spokesman for Progressive Liberalism." Ph.D. diss., Brown University, 1963, 288n.
18. Stephen Toulmin, introduction to vol. 4 of *The Later Works* (LW1:xi).
19. John J. McDermott, *The Philosophy of John Dewey*, vol. I (New York: G.P. Putnam's Sons, 1973), xxviii.
20. Toulmin, introduction to vol. 4 of *The Later Works* (LW4:xi).
21. Carl Mitcham and Robert Mackey, eds., *Philosophy and Technology* (New York: The Free Press, 1972), 1. See also Carl Mitcham. "Types of Technology," in *Research in Philosophy and Technology*, vol. I, Paul Durbin, ed. (Greenwich, Conn.: JAI Press, 1978), 229–94.

22. Mitcham (1978), 230–31.
23. Ibid.
24. Ibid., 232.
25. Mitcham is one of only a handful of philosophers who hold this view. Others include I. C. Jarvie and Emmanuel G. Mesthene. See I. C. Jarvie, "The Social Character of Technological Problems: Comments on Skolimowski's Paper," in Mitcham and Mackey (1972), 50–61. "Technology for me, then, is coterminous with our attempts to come to terms with our world; that is, our culture and our society; and, as such, it contains within it both pure tools and all knowledge" (p. 61).

See also Emmanuel G. Mesthene, *Technological Change* (New York: New American Library, 1970). For Mesthene, who received three academic degrees from Columbia University, technology is "tools in a general sense, including machines, but also including such intellectual tools as computer languages and contemporary analytic and mathematical techniques. That is, we define technology as the organization of knowledge for the achievement of practical purposes" (p. 25).
26. Mitcham and Mackey (1972), 2.
27. See R. W. Sleeper, *The Necessity of Pragmatism* (New Haven: Yale University Press, 1986).
28. Beard and Beard (1946), 789.
29. A very good example of the extent to which pragmatism has influenced sociologists to consider the meanings of quotidian objects is Mihaly Csikszentmihalyi and Eugene Rochberg-Halton, *The Meaning of Things: Domestic Symbols and the Self* (Cambridge: Cambridge University Press, 1981).
30. Albert Borgmann, *Technology and the Character of Contemporary Life* (Chicago: The University of Chicago Press, 1984). Borgmann writes of his categories: "These summaries distinguish a multitude of approaches, but all distinctions fit well one of three essential types: the substantive, the instrumentalist, and the pluralist views of technology" (p. 9).
31. See Jacques Ellul, *The Technological Society*, John Wilkinson, trans. (New York: Random House, 1964). See also Jacques Ellul. *The Technological System*, tr. Joachim Neugroschel, trans. (New York: Continuum, 1980).
32. Borgmann (1984), 9.
33. Ibid., 10.
34. Ibid.
35. Ibid.
36. Victor Ferkiss, *Technological Man: The Myth and the Reality* (New York: New American Library, 1969).
37. See Allan Bloom, *The Closing of the American Mind* (New York: Simon and Schuster, 1987). See also an excellent review of Bloom's book by Martha Nussbaum, "Undemocratic Vistas," *The New York Review of Books*, 5 November 1987, 20–26.
38. Borgmann (1984), 10.
39. Ibid., 11.
40. Ibid., 10.
41. William Barrett, *The Illusion of Technique* (Garden City, NY: Anchor Press/Doubleday, 1978), 18–19.
42. Ibid., 19.
43. Mitcham (1978), 233.
44. Ibid.
45. Mitcham (1978), 243.
46. Ibid., 242–57.
47. All references to Aristotle will be by means of Bekker's standard 1831 edition of the Greek text of Aristotle. Notation consists of a page number, a

column letter, and a line number. The translation I have used throughout this book is that collected by Jonathan Barnes in his edition of *The Complete Works of Aristotle* (Princeton: Princeton University Press, 1984), 2 volumes, Bollingen Series LXXI 2.

48. See Abraham Edel, *Aristotle and His Philosophy* (Chapel Hill: University of North Carolina Press, 1982). "We make things in order to use them in living. But contemplation is in his view the highest end" (p. 388).

49. Mitcham (1978), 258.

50. Francis Bacon, *The Works of Francis Bacon*, vol. IV, J. Spedding et al. eds. (1857–1874; reprint, New York: Garrett Press, 1968), 405.

2. KNOWING AS A TECHNOLOGICAL ARTIFACT

1. F. E. Peters, *Greek Philosophical Terms* (New York: New York University Press, 1967), 190.

2. Wolfgang Schadewaldt, "The Concepts of Nature and Technique According to the Greeks," in *Research in Philosophy and Technology*, vol. 2, Paul T. Durbin, ed. (Greenwich, Conn.: JAI Press, 1979), 166.

3. Ibid. (This is a paraphrase of Aristotle's *Nichomachean Ethics* VI 4, 1040a, 10 ff).

4. See *Nichomachean Ethics,* 1139b18, ff. "of things capable of being otherwise we do not know, the object of knowledge is of necessity. Therefore the object of knowledge is of necessity. Therefore it is eternal; for things that are of necessity in the unqualified sense are all eternal; and things that are eternal are ungenerated and imperishable." Jonathan Barnes, ed., *The Complete Works of Aristotle*, 2 vols. (Princeton, N.J.: Princeton University Press, 1985).

5. This is by no means the only traditional reading of Aristotle. Walter Ong, for example, in his important book *Ramus, Method and the Decay of Dialogue* (Cambridge: Harvard University Press, 1958), treated Aristotle's categories quite differently.

> The *Categories* or *Predicaments* of Aristotle are not a classification of things, nor of being-in-general, nor are they a classification of the whole range of human concepts as such. Neither are they categories in the modern sense of a system of classes into which items are "put." As their name indicates and a recent study confirms, they are types of predicates conceived of more or less as "accusations" (or "outcries" in the market place or assembly, *categoria*, transformed into latin as *praedicamenta*, things spoken out) which can be brought against a subject or "prime substance" (106–7).

But contrast this account to that of Manley Thompson:

> The word "category" was first used as a technical term in philosophy by Aristotle . . . . [who] held that every uncombined expression signifies (denotes, refers to) one or more things falling in at least one of . . . ten classes . . . .Each of the ten classes of entities signified constitutes a category, or genus, or entities, and each categorematic expression is said to be an expression in the category constituted by the class of entities it signifies. (*The Encyclopedia of Philosophy*, Paul Edwards, ed. [New York: Macmillan, 1967], s.v. "Categories.")

6. Dewey uses the term "technological" here in the sense he later described in *Human Nature and Conduct*. There he contrasted tools in a toolbox, passive and unused, to tools in use, actively engaged in modifying a situation. It is the passive use that he intends here.

7. Sidney Hook, *The Metaphysics of Pragmatism* (Chicago: Open Court, 1927), 29.

8. William James, *The Principles of Psychology* (Cambridge: Harvard University Press, 1983), 217.

9. Ibid.

10. Richard J. Bernstein, *John Dewey* (New York: Washington Square Press, 1967), 61.

11. Quoted in Bernstein (1967), 60.

12. Webster F. Hood, "Dewey and Technology: A Phenomenological Approach," *Research in Philosophy and Technology*, vol. 5 (1982), Paul Durbin, ed. (Greenwich, Conn.: JAI Press, 1982), 190.

13. Ibid.

14. Ibid., 191.

15. Ibid.

16. John J. McDermott, ed., *The Philosophy of John Dewey*, vol. 1 (New York: G. P. Putnam's Sons, 1973), xxiv.

17. John J. McDermott, ed., *The Philosophy of John Dewey*, vol. 2 (New York: G. P. Putnam's Sons, 1973), xxv.

18. R. W. Sleeper, *The Necessity of Pragmatism* (New Haven, N.J.: Yale University Press, 1986), 10.

19. See, for example, Sleeper (1986), 21ff.

20. See, for example, Max Horkheimer, *Eclipse of Reason* (1947; reprint, New York: Seabury Press, 1974), 171–72. See also my chapter 3, especially the responses of Stephen Pepper and Benedetto Croce to Dewey's *Art as Experience*.

21. As Bertrand P. Helm has forcefully and eloquently argued, Dewey's "temporalization" of time was virtually unique among philosophers who were his contemporaries, and his views on this matter were a source of great misunderstanding among his critics, including C. S. Peirce. (Bertrand P. Helm, *Time and Reality in American Philosophy* [Amherst, Mass.: The University of Massachusetts Press, 1985], 96ff.)

22. See Lewis S. Feuer, "John Dewey and the Back to the People Movement in American Thought," *Journal of the History of Ideas* XX (1959), 545–68.

23. Helm (1985), 117.

24. Willard Van Orman Quine, *Ontological Relativity and Other Essays* (New York: Columbia University Press, 1969).

25. James (1983), 224.

26. William James, "The Function of Cognition," in *The Writings of William James*, John J. McDermott, ed. (New York: Random House, 1967), 143.

27. For a particularly entertaining assessment of Dewey's educational program see John A. Stormer, *None Dare Call it Treason* (Florissant, Mo.: The Liberty Bell Press, 1964), 99ff. The copyright page of this book indicates that between February and July 1964 almost a million and a half copies were printed. The religious fundamentalists have not been silent since that time. In the nationally televised speech that effectively initiated his campaign for the 1988 Republican presidential nomination, the Reverend Pat Robertson singled Dewey out for criticism on three separate occasions. He was more critical of Dewey than he was of Karl Marx, whom he mentioned only once.

28. This remark is also interesting in view of the fact that some of Dewey's critics accused him of being a hard-line Baconian, of seeking to "dominate" nature.

Epilogue: Responsible Technology

> What empirical method exacts of philosophy is two things: First, that refined methods and products be traced back to their origin in primary experience, in all its heterogeneity and fullness; so that the needs and problems out of which they arise and which they have to satisfy be acknowledged. Secondly, that the secondary methods and conclusions be brought back to the things of ordinary experience, in all their coarseness and crudity, for verification. In this way, the methods of analytic reflection yield material which form the ingredients of a method of designation, denotation, in philosophy. (LW1:39;EN:33)

> Just as there is no ontological dualism within the self, classically known as body and soul, so too there is no ontological dualism between the self and the world. Now the startling consequence of this view . . . is that if man and the world are made of the same reality and only function differently, then the things of reality as made by man are ontologically similar. Artifacts, then, are human versions of the world acting as transactional mediations, representing human endeavor in relational accordance with the resistance and possibility endemic to both nature and culture.—John J. McDermott[1]

I

In a paper presented in 1959, at a celebration of the hundredth anniversary of Dewey's birth, Edwin A. Burtt suggested that if he had to pick a single word to typify Dewey's philosophical work, it would be "responsibility." Burtt was quick to point out that he did not intend the term in the limited sense that it has had in law, or even in the sense that it has usually had in ethics, but "in the meaning it might convey when applied by a reflective moralist to all philosophical issues."[2] Burtt suggested that sometime around 1890 the idea must have occurred to Dewey that "*all human action, including thinking as an important part of action, has consequences; and that the vital difference which men in*

general and philosophers especially are concerned about is whether responsibility for those consequences is accepted or not."[3]

I have pointed out that Dewey was the only major figure of the classic period of American philosophy who took it as *his* responsibility to enter into the rough-and-tumble of public affairs. I have also indicated some of the ways in which his work was influenced by the concrete social difficulties that he experienced firsthand. In the 1890s he was already constructing an account of personal responsibility that reflected his sensitivities to the problems of labor practices, immigration, and education, to name just a few. "Responsibility," he wrote in *The Study of Ethics*, "is a name for the fact that we are, and are something definite and concrete—specific individuals. I am myself, I am conscious of myself in my deeds (self-conscious), I am responsible, name not three facts, but one fact" (EW4:342). And further, "Every bad man is (in the substantial sense) irresponsible; he cannot be counted upon in action, he is not certain, reliable, trustworthy. He does not respond to his duties, to his functions. His impulses and habits are not co-ordinated, and hence do not answer properly to the stimuli, to the demands made. The vicious man is not socially responsible" (EW4:343).

But even those who might have been expected to be among Dewey's natural allies have not always understood his position with respect to these matters. It must have been a matter of considerable disappointment to Dewey, for example, that the response of C. S. Peirce to his 1903 *Studies in Logical Theory* was to chastise him for being irresponsible, for engaging in a "debauch of loose reasoning,"[4] and to suggest that Dewey's life in Chicago—a city that, as Peirce put it, "hasn't the reputation of being a moral place"—had apparently weakened his sense of dyads such as right and wrong, true and false.[5]

Dewey has fared little better among some of our contemporaries who claim to be sympathetic to his views. Richard Rorty, for example, misreads pragmatism as viewing "science as one genre of literature—or, put the other way around, literature and the arts as inquiries, on the same footing as scientific inquiries. Thus [pragmatism] sees ethics as neither more 'relative' or 'subjective' than scientific theory, nor as needing to be made 'scientific.' "[6]

If I have made my case in chapters 3 and 5, it should be clear not only that Dewey held no such view, but also that he argued quite strenuously that while science and literature utilize the same general method of inquiry (a method that is briefly reiterated in the epigraphs to this chapter), their respective tools, their respective ends-in-view, and their respective materials are quite different. I must confess that I cannot understand how it is possible to read Dewey, as Rorty has apparently done, as saying that the advances made by the scientific-technological revolution—advances based upon its novel utilization of instruments, among which was its new conception of maximum substitutability of variables—could have been made equally well with the tools and materials of literature. If this view of Rorty's is deconstructivist, it is clear that Dewey's work is not in the family tree of that school of thought: Rorty's view of this matter has little resemblance to the positions Dewey clearly and consistently held for more than sixty years. More specifically, Dewey spent hundreds of pages in his 1938 *Logic* arguing against just this kind of position.

The responsibility that Dewey held to be a characteristic trait of good men and women has a correlate in inquiry: inquiry is good if it is *reliable*. Inquiry that leads to the warrantable assertions that are its reliable products is inquiry that is successful, in the sense that it produces testable results. Rorty seems to have missed the central point of Dewey's account of inquiry as technological: inquiry issues products that are testable, and our concrete experience either "buys" those products by issuing checks for them, or it returns them as bad merchandise.

There is indeed a sense in which inquiry is as Rorty characterizes it: an ongoing conversation. But it is a distinguishing mark of Dewey's instrumentalism that conversations are themselves tools that enable practiced interlocutors to distinguish men and women who are responsible from those who are not, as well as to distinguish assertions that are better and more reliable from those that are less so. Far from being a "vocabulary . . . for unjustifiable hope,"[7] as Rorty has described it, Dewey's technological method is in fact a blueprint for the production of reliable consequences by responsible men and women.

Ralph Sleeper has, I think, correctly seen the central problem in Rorty's well-known version of Dewey's work. He thinks that the difficulty with Rorty's position lies not in his recognition and appropriation of Dewey's antifoundationalism, but rather in what he takes to be the consequences of that position. Rorty's Dewey leaves us with "ungrounded social hope," and this is a far cry, if Sleeper and I are correct, from what Dewey actually said. What offends Sleeper most of all is what he calls "Rorty's insouciant reductionism." Dewey's version of pragmatism, in Sleeper's view, "had seemed to offer us more than that. It had seemed to be teaching us how to transform the culture that is decaying around us, rather than just how to 'cope' with its collapse."[8]

II

It is a widely accepted view among professional philosophers that the most innovative and influential philosophers of the twentieth century are Wittgenstein, Heidegger, and Dewey. Of those three, only Dewey wrote extensively about public philosophy; only Dewey advanced a philosophy of education; and only Dewey had a coherent program to produce practical social amelioration.

In their very different ways, the responses of Wittgenstein and Heidegger to the communities in which they lived were somewhat

mystical. Despite his early training as an engineer, Wittgenstein seems to have had a profoundly private agenda that necessitated his withdrawal from public life for extended periods—to teach elementary school, to tend a garden, and even while occupying a place within an academic community to lead a life that was ascetic and to a great extent reclusive. Nevertheless, he served in the First World War as a volunteer on the side of Austria, and during the Second World War as an orderly in a hospital in England. When he came to reassess the position he had taken in the *Tractatus*, in which he began to treat language as instrumental, it was almost as if language became for him a tool that reflected his own introspective project; it became for him a tool whose principal use was the examination of language itself.

Heidegger, too, seemed unwilling to use, or incapable of using, language as a tool for producing extralinguistic products. His self-described peers are not engineers and social reformers, but poets: the German Romantic poets were the only ones beside himself, as Rorty has insightfully suggested, who seemed to Heidegger to inhabit the mountain peaks of European culture.

The case of Heidegger is more tragic even than that of the tormented Wittgenstein. Wittgenstein's mysticism was that of the sensitive thinker seeking to overcome what at times must have appeared to him to be insurmountable personal difficulties. Heidegger's mysticism, however, especially that of his mature work, was rooted in arrogant appropriation of the irrational blood and soil myths of a highly romanticized German-Greek cultural axis, and in the deeply destructive eschatalogical myths that have influenced European culture at least since the time of Augustine.

The more we learn of Heidegger's brief political career as *Führer*-rector of Freiburg University,[9] the more deplorable and even despicable seem his limited attempts at public praxis. No more than six months after Hitler suspended civil liberties, arrested eighty-one legally elected deputies to the *Reichstag*, began a systematic program of burning books and banning their authors, and announced the opening of the concentration camps (one of which was close by Heidegger's hometown, Messkirch), Heidegger "publicly sent Hitler a telegram stating his willingness to cooperate in the 'alignment' (*Gleichschaltung*) of the universities with the NSDAP's programs."[10]

Heidegger, like many other Germans of his generation, later claimed to have known nothing of the treatment of Jews at the hands of his fellow Nazi Party members. But the Jewish population of Baden, where he lived, "dropped dramatically from 20,600 in 1933 to 6400 in 1940, and . . . virtually all of the 6400 who remained were deported to France on October 22, 1940, and thence to Izbica, the death camp near Lublin. As Heidegger was lecturing on Nietzsche in the Forties, there were only 820 Jews left in all of Baden."[11]

What would have been John Dewey's response to the forcible removal and detention of thousands of his neighbors, to the suspension of civil liberties, and to the burning of books? It is possible to read the answer to these questions from the pages of his productive political life. Dewey loudly and consistently sided with those who he thought were the objects of unjust treatment. He was a founding member of the National Association for the Advancement of Colored People (NAACP) and a member of the Men's League for Women's Suffrage.[12] He was a leading member of the American Civil Liberties Union. He defended Bertrand Russell (who had for decades been one of his harsher critics) in 1940, when Russell was dismissed from the City College of New York on grounds of "atheism" and "hedonism." He was the chair of the Trotsky inquiry in Mexico City. It was Dewey's view that responsible men and women work to take control of barren and problematic situations in ways that attempt to ameliorate them and render them productive, and he worked to prove himself responsible.

Seen from this perspective, the criticism advanced during the height of World War II by Max Horkheimer—that the pragmatists were incapable of caring about "murders perpetrated behind closed frontiers"—seems particularly inappropriate. In *The Eclipse of Reason*, based on lectures he delivered in 1944 at Dewey's own Columbia University, Horkheimer was particularly critical of Dewey (whom he misread as an idealist in the same camp with F. H. Bradley), for abandoning the idea of "objective truth."[13] "According to pragmatism," he wrote, "truth is to be desired not for its own sake but in so far as it works best, as it leads us to something that is alien or at least different from truth itself."[14]

What this meant for Horkheimer was that by undercutting the objectivity of "God, cause, number, substance [and] . . . soul,"[15] pragmatism (whose "most radical and consistent form" he regarded as Dewey's) was reduced to the claim that "knowing is literally something which we do."[16] What had been regarded by Dewey as one of the great insights of the pragmatists thus became for Horkheimer, steeped in the static and contemplative metaphysics of the European tradition, an occasion for offense.

> If the world should reach a point at which it ceases to care not only about such metaphysical entities but also about murders perpetrated behind closed frontiers or simply in the dark, one would have to conclude that the concepts of such murders have no meaning, that they represent no "distinct ideas" or truths, since they do not make any "sensible difference to anybody." How should anyone react sensibly to such concepts if he takes it for granted that his reaction is their only meaning?[17]

But when Horkheimer advanced this criticism, he was not just exhibiting a failure to understand the written texts of Dewey's instrumentalism as well as a lack of knowledge of Dewey's actual political career; he was also begging his own question. He set up

examples that were patently incapable of being known—they were behind closed frontiers and in the dark—and then he berated Dewey and the other pragmatists for their contention that it is impossible to take action with respect to matters about which there is no information. If such murders were perpetrated behind truly closed borders, that is, if he did not know about them, then Horkheimer, too, would be unable to care about them. And if the borders were not completely closed, if some evidence were to leak out, a "sensible difference," to use the pragmatist phrase he mocks, would have been made in whoever had access to that evidence.

Horkheimer also misread Dewey's view of the nature of scientific change. From Dewey's point of view, he made a mistake that typifies the very straight-line instrumentalism that he and the other members of the Frankfurt School professed to despise when he wrote that "if Dewey means to say that scientific changes usually cause changes in the direction of a better social order, he misinterprets the interaction of economic, technical, political and ideological forces. The death factories in Europe cast as much significant light on the relations between science and cultural progress as does the manufacture of stockings out of air."[18]

Dewey's reply would, I think, have been that the European death factories were anything but scientific or technological. Their fixed agenda utilized technical means (in the sense of the straight-line instrumentalists) to further programs based, for example, on faulty eugenic studies. But the death camps were not for Dewey an example of technology in his reconstructed sense. They were instead the worst example of the straight-line instrumentalists's adherence to fixed ends, a program that was in that particular case rendered even more disastrous because intransigent ends were coupled with reliance on slovenly technical means, and therefore neither goals nor means had been checked.

Dewey's disciple C. E. Ayres, writing in 1943, shortly before the world came to know the enormity of what the Nazis had done, put this matter better than Dewey ever did. Though he writes of "nightmares" and "engines of destruction" in another sense, his remarks are equally applicable to the death factories.

> The truth is, of course, that the prophets of scientific doom are invoking not science but metaphysics; and they are doing so not altogether because they feel the weight of the dead hand of immemorial tradition, but in part from sheer ignorance. We are only just now beginning to realize that science and technology, the fine and the mechanical arts, contain within themselves the criterion of value by which they must be judged. Technological progress is not "meaningless apart from ends"; on the contrary it is the locus of meaning. What is wrong with the nightmares is that they are contrary to the actualities of science and technology, and what is wrong with the use of scientific tools as "engines of destruction" in war is not that war is an "unworthy end" but that it is a calamitous interruption of the activities by which alone civilization has made progress.[19]

III

What, in Dewey's view, constitutes responsible technology? This book is an attempt to suggest some answers to that question. By way of review and conclusion, it may be said that Dewey rejected what I have called "straight-line instrumentalism," or the view that neutral tools are brought to bear on ends that are valued for reasons external to the situations within which those tools have been developed. Drawing on the metaphors that accompanied Darwinian evolutionary theory, Dewey argued that human beings are organisms within nature and that their tool use is one of the developmental edges of natural activity. Tools and artifacts are no more neutral than are plants, nonhuman animals, or human beings themselves: they are interactive within situations that teem with values.

Responsible technology involves for Dewey the choice, the implementation, and the testing of goals that arise from those situations. There is no need for divine intervention to point the way, and the quest for absolute truth constitutes an impediment. Values arise out of inquiry, and once they are refined by inquiry they are brought back to the situations from which they originated in order to ascertain whether they are appropriate. Tools that are utilized in choosing, implementing, and testing enter into the articulation of ends, or things to be done, modifying those ends as the need arises. Evolving ends demand the modification of existing tools. Responsible technology thus remains flexible because it must accommodate changing situations. In addition to being resilient, responsible technology is redundant: it does not allow undue risks, and it backs itself up, both in terms of parallel development and in terms of the establishment of plateaus as possible fallback positions. Responsible technology is not so much radical as regenerative.

Responsible technology is not a thing, as Jacques Ellul and others have suggested. Nor should it be surprising that technology has no "core," since experience itself, of which technological activities and products are parts, is accessible only by shifts of interest and focus. Technology is instead the sum of concrete activities and products of men and women who engage in inquiry in its manifold forms: in the sciences, in the fine and useful arts, in business, in engineering, and in the arts we call political.

Where technology fails to be responsible, it is not because technology as method has failed, but because inquiry and testing have been misdirected, subsumed to nontechnological ends, or aborted. Ends have been dissociated from means. Fixed religious or political ideologies have taken the place of legitimate, testable inquiry. Economic and class interests have intervened where experimentation would have been appropriate.

I have suggested that Dewey would probably have been delighted at what appears to be a possible outcome of the long struggle concerning the Shoreham nuclear reactor, for that outcome indicates that it is now at least thinkable that even the largest industrial projects can be altered or canceled in response to the growth of new knowledge.

To those such as Hans Jonas, who have argued that responsibility to future generations must be based upon some metaphysical principle, such as an ontological responsibility to the "idea of Man,"[20] I think that Dewey would have argued that if we act responsibly, if we insist upon reliable forms of technology, the future will be as successful as it is possible for it to be. Dewey consistently argued that appeals to abstract metaphysical principles may serve as goals and patterns that can be taken back to the details of concrete situations, but if they are treated as immutable starting points they only tend to confuse otherwise productive debates.

Dewey also argued that we have no guarantee of success. Natural events could terminate human life, and human greed, laziness, or error could have the same result. The special place of human beings on earth lies in their development and use of intelligence: if intelligence fails or is thwarted, human beings will have lost their ecological niche. There is no god to save us.

Dewey was confident that the social problems of his time, which were not so different from our own, were tractable. Given the resources of material production, there is no reason why all the people of the world cannot have adequate food, shelter, and clothing. There is no reason why they cannot be weaned away from anachronistic and counterproductive outlooks and educated in the self-corrective methods of experimental science. Where the material commodities necessary to human development are lacking, it is not a failure of technology but a failure of imagination, a failure of diligence, or a failure of nerve.

But there was also a sense of urgency in Dewey's critique of technology. Failure to be responsible sets in motion trends and events that are increasingly difficult to divert or overcome. I think that Dewey would have argued that the destruction of the tropical rain forests, the desertification of vast areas of Africa, and the destruction of the environment due to acid rain and other industrial pollutants are not technological failures in the sense commonly intended by that term: they are instead problems that are consequent upon the failure to sharpen and use the technological tools required for intelligent social planning. And if intelligence is not exercised now, it may be increasingly difficult to do so. The opportunity may even be lost entirely.

For Dewey, technology was clearly identified as the tools and methods of productive inquiry, the tools and methods that are applicable even to those problems commonly described as the most intractable. Technology has worked well in the domain of natural sciences, but it is a method that men and women seem unwilling to apply beyond that sphere.

27. Ibid., xv.
28. Ibid., xvi.
29. Ibid., xxii.
30. Ibid., xxiii.
31. Ibid., 35.
32. Ibid., 57.
33. Ibid., 179–80.
34. Ibid., 212.
35. Ibid., 213.
36. Joseph Ratner, ed., *Characters and Events*, vol. 2 (New York: Henry Holt and Co., 1929), 782–89.
37. On the subject of passive resistance and the pragmatists, see K. Ramakrishna Rao, *Gandhi and Pragmatism* (Calcutta: Oxford & IBH Publishing Co., 1968), especially chapter 4, "The Experimentalism of John Dewey."
38. "Humanist Manifesto I," in *The New Humanist* VI, no. 3, (May/June 1933).
39. Karl Mannheim, *Freedom, Power, and Democratic Planning*, Adolph Lowe *et al.*, eds. (New York: Oxford University Press, 1950).
40. Ibid., 303.
41. Ibid.
42. Mills, 358. See also page 391. "The general type of action and thought which Dewey most pervasively utilizes and which forms his positive model in large part may be termed *technological*."
43. Ibid., 392–93.
44. Ibid., 405.
45. Ibid.
46. In 1917, the year that the United States became a belligerent in the First World War, a disaffected Randolph Bourne also characterized Dewey's variety of pragmatism as a type of straight-line instrumentalism, even though as late as 1915 he seemed to have grasped the extent to which that was a poor reading of Dewey's work. See Randolph Bourne, "John Dewey's Philosophy," in *The New Republic* II (13 March 1915), 154–56. This article is reprinted in Randolph Bourne, *The Radical Will: Randolph Bourne Selected Writings 1911–1918*, Olaf Hansen, ed. (New York: Urizen Books, 1977), 331–35. See also R. Bourne, "Twilight of Idols," in *Seven Arts* II (October 1917), 688–702. This article is reprinted in Bourne (1977), 336–47.

Mills quotes Bourne (Mills, 410), but misidentifies his article as being from *The Dial* and gives no more specific source. Bourne's disaffection with Dewey is palpable.

> To those of us who have taken Dewey's philosophy almost as our American religion, it never occurred that values could be subordinated to technique. We were instrumentalists, but we had our private utopias so clearly before our minds that the means fell always into its place as contributory. And Dewey, of course, always meant his philosophy, when taken as a philosophy of life, to start with values. But there was always that unhappy ambiguity in his doctrine as to just how values were created, and it became easier and easier to assume that just any growth was justified and almost any activity valuable so long as it achieved ends. The American, in living out this philosophy, has habitually confused results with product, and been content with getting somewhere without asking too closely whether it was the desirable place to get. It is now becoming plain that unless you start with the vividest kind of poetic vision, your instrumentalism is likely to land you just where it has landed this younger intelligentsia which is so happy and busily engaged in the national enterprise of war. You must have your vision and you must have your technique. The practical effect of Dewey's philosophy has evidently been to develop the sense of the latter at the expense of the former. Though he himself would develop them together, even in him there seems to be a flagging of values, under the influence of war (Bourne [1977], 343–44).

This passage from the 1917 article in *Seven Arts* foreshadows Mills' criticism of Dewey, although Bourne, unlike Mills, seems to have had some second thoughts about his analysis by the end of the passage.

Of course, Dewey's reply to criticism of this sort was already well developed by his 1903 *Studies*. But in his 1920 *Reconstruction in Philosophy* he put his point even more plainly: "When we take means for ends we indeed fall into moral materialism. But when we take ends without regard to means we degenerate into sentimentalism. In the name of the ideal we fall back upon mere luck and chance and magic or exhortation and preaching; or else upon a fanaticism that will force the realization of preconceived ends at any cost" (MW12:121; RP:73).
47. Either Mills or his editor, Horowitz, has given as a reference for this quotation Dewey's *Essays in Experimental Logic*, pp. 1–2. It does not appear on pp. 1–2 of the 1916 University of Chicago Press edition.

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1. John J. McDermott, *The Culture of Experience: Philosophical Essays in the American Grain* (New York: New York University Press, 1976), 220.
2. Edwin A. Burtt, "The Core of Dewey's Way of Thinking," in *The Journal of Philosophy* LVII, no. 13 (23 June 1960), 406.
3. Ibid. Emphasis in original.
4. Peirce, *Collected Papers*, 8:240.
5. Ibid.
6. Richard Rorty, *Consequences of Pragmatism* (Minneapolis: University of Minnesota Press, 1982), xliii.
7. Ibid., 208.
8. Ralph Sleeper, *The Necessity of Pragmatism* (New Haven: Yale University Press, 1986), 1.
9. Thomas Sheehan, "Heidegger and the Nazis," in *The New York Review of Books* (16 June 1988), 41–47. This is a lengthy critical review of Victor Farias, *Heidegger et le nazisme*, Myriam Benarroch and Jean-Baptiste Grasset, trans. (Paris: Editions Verdier, 1988).
10. Sheehan (1988), 46.
11. Ibid., 41.
12. Gary Bullert, *The Politics of John Dewey* (Buffalo, NY: Prometheus Books, 1983), 35.
13. Max Horkheimer, *The Eclipse of Reason* (1947; reprint, New York: Seabury Press, 1974), 46.
14. Ibid., 45.
15. Ibid., 46.
16. Ibid., 48.
17. Ibid., 46–47.
18. Ibid., 75.
19. C. E. Ayres, "The Significance of Economic Planning," in *Development of Collective Enterprise*, Seba Eldridge and Associates, ed. (Lawrence, Kan.: University of Kansas Press, 1943), 479.
20. Hans Jonas, *The Imperative of Responsibility*, Hans Jonas and David Herr, trans. (Chicago: University of Chicago Press, 1984), 43.

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CHAPTER 10

SCIENCE AND TECHNOLOGY

'The Origin of the Work of Art' introduces one of the central ideas of Heidegger's later philosophy, namely, the idea that what he calls 'the truth of beings' has a *history*: over the course of Western history, the truth of beings has changed in accordance with the opening and closing of different historical worlds. While 'The Origin of the Work of Art' discusses this history largely in terms of historical examples – the world of the Greek temple and the world of the Medieval cathedral – Heidegger alludes at several points to what he takes the modern truth of beings to be. He says, for example, that with the advent of the modern age, 'Beings became transparent objects capable of being mastered by calculation' (OBT, p. 48). Heidegger's appeal here to calculation and control suggests that what is definitive of the modern age is the rise of scientific thinking. Moreover, though not the central theme of his essay, Heidegger already here links the rise of this kind of thinking to a kind of loss. As 'mastered', objects are 'transparent', seen through, which suggests that something about them is ignored or overlooked (just what that is, according to Heidegger, requires considerable care in articulating).

At another point in the essay, Heidegger contrasts how a work of art 'sets forth the earth' with the way scientific inquiry ultimately destroys whatever is earthy in what it encounters. Calculating and measuring – analysis in general – serve only to destroy the materiality of what is encountered when that 'materiality' is understood in the way Heidegger associates with earth. The earthy characteristics of what is encountered go missing as soon as we approach them in calculative terms. What Heidegger refers to as 'the technological-scientific objectification of nature', which often has the 'appearance of mastery and progress', is instead 'an impotence of the will' (OBT,

p. 25) that only serves to efface what it seeks to comprehend. We can thus see in 'The Origin of the Work of Art' some indications of themes that will become central in essays written in the decades following its composition: the impact of the rise of scientific and technological thinking, both on human existence and the kind of world we encounter and engage. On the whole, Heidegger's later philosophy of science and technology can in part be understood as an attempt to measure the losses incurred by what are typically (and understandably) considered the impressive achievements in those domains. The history of the sciences and technology since the advent of modern science in the sixteenth and seventeeth centuries is apt to appear throughout as one of unalloyed *progress*, a steady increase in the scope and power of scientific theories and the correlative development of associated technologies. While Heidegger does not aim to deny such appearances outright, there is in his philosophy an attempt at least to disrupt those appearances, to suggest that something is threatened, if not lost, in the course of those gains. (The threat or 'danger' Heidegger aims to bring out is different from many of the usual ones concerning the negative impact of scientific and technological development such as the threat of nuclear annihilation, global warming, the loss of 'natural' environments and so on. It is an interesting and difficult question how Heidegger's engagement with science and technology itself engages these other, more familiar concerns. I will suggest below that the engagement is rather oblique, which should not be surprising given how rarely Heidegger treats familiar issues and concerns in a straightforward manner!)

10A SCIENCE AND THE ANNIHILATION OF THINGS

Heidegger's essay entitled 'The Thing' is throughout a meditation on loss, a kind of requiem for the proximity to *things* destroyed, paradoxically, by 'the frantic abolition of all distances' (PLT, p. 165). Though we are able to move from one place to another more quickly than ever before, and 'connect' with other parts of the world in ways and at speeds that Heidegger writing in the 1940s and 1950s could not have imagined, Heidegger argues that the net effect of all this moving and connecting is a kind of detachment, an inattention to important aspects or features of what surrounds us. Lost, in particular, is any engagement with the mere thing *as* a thing. (Here we see a place where Heidegger returns to his consideration of the notion of a thing, which served as a starting point for working out what a work of art is in 'The Origin of the Work of Art'.) But how does Heidegger come to understand the notion of a thing in the essays subsequent to 'The Origin of the Work of Art'? Moreover, how is it that things are effaced by 'technical-scientific objectivation', and why does it matter whether or not that effacement occurs? Let us take these questions more or less in order. Heidegger's account of the thing proceeds primarily by means of examples (the jug in 'The Thing', the bridge in 'Building, Dwelling, Thinking'). In attending to the jug, Heidegger emphasizes the difference between the jug, understood as a thing, and an *object*. He characterizes the jug as 'self-sustained', as 'self-supporting', and 'independent'. An object, by contrast, is to be understood primarily in relation to our experience, as something which stands 'over against' us, 'whether in immediate perception or by bringing it to mind in a recollective re-presentation' (PLT, p. 167). The thing is not a 'represented object'; in treating the thing as something primarily presented and represented, its thingly character is effaced. We can see in the contrast Heidegger draws between things and objects how he develops his earlier critique of standard accounts of a thing, those conceptions that he claimed ultimately do 'violence' to the thing. Here, he rejects the idea that being a thing consists in 'being a represented object', as that would mean defining the thing (its nature and existence) entirely in relation to our experience of it. Defining the thing this way would fail to do justice to its 'self-supporting' or 'independent' character. There is a deeper echo in this passage as well: Heidegger's talk here of the thing becoming an object when 'we place it before us' is reminiscent of his discussion in *Being and Time* of the transformation of the hammer from something useful to something objectively present when contemplation takes the place of active using. Just as the equipmental character of the item of equipment is effaced in the act of contemplation, so too is the thingly character of the thing obscured by an objectifying representation: '[N]o representation of what is present, in the sense of what stands forth and of what stands over against as an object, ever reaches to the thing *qua* thing' (PLT, pp. 168–9). And just as the hammer reveals itself most authentically when we take hold of it and hammer, so too the thingly character of the jug is revealed in its use: 'The jug's thingness resides in its being *qua* vessel. We become aware of the vessel's holding nature when we fill the jug' (PLT, p. 169).

In *Being and Time*, the revelation of what is objectively present effected by the change over from active use to detached contemplation marks the beginnings of scientific inquiry. Science recontextualizes the decontextualized *objects* discovered through contemplation, incorporating them into a systematic theory. Not surprisingly, in 'The Thing', Heidegger's contrasting of the thing with the (represented) object, though first spelled out in terms of perception and memory, quickly leads to a consideration of science. In working toward an adequate understanding of the jug *qua* thing, Heidegger first calls attention to the jug's being a vessel. Understanding the jug as a vessel leads in turn to an understanding of the jug as a *void*: in making the jug, the potter 'shapes the void'. 'From start to finish the potter takes hold of the impalpable void and brings it forth as the container in the shape of a containing vessel' (PLT, p. 169). The specific thingliness of the jug is not primarily a matter of the material which composes it, but the void the material encloses, since it is in terms of this void that its being a vessel to be filled and emptied is to be understood. It is at this point that Heidegger allows the voice of science to intrude, first by questioning this notion of a void: 'And yet, is the jug really empty?' (PLT, p. 169). The appearance of 'really' here marks an insistence that Heidegger will further develop, namely, that the sciences, physics in particular, will tell us the true nature of the thing. Heidegger writes:

> Physical science assures us that the jug is filled with air and with everything that goes to make up the air's mixture. We allowed ourselves to be misled by a semipoetic way of looking at things when we pointed to the void of the jug in order to define its acting as a container. (PLT, p. 169)

The natural sciences are here presented as offering a kind of rebuke to Heidegger's talk of the jug in terms of a shaped void, to the effect that such talk is expressive of (merely) a 'semipoetic way of looking at things'. As semipoetic, such language has no place within the natural sciences; indeed, one of the goals of science is to replace such colourful though inaccurate language with a rigorous, precise accounting of what there (really) is. Heidegger thus depicts the natural sciences as more than a little impatient with his way of talking, but Heidegger, for his part, is similarly impatient. While acknowledging the legitimacy of scientific description, at the same time he declares such descriptions incapable of reaching the thing *as* thing:

> These statements of physics are correct. By means of them, science represents something real, by which it is objectively controlled. But – is this reality the jug? No. Science always encounters only what *its* kind of representation has admitted beforehand as an object possible for science. (PLT, p. 170)

Here we see an echo of the remark from 'The Origin of the Work of Art', to the effect that the quest for objective control marks the effacement of the thing. Heidegger goes on to say that 'science makes the jug-thing a nonentity in not permitting things to be the standard for what is real' (PLT, p. 170) and, more dramatically, that 'science's knowledge, which is compelling within its own sphere, the sphere of objects, already had annihilated things as things long before the atom bomb exploded' (PLT, p. 170).

In what way does science 'annihilate' the thing? A clue to an answer lies in Heidegger's contention that 'science always encounters only what *its* kind of representation has admitted beforehand as an object possible for science.' We have seen already that 'its kind of representation' resists or rejects Heidegger's way of characterizing the thing as 'semipoetic', as a colourful but ultimately inaccurate way of characterizing what there really is. But what underwrites these charges of inaccuracy? Is it just that science prefers not to indulge in 'colourful' language? What is it really about such language that makes it inappropriate for science? Heidegger's remark in 'The Origin of the Work of Art' that in the modern age 'beings became objects that could be controlled and seen through by calculation' provides a clue. The rough idea is that the kind of control and calculation afforded by the natural sciences depends upon viewing what there is in ways that allow for *generalization* and *standardization*. Consider as an example Newton's law of gravitation, which posits a force of attraction between any two masses that varies in inverse proportion to the square of the distance between them. As a *law*, it is meant to be perfectly general or universal, applying to any and all massive bodies anywhere in the universe. As perfectly general or universal, the law factors out any other aspects or features something might have, and so considers what there is only with respect to mass. What matters for Newton's law is only the mass of an object: the law

yields the same gravitational force for any two bodies of equivalent masses (provided they are the same distance apart). The objects in question may vary in myriad other respects, but the application of the law is insensitive to any such variation. Indeed, the law demands such insensitivity, as a law that pertained uniquely to one thing in virtue of its unique characteristics would not be much of a law (it is not at all clear that it makes sense to talk of such a formulation as a law at all). The power of Newton's law is precisely its indifference to anything but mass and distance, as this is what allows for its general applicability: given the law, one can calculate gravitational force for any two masses, which in turn facilitates predictions about how those bodies will behave.

Laws of nature are but one example of the kind of generality science seeks. Another example would be the ways in which experiments work within science to test and extend theories. The proper functioning of an experiment within science requires the rigorous imposition of standards and controls: the parameters of an experimental 'set-up' must be carefully determined, along with the materials and procedures employed, so as to ensure the accuracy and repeatability of the results (the notions of accuracy and repeatability are inseparable in this context). An experiment that yields a unique, one-time result is absolutely useless *as* an experiment, as it cannot be verified through repetition, nor can the results be extrapolated to other materials and situations. Thus, an effective experiment does not demonstrate something only about *this* particular entity or *this* particular sequence of events, but instead yields insights that can be applied to indefinitely many entities or events that satisfy the well-defined constraints maintained by the experimental set-up. (Consider as an example the testing of a new drug or medication: in testing its efficacy or safety, we don't want to know only what it does on this particular occasion with respect to this particular specimen (this lab rat, say, or this volunteer); the whole point of the test is to tell us something that extends beyond this one instance.)

Scientific practice thus requires an indifference to, indeed intolerance of, what we might call *particularity*. The ways in which science 'treats' what there is (as point-masses, material systems, molecular compounds, zoological specimens and so on) are in the service of obtaining general (or generalizable) results: laws and principles that can be applied in virtue of something's instantiating the features generalized over by the law or principle in question. Such regimentation is at odds with the kind of particularity Heidegger ascribes to the thing. Note what Heidegger says in connection with the jug:

> In the scientific view, the wine became a liquid, and liquidity in turn became one of the states of aggregation of matter, *possible everywhere*. We failed to give thought to what the jug holds and how it holds. (PLT, p. 171 – my emphasis)

Heidegger's reference to 'the states of aggregation of matter' summarizes the ways in which the sciences efface the particularity of things: physics can only recognize the jug as, at best, one aggregation of matter, predictably related to other aggregates. I say 'at best' here because the notion of an *aggregate* has a kind of vagueness built into it: aggregates are not well-defined individuals, with well-delineated boundaries, such that questions concerning where an aggregate begins and ends, where one leaves off and another starts, do not admit of precise answers. From the standpoint of physics, the jug is much like the second of the physicist Sir Arthur Eddington's celebrated 'two tables' in *The Nature of the Physical World*. What Eddington refers to as the first table is the table as ordinarily perceived and described: something solid, relatively well defined and individuated, set off from its surroundings and so, as he puts it, 'substantial'. The 'second' table is the table as described by physics: 'My scientific table is mostly emptiness. Sparsely scattered in that emptiness are numerous electric charges rushing about with great speed; but their combined bulk amounts to less than a billionth of the bulk of the table itself.' From the standpoint of physics the substantiality of the table evanesces; indeed, the table is no longer manifest as an individual entity at all, but a kind of clustering (or aggregation) of the particles distributed in a volume of space where that clustering lacks precise borders and is really mostly empty space anyway: 'There is nothing *substantial* about my second table. It is nearly all empty space – space pervaded, it is true, by fields of force, but these are assigned to the category of "influences", not of "things".' Eddington does not, of course, think that there are really two tables, but two, ultimately competing, descriptions of what there is. Much of his argument is concerned to demonstrate the superiority of the second, scientific conception of reality, and so the outmoded, almost

mythological character of the first: 'The whole trend of modern scientific views is to break down the separate categories of "things", "influences", "forms", etc.' 'Break down' is not far short of 'annihilate'; either way, Eddington makes it clear that the notion of a thing, described by Heidegger as 'independent' and 'self-supporting', has no place in the language and outlook of modern science. As a result, Eddington would no doubt reproach Heidegger for his 'semipoetic' language insofar as that language is meant to convey a serious conception of reality.

In *What Is Called Thinking?*, Heidegger engages explicitly with the kind of view espoused by Eddington, when he invites us to consider (indeed, think about) standing before a tree in bloom. What Heidegger wants to keep in view via this invitation is the character of any such episode *as* an encounter with the tree, as an episode of meeting the tree 'face-to-face'. 'As we are in this relation of one to the other and before the other, the tree and we *are*' (WCT, p. 41). The principal thrust of Heidegger's discussion of this example is that much of what passes for thinking in philosophy and science falsifies such encounters, either by analysing the 'perceptual experience' of the one standing before the tree as a series of 'internal' mental (or neural) events such that the idea that the tree *is* drops out of the picture *or* by analysing the tree scientifically, which again leads to a kind of obliteration of the tree: 'Physics, physiology, and psychology . . . explain to us that what we see and accept is properly not a tree but in reality a void, thinly sprinkled with electric charges here and there that race hither and yon at enormous speeds' (WCT, p. 43). To adopt this perspective is to 'forfeit everything', since this perspective rules out the possibility of understanding this encounter as genuinely involving a 'face-to-face' meeting with a tree, which means that *anything* we are inclined to understand as a genuine engagement with 'self-supporting' things must be dismissed as a kind of quaint delusion or illusion. The important thing, for Heidegger, is to resist the allure of these modern, scientifically informed perspectives, as they are but the latest way of analysing, rather than thinking through, our untutored experience of the world. The threat posed by such analysis is the obliteration of that experience; the difficulty is still to think about it (Heidegger is *not* recommending that we just be oblivious) without such an analytical eye. As he contended in 'The Origin of the Work of Art', doing this requires letting beings be:

> When we think through what this is, that tree in bloom presents itself to us so that we can come and stand face-to-face with it, the thing that matters first and foremost, and finally, is not to drop the tree in bloom, but for once to let it stand where it stands. Why do we say 'finally'? Because to this day, thought has never let the tree stand where it stands. (WCT, p. 44)

We will consider shortly what is required to let things such as the tree be what they are. Perhaps surprisingly, a great deal of it has to do with how one thinks about (and uses) language. Before that, we need to consider Heidegger's views on technology.

10B MODERN TECHNOLOGY AS CHALLENGING-FORTH

There is a long-standing tendency to think about the relation between science and technology in the following manner: science is a kind of pure, theoretical inquiry, a disinterested attempt to figure reality out, while technology is the more interested application of those pure results. On this account, science has a kind of primacy, as it supplies the research that makes technological innovation or development possible. As Heidegger sees it, this way of thinking about science and technology obscures at least as much as it reveals. For one thing, the relation between scientific theorizing and technological innovation is far more complicated than this idea of a one-way line of research followed by application. Often, theoretical development is only possible given technological achievements: various things about atoms, for example, could only be discovered once researchers had figured out ways to isolate, smash and measure them. As Heidegger notes (well before it was fashionable to emphasize this point): 'Modern physics, as experimental, is dependent upon technical apparatus and upon progress in the building of apparatus' (QCT, p. 14). While Heidegger thinks that 'the establishing of this mutual relationship between technology and physics is correct', he regards this as 'a merely historiographical establishing of facts and says nothing about that in which this mutual relationship is grounded' (QCT, p. 14). Missing from this historiography is any insight into the 'essence' or 'ground' of both modern science and technology. To ask after the essence in this context is to ask after the most general characterization of this stage in the history of being. What, in other words, is the 'truth of beings' in the modern, scientific-technological age?

In thinking about the essence of technology, we need to be careful not simply to enumerate various kinds of technologies and technological devices and try to extract some set of common features. The essence of technology 'is by no means anything technological', and so Heidegger warns that 'we shall never experience our relationship to the essence of technology so long as we merely conceive and push forward the technological, put up with it, or evade it' (QCT, p. 4). Heidegger is especially concerned that we not stop with what seems like the obvious answer to his question. This easy answer consists of two statements: 'One says: Technology is a means to an end. The other says: Technology is a human activity' (QCT, p. 4). We might think of this as the build-a-better-mousetrap conception of technology, where there are already independently defined goals or ends (such as trapping mice), and human beings try to devise better means to those ends (such as by devising more sophisticated, efficient, reliable, humane, etc. kinds of traps). Technology on this view is subservient to ends that are otherwise already in place; technology is, moreover, subservient to us, to human beings who devise machines, devices, contraptions and so on.

Heidegger allows that there is something 'correct' about this 'instrumental' and 'anthropological' conception of technology. Indeed, it seems obviously right to say that technology does in many ways serve to attain ends that can be independently specified, and it again seems obviously right that technological devices are devised by people (they certainly don't spring up like mushrooms, reproduce like animals or fall from the sky like pennies from heaven). Although there is something correct about this definition, Heidegger thinks it is at best shallow (later in the essay, Heidegger seems unwilling to allow even this much, saying instead that it is 'in principle untenable' (QCT, p. 21)). The superficiality of this definition is evident for Heidegger in its failure to think through the means–ends relation to which it appeals. What kind of relation is this? What does it mean for something to serve as, or be, an instrument? Consider the following example. We say that a guitar is a musical instrument; it is thus a means to the end of producing music. If we leave the specification of the end as simply 'producing music', then the end does appear to be independent of the means: music can be played on or with the guitar, but also myriad other instruments as well. If I want to play 'Yankee Doodle', I can just as easily plink it out on the piano as pick it out on the guitar. There is, however, something misleading in this purported independence, whose plausibility is maintained by only specifying the end in a very general way. Though we might produce *some* music in some other way – using some other instrument – the music would not be *guitar music* without being played on the guitar (we can ignore for now the issue of synthesized guitar music). The guitar, in the hands of a musician, produces or 'brings forth' a very particular kind of music, and so even though the same 'tune' can be played on different instruments, in each case there is something irreducibly different. Moreover, the musician is the *kind* of musician he is in virtue of the instrument(s) he plays: many of the skills and abilities he has cannot be easily separated from those very instruments or transferred to others (a skilled guitarist may be totally at sea with a trombone, for example). The guitarist does not simply put the guitar to use, to produce something that might be brought about in some other way. If he were to sit down at the piano instead, that would not simply be using a different means to the same end; both the musician and the end would thereby be transformed as well.

The guitar, as an instrument, produces something, brings it forth, in a way that would not otherwise be possible. Guitar music does not just naturally occur, nor does the guitar more effectively facilitate the production of something that might be produced otherwise. But even in cases where the relation between means and ends, instrument and product, is not as tight, i.e. where there is a greater degree of independence in the specification of the means and ends, this relation of producing or bringing forth remains. The instrument is instrumental in bringing something forth, and so in revealing it *as* something so produced. For Heidegger, the revelatory capacity of the instrument links the instrument to the notion of *truth*, again understood as bringing things into unconcealment. He concludes from this that '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' (QCT, p. 12).

The problem with this line of thinking is that it does not (yet) differentiate *modern* technology from more general and long-standing phenomena. After all, human beings were producing things – using tools and instruments, deploying particular techniques and developing manufacturing procedures – well before the scientific and industrial revolutions whose advent Heidegger links to the

'annihilation' of things. Central to Heidegger's questioning of technology is that modern technology *is* a distinctive phenomenon. Thus, if the *essence* of modern technology is to be understood as a way of revealing, that 'way' must somehow stand apart from the ways in which 'traditional' technologies have been revelatory: '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' (QCT, p. 14).

Heidegger links traditional, pre-modern technologies, as bringing-forth, with *poiesis*: what is produced in these traditional technologies is brought into the open *as* distinctive, particular things. The rough idea is that hand-crafted items, for example, each have a kind of uniqueness or particularity, as each bears the traces of its own particular production, its own history. A skilled artisan is not a machine, nor does she strive to be: each item produced by the artist has its own history that is reflected in the sometimes slight, sometimes pronounced differences from the others the artisan has produced. Modern, machine technology strives precisely for the kind of uniformity that is so alien to skilled handicrafts: items that one buys 'off-the-shelf' should as much as possible be alike with one another, so that it does not matter that I choose this one rather than that one (and even when I opt for a 'custom' item, it is nonetheless customized in a standard way). But this means that the individual entity is not revealed as an individual, but instead as one of a more general kind, which can be substituted without effect more or less at will. Modern technology is not revelatory in the traditional sense, but in a wholly new way: the way of revealing characteristic of modern technology can be discerned not so much in what gets produced, the particular entities brought forth (since their particularity has been so deeply effaced), but in the underlying ways in which everything is organized so as to facilitate this kind of uniform, standardized production. Heidegger refers to this underlying way first as a kind of *challenging*: 'The revealing that rules throughout modern technology has the character of setting-upon, in the sense of a challenging-forth' (QCT, p. 16).

By 'challenging-forth', Heidegger means a view of what there is exclusively in terms what we might call *effective use*: what something is is a matter of what it can best be used for, where 'best' means most effectively or efficiently. (Machine-made goods exemplify this idea of challenging forth, since machines, with their standardized methods of production, produce items more efficiently than by hand: machines are faster and, due to the absence of variation, make fewer mistakes.) The paradigmatic example of this way of revealing, which underwrites and informs its emergence in other domains, is that of *energy*: 'The revealing that rules in modern technology is a challenging, which puts to nature the unreasonable demand that it supply energy that can be extracted and stored as such' (QCT, p. 14). In energy production, the earth is 'challenged' in various ways – oil wells are drilled; coal seams are mined; atoms are split; rivers are dammed – to yield energy, which can then in turn be used to power automobiles, factories, railway systems, airplanes and so on, and these too are subject to this challenging. Factories are challenged to produce the greatest amount at the least cost (where cost might be measured in various ways); railway systems are challenged to deliver goods (the faster and cheaper the better); automobiles are challenged to carry drivers and passengers effectively (where that might be a matter of speed, comfort, smoothness of ride and so on). According to this modern technological way of revealing:

> 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 has its own standing. We call it the standing-reserve. (QCT, p. 17)

What is translated as 'standing-reserve' (the German is *Bestand*) might be more straightforwardly rendered as simply *resource*: to challenge-forth means to reveal what there is as a variety of resources, to be effectively organized and used. We should be careful here not to construe this notion of world-as-resource as applying only within straightforwardly industrial contexts. Though abundantly evident in power plants and factories, the understanding of being that underwrites modern technological culture is far more, indeed maximally, pervasive. Even those things that might be regarded as escapes from the pressures of industrialized society – vacations, communing with nature, leisure time – are themselves resources to be challenged: my vacation is challenged to yield comfort and relaxation, my walk in the woods edification, while my 'leisure time' is itself a resource to be used effectively.

A careful reader might well at this point wonder how Heidegger's observations concerning the way a technological understanding of being reveals what there is as a network of resources square with

his earlier characterization of Da-sein's world as a referential totality of useful entities. As we saw in our discussion of his introduction of the notion of *earth* in 'The Origin of the Work of Art', Heidegger in *Being and Time* does not allow for anything in everydayness that resists the category of handiness apart from the mere stuff of objective presence, which, as amenable to scientific theorizing, lacks the 'revealing-concealing' character of his later notion of earth. For everyday Da-sein, 'The forest is a forest of timber, the mountain a quarry of rock, the river is water power, the wind is wind "in the sails"' (BT, p. 66/69). This does not sound too far off from the idea of resource or standing-reserve as it appears in 'The Question Concerning Technology', though in *Being and Time* Heidegger's descriptions are not cast in any kind of negative light: that everyday Da-sein encounters things in this manner does not seem to be any cause for concern or worry. But the technological understanding of being is something that Heidegger regards as an 'extreme danger'. There are no such alarms being sounded in *Being and Time*.

The question arises of whether this new tone of alarm marks another example of the divergence between early and later Heidegger. In other words, is Heidegger in 'The Question Concerning Technology' casting his earlier descriptions of everyday experience in a darker, more worrisome way? There seems to me to be two ways of handling these sorts of questions. One way is to see Heidegger's descriptions in *Being and Time* as at least intimating what he will later describe as the technological mode of revealing, and so we can understand Heidegger in his later essays to be delving deeper into phenomena already in view in *Being and Time*. This way makes a certain degree of sense, since what Heidegger later describes as the essence of technology would already have held sway in the era in which he is writing *Being and Time*. Thus, a descriptively adequate account of everyday Da-sein should carry traces at least of this technological way of revealing, even without being named as such and even without being painted in dark or ominous tones. That Heidegger so paints it later is evidence of further reflection on more or less the same phenomena: that everyday Da-sein sees a forest as 'a forest of timber' or the mountain as 'a quarry of rock' is something that later struck Heidegger as symptomatic of a deeply disturbing, threatening way of revealing what there is.

There is, however, another interpretive move one could make, which does not postulate this kind of continuity between *Being and*

Time and the later writings on technology. According to this approach, the descriptions Heidegger offers in *Being and Time* are meant to be far more general, and so in a sense more neutral, than what he later describes under the rubric of the essence of technology. Encountering things as useful is not equivalent to encountering what there is as standing-reserve, since one can do the former without doing the latter. After all, everyday Da-sein is not a creature specifically of modernity, and so the idea that Da-sein encounters things as useful or handy should likewise not be so confined: pre-modern, everyday Da-sein encounters what there is as useful, though not as resources in the modern, technological sense. There are passages in 'The Question Concerning Technology' that make this kind of distinction. Most notably, immediately after introducing the idea of 'challenging', with its demands on nature to 'supply energy that can be extracted and stored as such', he asks:

> But does this not hold 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. (QCT, p. 14)

Heidegger's choice of a windmill is especially apt, as it harkens back to his descriptions in *Being and Time* without explicitly referring to them. The owner of the windmill no doubt encounters the wind as 'wind in the sails', but Heidegger's suggestion is that this is not (yet) the kind of challenging-forth characteristic of modern technology. (I leave aside whether Heidegger can sustain this distinction; what matters for now is just that he wants to make it at all.) This example is followed closely by another, which contrasts the field worked by the peasant and one cultivated by 'the mechanized food industry':

> 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 to maintain. The work of the peasant does not challenge the soil of the field. In the sowing of the grain it places the 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. (QCT, pp. 14–15)

Finally, Heidegger mentions 'the forester who, in the wood, measures the felled timber and to all appearances walks the same forest path in the same way as did his grandfather'; despite the apparent similarity between the forester today and his grandfather, he is 'today commanded by profit-making in the lumber industry, whether he knows it or not' (QCT, p. 18). In all these contrasting cases, it seems clear that the category of useful things is equally applicable to both sides of the contrast – the forester's grandfather certainly experienced his trusty axe as something *for* felling trees, the peasant his plough as something *for* tilling the fields and so on – though not the notion of standing-reserve. Again, Heidegger's insistence here on this distinction may not be well founded, as there may be more than a little dewy-eyed nostalgia for bygone times in his characterizations of pre-modern life (I will try to address this charge of nostalgia below). Be that as it may, it is nonetheless significant that Heidegger does so insist, which suggests that we should be extremely cautious in any attempt to assimilate handiness (or readiness-to-hand) and standing-reserve.

10C TECHNOLOGY AS ENFRAMING

The notions of challenging-forth and standing-reserve are bound together by a third term: 'We now name that challenging claim which gathers man thither to order the self-revealing as standing-reserve: "*Ge-stell*" [Enframing]' (QCT, p. 19). As Heidegger himself acknowledges, he is here deploying an ordinary German word to do some extraordinary work: 'According to ordinary usage, the word *Gestell* means some kind of apparatus, e.g., a book rack. *Gestell* is also the name for a skeleton' (QCT, p. 20). My German–English dictionary also lists 'stand', 'rack', 'chassis' and 'bedstead' among the meanings for *Gestell*. Varying only by the addition of a hyphen, 'the employment of the word *Ge-stell* that is now required of us seems equally eerie [as using it as the name for a skeleton], not to speak of the arbitrariness with which words of a mature language are thus misused' (QCT, p. 20). Despite his own admissions of idiosyncrasy, Heidegger's terminology here is not overly difficult to understand (at least no more so than other ordinary and coined terms he puts to his own philosophical uses), as it serves to summarize the driving idea of modern technology of ordering what there is as standing-reserve. *Ge-stell* is more naturally translated as 'framework', which easily allows the insertion of a hyphen ('frame-work'). *Ge-stell* thus suggests working over what there is, working it into one all-encompassing framework, i.e. ordering what there is as an interconnected system of resources to be exploited in order to yield resources that themselves can be ordered: 'In Enframing, that unconcealment comes to pass in conformity with which the work of modern technology reveals the real as standing-reserve. This work is therefore neither only a human activity nor a mere means within such activity' (QCT, p. 21).

Heidegger's last remark further illustrates the limitations of the anthropological, instrumental conception of technology canvassed at the opening of the essay. Indeed, the conception is doubly problematic, foundering both with respect to instrumentality and anthropology. To begin with the former, if Heidegger is right about the distinctive character of technological revealing, as the ordering of what there is as a framework of resources, then it is not merely instrumental with respect to already-defined ends or goals. Technology, as a distinctive mode of revealing, is transformative not just with respect to means, but to ends as well. More radically, there is ultimately something distinctly endless about modern technology, which is driven by a demand for effective, efficient ordering, which leads only to more ordering and so on. In the end, efficiency becomes a kind of endless end-in-itself. Moreover, the demand for efficient ordering is not simply something that human beings do or make; human beings are no less subject to the challenging-forth characteristic of modern technology: 'Enframing means the gathering together of that setting-upon which sets upon man, i.e., challenges him forth, to reveal the real, in the mode of ordering, as standing-reserve' (QCT, p. 20). This is why Heidegger ultimately concludes that 'the merely instrumental, merely anthropological definition of technology is therefore in principle untenable' (QCT, p. 21).

10D THE 'SUPREME DANGER' OF MODERN TECHNOLOGY

The idea that man himself is as much set-upon by modern technology as anything else is very much at odds with a standard conception of technology, wherein it constitutes the epitome of human domination or mastery. On this standard model, human beings utilize technology to further their own various ends (here we see how

the instrumental and anthropological conceptions of technology fit together). Heidegger acknowledges that there is something right about this: 'Who accomplishes the challenging setting-upon through which what we call the real 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' (QCT, p. 18). Correct though these answers are, there is ultimately something deeply misleading about them, and in two respects. The first respect concerns the relation that obtains generally between the different understandings of being that have arisen and declined over time and human beings, in that these various understandings, their arising and declining, are not themselves human achievements or accomplishments. The ways in which beings are revealed are not subject to human control. That is why Heidegger follows up his pair of questions and answers with the qualification that 'man does not have control over unconcealment itself, in which at any given time the real shows itself or withdraws. The fact that the real 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' (QCT, p. 18). Here we can see a development of Heidegger's appeal to *thrownness* in *Being and Time*, which named the way in which Da-sein is 'delivered over' to its existence. Da-sein cannot get back behind its thrownness and achieve a kind of self-mastery all the way down (Da-sein, as authentic or self-owned, can only resolutely take over its already ongoing projection of possibilities).

Human beings are the ones for whom, in a space of intelligibility afforded by the opening of a clearing, things are manifest or intelligible, but the shape of that space so to speak is not itself something that human beings control; rather, the shape is something to which human beings are 'destined'. Any such way of being destined involves what Heidegger refers to as 'danger': 'The destining of revealing is as such, in every one of its modes, and therefore necessarily, *danger*' (QCT, p. 26). The danger lies in the ways in which every way of revealing is also a concealing: one way of opening onto what there is is at the same time a closing off of another way. Heidegger suggests, for example, that the rise of a cause–effect understanding of reality closes off an understanding of God as something mysterious and holy: God is reduced to 'the god of the philosophers', the first in an order of efficient causes.

What might have originally seemed exalted, a testimony to God's supremacy, is now either only a kind of causal supremacy or sentimental superstition.

Thus, the human-beings-as-masters picture is at odds with what holds generally with respect to revealing and concealing, but the rise of modern technology further disrupts this picture despite its tendency to lend credence to that very idea. Heidegger claims that 'when destining reigns in the mode of Enframing, it is the supreme danger'. (QCT, p. 26). Heidegger says that this heightened, indeed 'supreme', danger 'attests itself in two ways'. The first is the kind of disappearance or annihilation already noted in our discussion of the fate of *things* in scientific theorizing. However, in 'The Question Concerning Technology', Heidegger extends this sense of disappearance all the way to *objects*; 'thing' and 'object' are by no means equivalent notions for the later Heidegger, and so it is not at all clear that we can identify *this* disappearance with the one worked out in such essays as 'The Thing' and 'Building, Dwelling, Thinking'. At the same time, the proximity of the initial laying out of these ideas in his Bremen lectures suggests a close relation. Scientific theorizing and practice efface the particularity of things by demanding repeatability and generalizability, but this demand is itself subservient to the kind of challenging-forth central to technology. Calculability, predictability, standardization, generalizability, all such notions ultimately contribute to the effective and efficient exploitation of the world as a vast system of resources. Human beings thereby find themselves 'in the midst of objectlessness', and so as 'nothing but the orderer of the standing-reserve'. The first attestation to the 'supreme danger' of enframing precipitates the second: since technology relegates to human beings the sole task of being the 'orderer of the standing-reserve', this brings them to 'the very brink of a precipitous fall'. The 'fall' in question involves human beings ultimately being subjected to enframing, that is, coming to view themselves as just more standing-reserve.

The supreme danger is thus one of human beings becoming just more resources to be effectively and efficiently ordered. Heidegger himself notes the advent of the phrase 'human resources', which is by now well entrenched in common usage, but again it is important not to limit the phenomena he is describing to specifically work-related contexts. While it may be true that the workplace is one place where the transformation of human beings into resources is

especially evident, it is by no means the only place. Consider, for example, another common conception of human beings in modern society, namely as *consumers*. As the name suggests, consumers are users of resources, which by itself establishes a connection with standing-reserve. But the designation also pulls human beings within the sphere in another way: consumers do not just use resources, but are themselves resources to be measured, quantified and indexed. Consumers collectively form *markets* for goods and services, and those purveying such goods and services strategize endlessly to target those markets effectively. Witness the almost-constant deluge of advertising on everything from television to T-shirts, websites to stickers on fruit. While those ads may offer the appearance of addressing a 'unique you', an 'individual', they are very much aimed at an anonymous, multiple audience, whose 'value' is measured in 'spending power' (hence, some collectives of consumers are more valuable resources than others, as the frenzied quest for 'reaching' the 18–34 year-old market illustrates). But being a consumer is not just a way of being designated, from the outside, but it is an attitude or orientation that one can take up and inhabit. That is, consuming is a way of being, a way of organizing my activities, such that 'What can I buy today?' becomes an all-important question (leading a life dominated by consumption can be far more subtle than this, in the sense that living primarily as a consumer need not involve ever explicitly asking this question of oneself).

Being a consumer is one way of being a resource, but certainly not the only way (Heidegger at one point mentions being a patient, understood as part of a 'supply' for a clinic, which seems in these HMO-dominated days to be all the more relevant). We might see Heidegger's worries about the threat of human beings becoming resources as taking over the role occupied by *das Man* in *Being and Time*, as again part of the threat concerns similar kinds of anonymity and interchangeability. Moreover, there are similarities with respect to what specifically is threatened in each case. Recall that the threat posed by *das Man* resides in the ways in which it conceals, indeed actively suppresses especially when it comes to death, the idea that Da-sein's being is an issue for it. Da-sein, as a *Man*-self, fails to face up to the kind of being it is, and so fails to take over its being as something whose projection it is responsible for. The threat posed by the transformation of human beings into resources is similar in the sense that it likewise obscures from view something essential about human beings: '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' (QCT, p. 28).

Enframing 'conceals revealing itself' (QCT, p. 27), which would appear to mean that the technological way of things showing up does not itself show up *as* a way of showing up (Heidegger suggests this meaning when he says that 'man stands so decisively in attendance on the challenging-forth of Enframing that he does not apprehend Enframing as a claim' (QCT, p. 27)). Rather, it shows up as something for which no competitor or alternative ways of showing up are possible. Once everything is enframed as a resource, then there are simply more or less efficient ways of 'ordering' those resources. For example, where I live in West Virginia, coal is still an abundant natural resource, but many environmentalists have tried to argue that in the long term, areas unmarred by coal mining are more valuable for tourism and recreation. On the face of it, the anti-mining side of the argument wishes to halt the challenging-forth of West Virginia's landscape. But notice that the argument here is framed in terms of resources on *both* sides: what is at issue in the debate is what kind of resource something is best understood as being (a resource for energy production versus a resource for tourism and recreation), where 'best' means most effectively used overall. The idea that West Virginia's undeveloped areas are something *other* than resources – places of intrinsic value, say, or 'sacred space' – is apt to be met with a smile of derision as a kind of quaint, 'crunchy' outlook founded more on sentiment than any kind of rationality. While this might be part of what Heidegger has in mind, the idea that technological revealing broaches no alternatives cannot be the whole of the matter, since he has already said that *every* historical understanding of being – every opening onto what there is – carries the danger of concealing alternative ways of things being revealed. The Medieval Christian understanding of being did not exactly countenance alternatives either, nor did the world of the Greek temple: for those who inhabited those worlds, those worlds did not have the status of one way things show up among others. That enframing 'conceals revealing itself' must mean something more than that the 'reach' of enframing promises to be total (again, Medieval Christianity aspired to that kind of reach too).

What Heidegger has in mind here in explaining the 'supreme danger' of modern technology is not so much whether that understanding countenances alternatives, but whether human beings, as themselves enframed, can any longer be receptive to alternatives. All of the previous epochs in the history of being have clearly allowed for, though perhaps did not necessarily encourage, that kind of receptivity, since new openings onto what there is came to replace them. This is a deeper kind of threat than the danger that is part and parcel of any historical understanding of being, since it threatens to alter the 'essence' of human beings (notice also that the threat is other than the standard litany of threats cited in relation to technological development):

> 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 affected 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. (QCT, p. 28)

As one more resource among others, to be ordered effectively and efficiently, human beings may no longer be able to view themselves in a distinctive way, as the ones to and for whom things are disclosed. Because enframing encompasses human beings in the same way as everything else, 'man . . . fails in every way to hear in what respect he ek-sists, from out of his essence, in the realm of an exhortation or address, and thus *can never* encounter only himself' (QCT, p. 27). Again, there is an echo of *Being and Time* here. Just as the danger Heidegger warns of bears traces of the ways the conformity demanded by *das Man* blocks Da-sein's insight into the special character of its own existence, the importance noted here of man encountering 'only himself' is reminiscent of the *anxiety* that 'individualizes' Da-sein, thereby breaking the grip of *das Man*. Using the terminology of *Being and Time*, Heidegger's concern here is that Da-sein may no longer have the capacity for anxiety, and so may no longer experience itself in a distinctive way. (What might have previously counted as anxiety may be just one more thing to be effectively managed.)

10E THE SAVING POWER

Despite the darkness of Heidegger's tone in 'The Question Concerning Technology' (and elsewhere in his later writings), his attitude is not exclusively pessimistic. Despite the 'extreme danger' posed by the advent of the modern technological age, there remains the possibility of developing what he calls at the outset of the essay a 'free relationship' to technology. He explains that 'the relationship will be free if it opens our human existence to the essence of technology' (QCT, p. 3). By the close of the essay, Heidegger further develops this idea, noting that, paradoxically, the possibility of such a 'free relationship' is bound up with the notion of enframing:

> It is precisely in Enframing, which threatens to sweep man away into ordering as the supposed single 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 coming to presence of technology. (QCT, p. 32)

Heidegger presents his thinking here as guided by the words of the poet Hölderlin, who writes:

> *But where danger is, grows*
> *The saving power also.*

The 'saving power' is not so much technology, or even enframing, itself (as when people talk about technological solutions to the problems engendered by the spread of technology), but what Heidegger here calls 'paying heed' to technology. The idea here is that the very activity of questioning the essence of technology, of revealing enframing as that essence, is constitutive of remaining free with respect to technology, since that activity (thinking) is constitutive of human freedom in general. By thinking in this manner, we are thereby

> sojourning within the open 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 thing, 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. (QCT, pp. 25–6)

Developing a free relationship to technology does not mean aspiring to a life free *from* technology (though Heidegger's nostalgia for the life of pre-technological peasants sometimes encourages this interpretation), but instead leading a life that is not pervasively ordered by technology. In his address '*Gelassenheit*', translated as 'Discourse on Thinking' (but meaning something like 'releasement' or 'letting-be-ness'), Heidegger spells out this notion of a free relation in remarkably straightforward terms:

> We can use technical devices, and yet with proper use also keep ourselves so free of them, that we may let go of them at any time. We can use technical devices as they ought to be used, and also let them alone as something which does not affect our inner and real core. We can affirm the unavoidable use of technical devices, and also deny them the right to dominate us, and so to warp, confuse, and lay waste our nature. (DT, p. 54)

If we can succeed in maintaining this orientation to technology, 'our relation to technology will become wonderfully simple and relaxed. We let technical devices enter into our daily life, and at the same time leave them outside, that is, let them alone, as things which are nothing absolute but remain dependent upon something higher' (DT, p. 54).

It is not entirely clear what this 'wonderfully simple and relaxed' relation to technology is really supposed to look like, nor is it clear how one really sets about developing or maintaining such a relation. Various ideas suggest themselves – turning off the television; leaving one's cellular phone off (or, better, at home); spending less time on the computer; recognizing alternative ways to get from one place to another – but it is uncertain whether these sorts of helpful hints are what Heidegger has in mind and, if they are, whether they cut deep enough to establish the kind of free relation he has in mind. (All of the ones I have proposed may not cut deep enough by all being *individual* in nature, whereas the kind of enframing Heidegger warns of operates much more globally.) It may, however, be enough that such small endeavours start one on the way toward the kind of relationship he is naming here. By striving to make 'technical devices' count less – for example, by no longer frantically checking one's voicemail or e-mail, by no longer organizing one's time according to what programmes are on television, by getting out and walking rather than always driving everywhere – doing these things mark a refusal to *bind oneself* to technology; doing that, in turn, facilitates the recognition that insofar as one is, or has been, bound to technology, that is something one *can* undo (or at least alleviate), and recognizing *that* just is the recognition of one's own freedom in relation to the technological. Heidegger says that 'everything, then, depends upon this: that we ponder this arising and that, recollecting, we watch over it' (QCT, p. 32). The small steps enumerated here, though neither complete nor decisive, at least serve to foster the kind of pondering and recollecting he calls for, as each of them involves (and encourages) a kind of mindfulness with respect to technology. The 'simple and relaxed' relation Heidegger describes, wherein one is not dominated by technology, involves a continued willingness to think about one's relation to the myriad 'technical devices' that populate our lives, and that kind of thinking is a step, at least, on the way to the deeper level of thought Heidegger himself enacts in 'The Question Concerning Technology'.

But all of this can never entirely counteract the danger posed by the advent of technology: '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' (QCT, pp. 33–4). There appears to be a residual pessimism in Heidegger's writing after all, insofar as he discourages the idea that some concrete course of action might cure what ails us in the modern age. The best one can do is to continue to question – 'For questioning is the piety of thought' (QCT, p. 35) – and this means questioning the ways in which science and technology encourage us to conceive of and describe the world (including ourselves). Recall the ways in which science dismisses more poetic modes of speech, which amounts to a dismissal of the things named and called to by that speech. At the close of 'The Question Concerning Technology', Heidegger again invokes Hölderlin in order to suggest that the 'saving power' he envisions resides nowhere else than in the poetic dimensions of language:

> The same poet from whom we heard the words
> *But where danger is, grows*
> *The saving power also.*
> says to us:
> . . . *poetically dwells man upon this earth.* (QCT, p. 34)

To Heidegger's thoughts on poetry and dwelling we now turn.

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WHAT IS CALLED THINKING?

The Question Concerning Technology

and Other Essays

(1954 / 1977)

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The Question Concerning Technology

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 a way 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.[1] When we

1. "Essence" is the traditional translation of the German noun *Wesen*. One of Heidegger's principal aims in this essay is to seek the true meaning of essence through or by way of the "correct" meaning. He will later show that *Wesen* does not simply mean *what* something is, but that it means, further, the way in which something pursues its course, the way in which it remains through time as what it is. Heidegger writes elsewhere that the noun *Wesen* does not mean *quidditas* originally, but rather "enduring as presence" (*das Währen als Gegenwart*). (See *An Introduction to Metaphysics*, trans. Ralph Manheim [New York: Doubleday, 1961], p. 59.) *Wesen* as a noun derives from the verb *wesen*, which is seldom used as such in modern German. The verb survives primarily in inflected forms of the verb *sein* (to be) and in such words as the adjective *anwesend* (present). The old verbal forms from which *wesen* stems meant to tarry or dwell. Heidegger repeatedly identifies *wesen* as "the same as *währen* [to last or endure]." (See p. 30 below and SR 161.) As a verb, *wesen* will usually be translated

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 That which 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 conceive and push forward 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,[2] to which today we particularly like to do 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, or, in Latin, an *instrumentum*.[3]

here with "to come to presence," a rendering wherein the meaning "endure" should be strongly heard. Occasionally it will be translated "to essence," and its gerund will be rendered with "essencing." The noun *Wesen* will regularly be translated "essence" until Heidegger's explanatory discussion is reached. Thereafter, in this and the succeeding essays, it will often be translated with "coming to presence." In relation to all these renderings, the reader should bear in mind a point that is of fundamental importance to Heidegger, namely, that the root of *wesen,* with its meaning "to dwell," provides one integral component in the meaning of the verb *sein* (to be). (Cf. *An Introduction to Metaphysics*, p. 59.)

2. "Conception" here translates the noun *Vorstellung.* Elsewhere in this volume, *Vorstellung* will usually be translated by "representation," and its related verb *vorstellen* by "to represent." Both "conception" and "representation" should suggest a placing or setting-up-before. Cf. the discussion of *Vorstellung* in AWP 131–132.

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 envisioning 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 handwork technology, something 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 sawmill in a secluded valley of the Black Forest is a primitive means compared with the hydroelectric plant in the Rhine River.

But this much remains correct: modern technology too is a means to an end. That 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 "spiritually 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

3. *Instrumentum* signifies that which functions to heap or build up or to arrange. Heidegger here equates it with the noun *Einrichtung,* translated "contrivance," which can also mean arrangement, adjustment, furnishing, or equipment. In accordance with his dictum that the true must be sought by way of the correct, Heidegger here anticipates with his identification of technology as an *instrumentum* and an *Einrichtung* his later "true" characterization of technology in terms of setting-in-place, ordering, Enframing, and standing-reserve.

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 come to pass.[4] 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 out of 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 in keeping with which the kind of means to be used is determined is also 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 chalice required 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 just four causes? In relation to the aforementioned four, what does "cause" really mean? From

4. "Come to pass" translates *sich ereignet*. For a discussion of the fuller meaning of the verb *ereignen*, see T 38 n. 4, 45.

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 the latter 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 falls 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*].[5] 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 out 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 sacrificial vessel is at the same time indebted to the aspect (*eidos*) 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.

5. *Das, was ein anderes verschuldet* is a quite idomatic expression that here would mean to many German readers "that which is the cause of something else." The verb *verschulden* actually has a wide range of meanings—to be indebted, to owe, to be guilty, to be responsible for or to, to cause. Heidegger intends to awaken all these meanings and to have connotations of mutual interdependence sound throughout this passage.

But there remains yet a third 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.[6] 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 out of 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" or "purpose," and so misinterpreted. The *telos* is responsible for what as matter and for 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 whence the sacrificial vessel's bringing forth and resting-in-self 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 being responsible 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

6. Literally, "confines into"—the German preposition *in* with the accusative. Heidegger often uses this construction in ways that are unusual in German, as they would be in English. It will ordinarily be translated here by "within" so as to distinguish it from "in" used to translate *in* with the dative.

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 to 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, actually 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 presencing of something that presences. The four ways of being responsible bring something into appearance. They let it come forth into presencing [*An-wesen*].[7] 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. It is in the sense of such a starting something on its way into arrival that being responsible is an occasioning or an inducing to go forward [*Ver-an-lassen*].[8] On the

7. By writing *An-wesen*, Heidegger stresses the composition of the verb *anwesen*, translated as "to presence." The verb consists of *wesen* (literally, to continue or endure) with the prepositional prefix *an-* (at, to, toward). It is man who must receive presencing, man *to* whom it comes as enduring. Cf. *On Time and Being*, trans. Joan Stambaugh (New York: Harper & Row, 1972), p. 12.

8. *Ver-an-lassen* is Heidegger's writing of the verb *veranlassen* in noun form, now hyphenated to bring out its meaning. *Veranlassen* ordinarily means to occasion, to cause, to bring about, to call forth. Its use here relates back to the use of *anlassen* (to leave [something] on, to let loose, to set going), here translated "to start something on its way." *Anlassen* has just been similarly written as *an-lassen* so as to emphasize its composition from *lassen* (to let or leave) and *an* (to or toward). One of the functions of the German prefix *ver-* is to intensify the force of a verb. André Préau quotes Heidegger as saying: "*Ver-an-lassen* is more active than *an-lassen*. The *ver-*, as it were, pushes the latter toward a doing [*vers un faire*]." Cf. Martin Heidegger, *Essais et Conférences* (Paris: Gallimard, 1958), p. 16 n.

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 striking against and releasing, and 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? They let what is not yet present arrive into presencing. Accordingly, they are unifiedly ruled over 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 onton eis to on ionti hotōioun aitia pasa esti poiēsis.* "Every occasion for whatever passes over and goes forward into presencing from that which is not presencing is *poiēsis*, is bringing-forth [*Her-vor-bringen*]."[9]

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 handcraft 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 bursting open belonging to bringing-forth, e.g., the bursting of a blossom into bloom, in itself (*en heautōi*). In contrast, what is brought forth by the artisan or the artist, e.g., the silver chalice, has the bursting open belonging to bringing-forth not in itself, but in another (*en allōi*), in the craftsman or artist.

9. The full gamut of meaning for the verb *hervorbringen*, here functioning as a noun, includes to bring forth or produce, to generate or beget, to utter, to elicit. Heidegger intends that all of these nuances be heard. He hyphenates the word in order to emphasize its adverbial prefixes, *her-* (here or hither) and *vor-* (forward or forth). Heidegger elsewhere makes specific the meaning resident in *Her-vor-bringen* for him by utilizing those prefixes independently. Thus he says (translating literally), "Bringing-forth-hither brings hither out of concealment, forth into unconcealment" (cf. below, p. 11); and—after identifying working (*wirken*) and *her-vor-bringen*—he says that working must be understood as "bringing *hither*—into unconcealment, *forth*—into presencing" (SR 161). Because of the awkwardness of the English phrase "to bring forth hither," it has not been possible to include in the translation of *her-vor-bringen* the nuance of meaning that *her-* provides.

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 handwork and art? What is the bringing-forth in which the fourfold way of occasioning plays? Occasioning has to do with the presencing [*Anwesen*] of that which at any given time comes to appearance in bringing-forth. Bringing-forth brings hither out of concealment forth into unconcealment. Bringing-forth comes to pass only insofar as something concealed comes into unconcealment. This coming rests and moves freely within what we call revealing [*das Entbergen*].[10] The Greeks have the word

10. The verb *entbergen* (to reveal) and the allied noun *Entbergung* (revealing) are unique to Heidegger. Because of the exigencies of translation, *entbergen* must usually be translated with "revealing," and the presence of *Entbergung*, which is rather infrequently used, has therefore regrettably been obscured for want of an appropriate English noun as alternative that would be sufficiently active in meaning. *Entbergen* and *Entbergung* are formed from the verb *bergen* and the verbal prefix *ent-*. *Bergen* means to rescue, to recover, to secure, to harbor, to conceal. *Ent-* is used in German verbs to connote in one way or another a change from an existing situation. It can mean "forth" or "out" or can connote a change that is the negating of a former condition. *Entbergen* connotes an opening out from protective concealing, a harboring forth. For a presentation of Heidegger's central tenet that it is only as protected and preserved—and that means as enclosed and secure—that anything is set free to endure, to continue as that which it is, i.e., to be, see "Building Dwelling Thinking" in *Poetry, Language, Thought*, trans. Albert Hofstadter (New York: Harper & Row, 1971), p. 149, and cf. p. 25 below.

Entbergen and *Entbergung* join a family of words all formed from *bergen*—*verbergen* (to conceal), *Verborgenheit* (concealment), *das Verborgene* (the concealed), *Unverborgenheit* (unconcealment), das *Unverborgene* (the unconcealed)—of which Heidegger makes frequent use. The lack of viable English words sufficiently numerous to permit a similar use of but one fundamental stem has made it necessary to obscure, through the use of "reveal," the close relationship among all the words just mentioned. None of the English words used—"reveal," "conceal," "unconceal"—evinces with any adequacy the meaning resident in *bergen* itself; yet the reader should be constantly aware that the full range of connotation present in *bergen* sounds for Heidegger within all these, its derivatives.

alētheia for revealing. The Romans translate this with *veritas*. We say "truth" and usually understand it as the correctness of an idea.

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, belongs instrumentality.[11] 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.[12]

This prospect strikes us as strange. Indeed, it should do so, 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

11. Here and elsewhere "belongs within" translates the German *gehört in* with the accusative (literally, belongs into), an unusual usage that Heidegger often employs. The regular German construction is *gehört zu* (belongs to). With the use of "belongs into," Heidegger intends to suggest a relationship involving origin.

12. Heidegger here hyphenates the word *Wahrheit* (truth) so as to expose its stem, *wahr*. He points out elsewhere that words with this stem have a common derivation and underlying meaning (SR 165). Such words often show the connotations of attentive watchfulness and guarding that he there finds in their Greek cognates, *horaō, ōra*, e.g., *wahren* (to watch over and keep safe) and *bewahren* (to preserve). Hyphenating *Wahrheit* draws it overtly into this circle of meaning. It points to the fact that in truth, which is unconcealment (*Unverborgenheit*), a safekeeping carries itself out. *Wahrheit* thus offers here a very close parallel to its companion noun *Entbergung* (revealing; literally, harboring forth), built on *bergen* (to rescue, to harbor, to conceal). See n. 10, above. For a further discussion of words built around *wahr*, see T 42, n. 9.

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 poietic.

The other point 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 names 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 perspectives 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 envisioned as completed, and from this gathering determines the manner of its construction. Thus what is decisive in *technē* does not lie at all in making and manipulating nor in the using of means, but rather in the aforementioned revealing. 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 [*West*] 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 handcraftsman, 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 historiographical 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 happens to think 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*],[13] which puts to nature the unreasonable demand that it supply energy that 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 into the putting 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 [*bestellte*] appears differently than it did when to set in order still meant to take care of and

13. *Herausfordern* means to challenge, to call forth or summon to action, to demand positively, to provoke. It is composed of the verb *fordern* (to demand, to summon, to challenge) and the adverbial prefixes *her-* (hither) and *aus-* (out). The verb might be rendered very literally as "to demand out hither." The structural similarity between *herausfordern* and *her-vor-bringen* (to bring forth hither) is readily apparent. It serves of itself to point up the relation subsisting between the two modes of revealing of which the verbs speak—modes that, in the very distinctive ways peculiar to them, occasion a coming forth into unconcealment and presencing. See below, 29–30.

to maintain. The work of the peasant does not challenge the soil of the field. In the sowing of the grain it places the 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 [*stellt*] nature.[14] 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 released either for destruction or for peaceful use.

This setting-upon that challenges forth the energies of nature is an expediting [*Fördern*], 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 supplied in order that it may simply be present somewhere or other. It is stockpiled; 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.

14. The verb *stellen* (to place or set) has a wide variety of uses. It can mean to put in place, to order, to arrange, to furnish or supply, and, in a military context, to challenge or engage. Here Heidegger sees the connotations of *herausfordern* (to challenge, to call forth, to demand out hither) as fundamentally determinative of the meaning of *stellen*, and this remains true throughout his ensuing discussion. The translation of *stellen* with "to set upon" is intended to carry this meaning. The connotations of setting in place and of supplying that lie within the word *stellen* remain strongly present in Heidegger's repeated use of the verb hereafter, however, since the "setting-upon" of which it speaks is inherently a setting in place so as to supply. Where these latter meanings come decisively to the fore, *stellen* has been translated with "to set" or "to set up," or, rarely, with "to supply."

Stellen embraces the meanings of a whole family of verbs: *bestellen* (to order, command; to set in order), *vorstellen* (to represent), *sicherstellen* (to secure), *nachstellen* (to entrap), *verstellen* (to block or disguise), *herstellen* (to produce, to set here), *darstellen* (to present or exhibit), and so on. In these verbs the various nuances within *stellen* are reinforced and made specific. All these meanings are gathered together in Heidegger's unique use of the word that is pivotal for him, *Ge-stell* (Enframing). Cf. pp. 19 ff. See also the opening paragraph of "The Turning," pp. 36–37.

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.[15] In the context of the interlocking processes pertaining to the orderly disposition of electrical energy, even the Rhine itself appears as something at our command. The hydroelectric 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 out of 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 speaks out of the two titles, "The Rhine" as dammed up into the *power* works, and "The Rhine" as uttered out of 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. 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. 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 challenging revealing.

15. In these two sentences, in order to show something of the manner in which Heidegger gathers together a family of meanings, a series of *stellen* verbs—*stellen* (three times), *herstellen, bestellen*—have been translated with verbal expressions formed around "set." For the usual meanings of these verbs, see n. 14.

What kind of unconcealment is it, then, that is peculiar to that which comes to stand forth through this setting-upon that challenges? 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 has its own standing. We call it the standing-reserve [*Bestand*].[16] The word expresses here something more, and something more essential, than mere "stock." The name "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 challenging revealing. 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 ensure the possibility of transportation. For this it must be in its whole structure and in every one of its constituent parts, 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 out of the essence of technology within which it belongs. Seen in terms of the standing-reserve, the machine is completely unautonomous, for it has its standing only from the ordering of the orderable.)

The fact that now, wherever we try to point to modern technology as the challenging revealing, the words "setting-upon," "ordering," "standing-reserve," obtrude and accumulate in a dry, monotonous, and therefore oppressive way, has its basis in what is now coming to utterance.

16. *Bestand* ordinarily denotes a store or supply as "standing by." It carries the connotation of the verb *bestehen* with its dual meaning of to last and to undergo. Heidegger uses the word to characterize the manner in which everything commanded into place and ordered according to the challenging demand ruling in modern technology presences as revealed. He wishes to stress here not the permanency, but the orderability and substitutability of objects. *Bestand* contrasts with *Gegenstand* (object; that which stands over against). Objects indeed lose their character as objects when they are caught up in the "standing-reserve." Cf. Introduction, p. xxix.

Who accomplishes the challenging setting-upon through which what we call the real 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 real shows itself or withdraws. The fact that the real 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 ordering revealing 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, in the wood, measures the felled timber and to all appearances walks the same forest path in the same way as did his grandfather is today commanded by profit-making in the lumber industry, 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 through which man is already passing 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 and has done so, 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 come to pass 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, ensnares 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 an ordering revealing is, then, no merely human doing. Therefore we must take that challenging that sets upon man to order the real as standing-reserve in accordance with the way in which it shows itself. That challenging gathers man into ordering. This gathering concentrates man upon ordering the real as standing-reserve.

That which primordially unfolds the mountains into mountain ranges and courses through them in their folded togetherness 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 that challenging claim which gathers man thither to order the self-revealing as standing-reserve: "*Ge-stell*" [Enframing].[17]

We dare to use this word in a sense that has been thoroughly unfamiliar up to now.

17. The translation "Enframing" for *Ge-stell* is intended to suggest, through the use of the prefix "en-," something of the active meaning that Heidegger here gives to the German word. While following the discussion that now ensues, in which Enframing assumes a central role, the reader should be careful not to interpret the word as though it simply meant a framework of some sort. Instead he should constantly remember that Enframing is fundamentally a calling-forth. It is a "challenging claim," a demanding summons, that "gathers" so as to reveal. This claim *enframes* in that it assembles and orders. It puts into a framework or configuration everything that it summons forth, through an ordering for use that it is forever restructuring anew. Cf. Introduction, pp. xxix ff.

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 *Ge-stell* [Enframing] that is now required of us seems equally eerie, not to speak of the arbitrariness with which words of a mature language are thus misused. Can anything be more strange? Surely not. Yet this strangeness is an old usage of thinking. And indeed thinkers accord with this usage 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 *eidos* for that which in everything and in each particular thing endures as present. For *eidos*, 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.[18] Aspect (*idea*) names and is, also, 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 other instances, the use of the word *Gestell* as the name for the essence of modern technology, which we now venture here, is almost harmless. Even so, the usage now required remains something exacting and is open to misinterpretation.

Enframing means the gathering together of that setting-upon which sets upon man, i.e., challenges him forth, to reveal the real, in the mode of ordering, as standing-reserve. Enframing means that way of revealing which holds sway in the essence of modern technology and which is itself nothing technological. On the other hand, all those things that are so familiar to us and are standard parts of an assembly, such as rods, pistons, and chassis, belong to the technological. The assembly itself, however, together with the aforementioned stockparts, falls within

18. Where *idea* is italicized it is not the English word but a transliteration of the Greek.

the sphere of technological activity; and this activity always merely responds to the challenge of Enframing, but it never comprises Enframing itself or brings it about.

The word *stellen* [to set upon] in the name *Ge-stell* [Enframing] not only means 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., the erecting of a statue in the temple precinct—and the challenging ordering now under consideration are indeed fundamentally different, and yet they remain related in their essence. Both are ways of revealing, of *alētheia*. In Enframing, that unconcealment comes to pass in conformity with which the work of modern technology reveals the real 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 cannot 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. That 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. Rather 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 therefore 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 physics 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 first not simply for technology but for the essence of modern technology. For already in physics the challenging gathering-together into ordering revealing holds sway. But in it that gathering does not yet come expressly to appearance. Modern physics is the herald of Enframing, a herald whose origin is still unknown. The essence of modern technology has for a long time been concealing itself, 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.[19] 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 the arising that holds sway becomes manifest to us men only later. That which is primally early shows itself only ultimately to men.[20] 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 what is early.

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, the historically earlier.

19. "Coming to presence" here translates the gerund *Wesende*, a verbal form that appears, in this volume, only in this essay. With the introduction into the discussion of "coming to presence" as an alternate translation of the noun *Wesen* (essence), subsequent to Heidegger's consideration of the meaning of essence below (pp. 30 ff.), occasionally the presence of *das Wesende* is regrettably but unavoidably obscured.

20. "That which is primally early" translates *die anfängliche Frühe*. For a discussion of that which "is to all present and absent beings . . . the earliest and most ancient at once"—i.e., *Ereignen, das Ereignis*—see "The Way to Language" in *On the Way to Language*, trans. Peter D. Hertz (New York: Harper & Row, 1971), p. 127.

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 all its retreating from the representation turned only toward objects that has alone been standard till recently, will never be able to renounce this one thing: that nature reports itself in some way or other that is identifiable through calculation and that it remains orderable as a system of information. This system is determined, then, out of 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.*

Because the essence of modern technology lies in Enframing, modern technology must employ exact physical science. Through its so doing, the deceptive illusion arises that modern technology is applied physical science. This illusion can maintain itself only so long as neither the essential origin of modern science nor indeed the essence of modern technology is adequately found out through 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 brought to, 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 real reveals itself as standing-reserve.

* W. Heisenberg, "Das Naturbild in der heutigen Physik," in *Die Künste im technischen Zeitalter* (Munich, 1954), pp. 43 ff.

Again we ask: Does this revealing happen somewhere beyond all human doing? No. But neither does it happen exclusively *in* man, or decisively *through* man.

Enframing is the gathering together that belongs to that setting-upon which sets upon man and puts him in position to reveal the real, 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 comes to presence.

The essence of modern technology starts man upon the way of that revealing through which the real everywhere, more or less distinctly, becomes standing-reserve. "To start upon a way" means "to send" in our ordinary language. We shall call that sending-that-gathers [*versammelde Schicken*] which first starts man upon a way of revealing, *destining* [*Geschick*].[21] It is from out of this destining that the essence of all history [*Geschichte*] is determined. History is neither simply the object of written chronicle nor simply the fulfillment of human activity. That activity first becomes history as something destined.* 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

21. For a further presentation of the meaning resident in *Geschick* and the related verb *schicken*, cf. T 38 ff., and Introduction, pp. xxviii ff.

* See *Vom Wesen der Wahrheit*, 1930; 1st ed., 1943, pp. 16 ff. [English translation, "On the Essence of Truth," in *Existence and Being*, ed. Werner Brock (Chicago: Regnery, 1949), pp. 308 ff.]

every way of revealing. Bringing-forth, *poiēsis*, is also a destining in this sense.

Always the unconcealment of that which is[22] goes upon a way of revealing. Always the destining of revealing holds complete sway over man. 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 and hears [*Hörender*], and not one who is simply constrained to obey [*Höriger*].

The essence of freedom is *originally* not connected with the will or even with the causality of human willing.

Freedom governs the open in the sense of the cleared and lighted up, i.e., of the revealed.[23] It is to the happening of revealing, i.e., of truth, that 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 open, goes into the open, and brings into the open. The freedom of the open 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 there shimmers that veil that covers what comes to presence 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 upon 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, then we experience Enframing as a destining of revealing. In this way we are already sojourning within the open 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

22. *dessen was ist.* On the peculiar significance of *das was ist* (that which is), see T 44 n. 12.

23. "The open" here translates *das Freie*, cognate with *Freiheit*, freedom. Unfortunately the repetitive stress of the German phrasing cannot be reproduced in English, since the basic meaning of *Freie*—open air, open space—is scarcely heard in the English "free."

thing, 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 pushing forward 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 be admitted more and sooner and ever more primally to the essence of that which is unconcealed and to its unconcealment, in order that he might experience as his essence his needed belonging to revealing.

Placed between these possibilities, man is endangered from out of 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 quail at the unconcealed and may misinterpret it. Thus where everything that presences exhibits itself in the light of a cause-effect coherence, even God can, for representational thinking, 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 origin 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 can 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 danger as such.

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 does so, rather, 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 to the posture of lord of the earth. In this way the impression 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 real must present itself to contemporary man in this way.* *In truth, however, precisely nowhere does man today any longer encounter himself, i.e., his essence.* Man stands so decisively in attendance on the challenging-forth of Enframing that he does not apprehend 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 ek-sists, from out of his essence, in the realm of an exhortation or address, and thus *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 that kind of revealing which 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 that which 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 it conceals revealing itself and with it That wherein unconcealment, i.e., truth, comes to pass.

* "Das Naturbild," pp. 60 ff.

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. There is no demonry of technology, but rather there is the mystery of its essence. 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 affected 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. 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 genuine appearing. If the essence of technology, Enframing, is the extreme danger, and 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 into appearance the saving power in its arising?

In what respect does the saving power grow there also 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 in that wherein 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 is actually 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 real and possible trees. Is then the essence of technology, Enframing, the common genus for everything technological? If that 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 executer, within Enframing; but Enframing is never the essence of technology in the sense of a genus. Enframing is a way of revealing having the character of 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, apportions itself into the revealing that brings forth and that also challenges, and which allots itself to man. The challenging revealing 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 in which they "essence" [*Wesen*]. Johann Peter Hebel in a poem, "Ghost on Kanderer Street," for which Goethe had a special fondness, uses the old word *die Weserei*. It means the city hall inasmuch as there the life of the community gathers and village existence is constantly in play, i.e., comes to presence. 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 essences, what comes to presence, in the sense of what endures. But they think what endures as what remains permanently [*das Fortwährende*] (*aei on*). And they find what endures permanently in what, as that which remains, tenaciously persists throughout all that happens. That which remains they discover, in turn, in the aspect [*Aussehen*] (*eidos, 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 essencing 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 essences lets itself be seen only from out of that permanent enduring in which Enframing comes to pass as a destining of revealing. Goethe once uses the mysterious word *fortgewähren* [to grant permanently] in place of *fortwähren* [to endure permanently].* He hears *währen* [to endure] and *gewähren* [to grant] here in one unarticulated accord.[24] And if we now ponder more carefully than we did before what it is that actually endures and perhaps alone endures, we may venture to say: *Only what is granted endures. That which endures primally out of the earliest beginning is what grants.*[25]

As the essencing of technology, Enframing is that which 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 real as standing-reserve still remains a destining that starts man upon a way of revealing. As this destining, the coming to presence of technology gives man entry into That which, of himself, he can neither invent nor in any way make. For there is no such thing as a man who, solely of himself, is only man.

But if this destining, Enframing, is the extreme danger, not only for man's coming to presence, but for all revealing as such, should this destining still be called a granting? Yes, most emphat-

* "Die Wahlverwandtschaften" [Congeniality], pt. II, chap. 10, in the novelette *Die wunderlichen Nachbarskinder* [The strange neighbor's children].

24. The verb *gewähren* is closely allied to the verbs *währen* (to endure) and *wahren* (to watch over, to keep safe, to preserve). *Gewähren* ordinarily means to be surety for, to warrant, to vouchsafe, to grant. In the discussion that follows, the verb will be translated simply with "to grant." But the reader should keep in mind also the connotations of safeguarding and guaranteeing that are present in it as well.

25. *Nur das Gewährte währt. Das anfänglich aus der Frühe Währende ist das Gewährende.* A literal translation of the second sentence would be, "That which endures primally from out of the early. . . ." On the meaning of "the early," see n. 20 above.

ically, if in this destining the saving power is said to grow. Every destining of revealing comes to pass from out of a granting and as such a granting. For it is granting that first conveys to man that share in revealing which the coming-to-pass of revealing needs.[26] As the one so needed and used, man is given to belong to the coming-to-pass of truth. The granting that sends in 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 coming to presence on this earth. It is precisely in Enframing, which threatens to sweep man away into ordering as the supposed single 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 coming to presence of technology.

Thus the coming to presence of technology harbors in itself what we least suspect, the possible arising of the saving power.

Everything, then, depends upon this: that we ponder this arising and that, recollecting, we watch over it. How can this happen? Above all through our catching sight of what comes to presence in technology, instead of merely staring at the technological. So long as we represent technology as an instrument, we remain held fast in the will to master it. We press on past the essence of technology.

When, however, we ask how the instrumental comes to presence as a kind of causality, then we experience this coming to presence as the destining of a revealing.

When we consider, finally, that the coming to presence of the essence of technology comes to pass in the granting that needs and uses man so that he may share in revealing, then the following becomes clear:

26. Here and subsequently in this essay, "coming-to-pass" translates the noun *Ereignis*. Elsewhere, in "The Turning," this word, in accordance with the deeper meaning that Heidegger there finds for it, will be translated with "disclosing that brings into its own." See T 45; see also Introduction, pp. xxxvi–xxxvii.

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 coming-to-pass of revealing and so radically endangers the relation to the essence of truth.

On the other hand, Enframing comes to pass for its part in the granting that lets man endure—as yet unexperienced, but perhaps more experienced in the future—that he may be the one who is needed and used for the safekeeping of the coming to presence of truth.[27] Thus does the arising of the saving power appear.

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 coming to presence of truth, comes to pass.

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 coming to presence 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 unconcealedness 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

27. "Safekeeping" translates the noun *Wahrnis*, which is unique to Heidegger. *Wahrnis* is closely related to the verb *wahren* (to watch over, to keep safe, to preserve), integrally related to *Wahrheit* (truth), and closely akin to *währen* (to endure) and *gewähren* (to be surety for, to grant). On the meaning of *Wahrnis*, see T 42, n. 9 and n. 12 above.

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, a revealing 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 that revealing that brings forth truth into the splendor of radiant appearing also was called *technē*.

Once there was a time when the bringing-forth of the true into the beautiful was called *technē*. And the *poiēsis* of the fine arts also was called *technē*.

In Greece, at the outset of the destining of the West, the arts soared to the supreme height of the revealing granted them. They brought the presence [*Gegenwart*] of the gods, brought the dialogue of divine and human destinings, to radiance. And art was simply called *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. Art works were not enjoyed aesthetically. Art was not a sector of cultural activity.

What, then, was art—perhaps only for that brief but magnificent time? Why did art bear the modest name *technē*? Because it was a revealing that brought forth and hither, 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 dwells man upon 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 coming to presence 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 look into that which grants and our trust in it?

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 come to presence in the coming-to-pass 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 on art, for its part, does not shut its eyes to the constellation of truth after 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 coming to presence of technology, that in our sheer aesthetic-mindedness we no longer guard and preserve the coming to presence of art. Yet the more questioningly 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.

Thinking About Technology

Foundations of the Philosophy of Technology

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For Donna

CHAPTER FIVE

Technology and Ideology

In Chapters 1 and 2 and at the end of Chapter 4 I argued that essential to understanding any innovation or invention are the people involved in its creation and use. One of the reasons for developing this position is the argument that led to the definition of technology as humanity at work. But there is a second reason, equally important. The failure to include the decisions and actions of the appropriate individuals results in philosophical accounts that appear isolated from the remainder of the philosophical conversation, and this is often why philosophers have been seen as having failed to provide an adequate account of technological issues. That is to say, a reason philosophers have been unsuccessful in their treatments of technology is that, for the most part, the questions technologies have raised for them have been addressed in a way that makes it difficult, if not impossible, to integrate them into the broader philosophical discussion concerned with making our way around in the world. There are, in particular, four approaches to analyzing technology from an ostensibly philosophical perspective that have led to the paradoxical result of diverting discussions of technologies away from the broader philosophical dialogue. They are: (1) discussing technology from the context of an ideological bias; (2) attacking or praising some invention simply in terms of whether or not it promotes or threatens some privileged set of moral values; (3) assuming that technology is a monolithic "thing" that is autonomous; and (4) seeing technological innovation as necessarily posing a threat to our political system and our way of life. This last approach may be seen as just a specific instance of (1), but it deserves special treatment since it has an independent history. The remainder of this chapter and the next two are devoted to showing why viewing technologies in these ways is not the proper way to think about technologies if we are interested in exploring their philosophical implications.

Section 1. Some Preliminaries: About Heidegger

One way to contextualize some of the four claims noted above is to see them against the background of the philosophical position of Martin Heidegger. In many respects Heidegger's view embodies these positions, or at least he anticipates them. As we shall see, Heidegger's way of reasoning proceeds at a formally abstract level and it invokes a vocabulary and a way of thinking about technology that make it extremely difficult to understand, no less to integrate, his ideas into a broader discussion. As such he is an ideal candidate for exemplifying some of the complaints we have been working against.

The difficulty of understanding Heidegger is notorious. And, as one might suppose, there are several responses to this issue of difficulty. One can dismiss his writings as simple ravings; one can impute to him various motives, such as deliberate obscurantism or hubris; or one can, as Richard Bernstein does, see Heidegger's idiosyncratic use of language and unorthodox methodology as a deliberate effort to force us to rethink some common notions.[1] This last option is the most charitable way to read Heidegger, and it is the one we will pursue.[2] To do so is to invoke the principle of charity. Basically the idea is this: before you defend or attack an argument or a thesis, do the best possible job of explicating it and making the case for it. For only then will your negative criticisms be considered honest and your positive defense be seen as a serious effort to extend the ideas and not mere sycophantism. Unfortunately, Heidegger has suffered from followers who immerse themselves in his language and ape his philosophical method, only to discredit his views by producing work that sounds profound but that is, at best, Heideggeresque but without much content. Heidegger is not the only philosopher to have garnered his share of disciples who merely mouth the words of the great man and refuse to move beyond his thought. This is a tradition that extends back to Ancient Greece. That it is an old phenomenon is not to say that it is a behavior that we endorse, only to acknowledge sadly that not all that sounds like philosophy is serious philosophical thinking.

Disciples and sycophants aside, the consensus remains that Heidegger is a serious thinker, one of the most important of this century, and therefore

1. Bernstein 1993, chap. 4.

2. Though I will break from Bernstein's account by explicating Heidegger without resorting to his special terminology. If a philosophical theory cannot be discussed except by invoking technical jargon, then it is suspect. There is the suggestion that maybe the ideas being tossed about are not germane to anything—that they live in a special world all their own. Remembering that we are trying to draw discussions of the philosophy of technology into the broader philosophical framework, we must avoid jargon and seek a common, understandable language.

it is incumbent upon us to engage him in our discussion, if our view of philosophy as a dialogue is to be something more than empty rhetoric.

The place to start is Heideggger's well-known essay "On the Question of Technology."[3] The structure of the argument is as follows:

1. Traditional accounts of technology see it as a means to an end. This is fine for older technology.

2. This instrumental definition of technology has at its core the concept of causality.

3. Aristotle's fourfold account of technology seems the best way to capture this sense of causality.

4. However, if we are going to use Aristotle's theory of causes, then we should understand it as the Ancient Greeks did.

5. Taken together, the four causes should be seen as being responsible for something else coming to be.

6. Applied to older technologies, we can see technology as responsible for the harnessing of nature, making it available as a set of forces to be used to meet our ends.

7. Modern technology is different from traditional older technology in that the object we are responsible for putting into our arsenal of resources is not just nature, but humanity itself.

8. With the resources of modern science at our command, we are forced (perhaps by the mere having of this knowledge) into turning our knowledge not only against nature but against ourselves.

9. That is why modern technology is a danger.

In Heidegger's own discussion much is made of two distinctions: (a) "true" versus "correct"; and (b) the definition of technology versus the essence of technology. Something can be correct but not true; hence the search for what is true is a function of having a correct account that is

3. When I say that this is the place to start, it should be remembered that Heidegger produced a substantial body of work in what can be called a systematic philosophy. His collected works, the *Gesamtausgabe*, consists of almost 200 volumes. Clearly the position he articulates in "On the Question of Technology" has to be understood in the context of his larger project. An analysis of that project is, however, beyond our scope here.

somehow flawed. This distinction is at the heart of Heidegger's philosophical method. The second distinction frames the structure of "On the Question of Technology." We may have a correct definition of technology as instrumental, but that does not capture the essence of technology. In his search for the essence of technology, he first locates the essence of the instrumental definition in causality. He then asks us to consider what would happen if the instrumental definition were only correct but not true. His search for the essence of modern technology then takes off from reconsidering the original meaning of the Greek account of Aristotle's four causes, leading to the conclusion that because of some uncontrollable power we are forced to treat human beings as mere resources, which is dehumanizing.[4]

While I have difficulties with many of the assertions that come in the twists and turns of the argument, it is the basic assumption, that there is an essence of technology that is uncoverable, that I find fundamentally flawed. It is this same assumption that lies at the heart of the arguments put forth by contemporary social critics. Technology is seen as a thing, a force, in and of itself. It is made into an object against which we can rail. But Heidegger gives no reason nor any argument for the existence of whatever it is that is the force that pushes us into using human beings as resources. By creating an essence for technology, what he has done is to sidestep the real issue, which is: Why do people do what they do to other people? Maybe it is a question he did not want to address or couldn't (see footnote 4). But surely it is no answer to attribute our behavior to some essence of technology.

Further, that the essence of technology Heidegger speaks of is not its definition is in itself an interesting move. Heidegger uses a word to capture what he thinks about technology's power: *Enframing*. But it is just a word, not a definition. And it is a word that really does nothing more that stand in for his whole account. This move makes it impossible really to come to grips with the force of Heidegger's account outside of his own argument. For to deal with it, you have to enter into Heidegger's special way of thinking and his jargonistic use of language, which essentially makes you a captive of his semantics. Once you step outside Heidegger's linguistic web, the force of his way of reasoning loses its punch. For now

4. This is of course the result that Kant argued against—one formulation of the Categorical Imperative being "Do not treat others as means to an end." So it may be that this result argues against a deep-seated Kantian overlay for Heidegger. However, while Heidegger finds the dehumanizing nature of technology disconcerting, his reaction to modern technology is even more puzzling to the modern reader when we discover that Heidegger was a Nazi, a member of the National Socialist Party who enthusiastically endorsed Hitler, the master of dehumanization. See Richard Bernstein's "Heidegger's Silence: *Ethos* and Technology" for an excellent discussion of this dilemma (1993, chap. 4, esp. 118-36).

we can ask: Where did this force that compels us in this way come from? And the answer is that it is an *ad hoc* assumption introduced into the argument through the semantic contortions of the method. By refusing to work toward a definition of modern technology, Heidegger has essentially made the issue unapproachable or, worse still, unchallengeable.

Finally, we need to look at Heidegger's alleged refutation of the instrumental definition of technology. Here is what he has to say in his own words.[5]

> 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 an activity. The merely instrumental, merely anthropological definition of technology is therefore in principle untenable. (Heidegger 1954, 327)

It looks as if Heidegger is claiming that technology cannot be conceived of as merely instrumental because it essentially involves nature. But it would seem, by his own reasoning (one hesitates to call it logic), since the result of enframing is to reveal nature as a standing reserve, i.e., to come to understand nature in such a way as to make it possible to harness nature's energies to achieve specific human ends, that the instrumental nature of technology is what is continuously paramount. Further, Heidegger never gives a reason why we must consider the instrumental only with respect to nature—the instrumental can also pertain to the world of ideas, for instance, as in mathematics. So it is not clear that Heidegger has given us anything approaching an argument, much less a conclusive argument, against the instrumental conception of technology.

Despite these concerns, Heidegger's influence is considerable. And it is against that background that we should consider the rest of this chapter.

Section 2. Technology and Ideology

Much philosophical concern about technology can be found in the form of various *value judgments* about the merits of, or threats posed by, particular artifacts or systems. In this sense that form of the philosophy of technology is no more exclusively the work of philosophers than any other set of pronouncements of this kind. This kind of philosophy is nothing

5. This is, of course, a translation and not Heidegger in his own German words, which raises an important issue pointed out by Carl Mitcham in correspondence. Heidegger is extremely difficult to translate. And it just may be that the many problems English-speakers have in understanding Heidegger come from the difficulties inherent in translation, exacerbated when dealing with a deeply original thinker.

more than *social criticism*. In Chapter 1, I suggested that the kind of social criticism that characterizes so much philosophy of technology is often difficult to incorporate into the larger philosophical discussion. My reason for making this claim is that the social criticisms I am thinking of rarely make their epistemological and metaphysical suppositions clear. Thus forecasts of dire consequences to follow the introduction of a given innovation generally do not make explicit or even make it easy to figure out what the source of knowledge is upon which the forecast is based or even what counts as knowledge appropriate to these worries. If we don't know what kind of knowledge is being invoked, then it is hard to assess the particular criticism. If we can't assess the criticism, then it is unclear how to incorporate it into our thinking about the way the world works and what actions we should take. This is not an obscure point. Advertisers, for example, know well how important it is to justify their claims about the various attributes of their products. We see this when someone makes a claim that the wonderful effects they are promising for their product are "scientifically proven." When advertisers invoke the aura of science in this way, the audience "knows" that the evidence is reliable because they have already adopted the set of assumptions about the reliability of scientific results. They are then able to assess the claims and their relevance for their own lives, i.e., to decide whether or not to buy the product.

When it comes to understanding the nature of the metaphysical commitments of the social critics, it is often difficult to see where their justification comes from for asserting the causal powers of Technology. Many social critics worry about the existence of something called "Technology" pure and simple, a Heideggerian thing that has its own nonhuman source of power and direction. It is supposed to control our lives. It is not identical to the specific innovations and inventions whose genesis and introduction into society we can trace and examine. But I find the social critics' perspective puzzling. What does it mean to say, for example: "Technology is taking over our lives?" One way to understand this claim is to interpret "Technology" as a thing in itself that has its own set of causal powers and operates on its own, independent of human interference.

Why is it that these purportedly philosophical investigations into technology are, in a certain sense, unreachable by the general philosophical community? One answer is that most of this form of social criticism is framed in the context of a specific ideology that presupposes the intrinsic merits of a particular value or set of values, usually moral values, and that frames its perception of the world in terms of how these values are being thwarted.

Ideologies are interestingly negative. People who employ them are generally concerned with imputing motives to other people or things they believe are keeping them from Utopia, where the full-blown consequences of their particular utopian visions are rarely explored or exposed by their advocates. Consider the following example, paying particular attention to the rhetorical language. The passages are taken from Langdon Winner's *The Whale and the Reactor*. My objections to Winner's claims are two: (1) many of his arguments are flawed and unsupported; but most important, (2) his discussion is unrelentingly ideological. That is, he insists on characterizing specific complex systems of artifacts as the embodiment of ideologies. I find this a strange claim. Against it, I argue that tools and technical systems *are inherently ideologically neutral*. Individuals with particular axes to grind may employ a tool to achieve their ends, but this does not make the tool itself ideological.

In the selection below, Winner is relaying his reactions to a visit to the site of the Diablo Canyon nuclear reactor on the coast of California, which just happens to be near his boyhood home:

> Feelings of anticipation swelled in me as the bus rolled to the top of the last hill separating us from our view of the Diablo Canyon site. As it reached the summit of a small plateau, I looked out over a vista that sent me reeling. Below us, nestled on the shores of a tiny cove, was the gigantic nuclear reactor, still under construction, a huge brown rectangular block and two white domes. In tandem the domes looked slightly obscene, like breasts protruding from some oversized goddess who had been carefully buried in the sand by the scurrying bulldozers. A string of electric cables suspended from high-energy towers ran downhill, awaiting their eventual connection to the power plant. In the waters just off shore lay two large rocks surrounded by a blanket of surf, as elegant in appearance as any that one finds along the Pacific coast. One of them, Diablo or "Devil's" Rock, loomed as a jagged pinnacle. Next to it, not too far away, was a smaller, but even more finely sculptured piece of stone, Lion Rock, which looked very much like a lion at rest or, more accurately, like the Sphinx itself reclining on its haunches, paws outstretched on the surface of the ocean, silently asking its eternal question. At precisely that moment another sight caught my eye. On a line with the reactor and Diablo Rock but much farther out to sea, a California grey whale suddenly swam to the surface, shot a tall stream of vapor from its blow hole into the air, and then disappeared beneath the waves. An overpowering silence descended over me.
>
> * * * * * *
>
> Although I had known some of the details of the planning and construction of the Diablo Canyon Reactor, I was truly shocked to see it actually sitting near the beach that sunny day in December. As the grey whale surfaced, it seemed for all the world to be asking, Where have you been? The answer was, of course, that I'd been in far-away places studying the moral and political dilemmas that modern technology involves, never imagining that one of the most pathetic examples was right in my hometown. My experience with the reactor itself, seeing it at a particular time and place, said infinitely more than all of the analyses and findings of all the detailed studies I had been reading ever could.
>
> About that power plant, of course, the standard criticisms of nuclear power certainly hold. It does pose the dangers of catastrophic nuclear accident similar to the one at Three Mile Island. Certainly it will produce routine releases of low-level radiation and thermal pollution of the surrounding ocean water. No one has developed a coherent plan for storing long-lived radioactive wastes that this plant and others like it will generate. Already ten times more costly than originally estimated, its $5.5 billion price tag does not include the tens of millions of dollars it will cost to decommission the thing when its working life has ended. From the point of view of civil liberties and political freedom, Diablo Canyon is a prime example of an inherently political technology. Its workings require authoritarian management and extremely tight security. It is one of those structures, increasingly common in modern society, whose hazards and vulnerability require them to be well policed. What that means, of course, is that insofar as we have to live with nuclear power, we ourselves become increasingly well policed. (Winner 1986, 165, 175)

It is perfectly clear that Winner is advocating a definite point of view. There is nothing wrong with that. Winner is opposed to nuclear energy. But we have to wait until he lists the "'standard' criticisms of nuclear power" before we get either an argument or any factual information that might possibly back up his point of view. And even at that point, the manner in which he advances his reasons should cause the innately cautious reader to become suspicious. The cause for suspicion is quite straightforward: Winner lists the criticisms as if they were established facts. But just because someone offers up a criticism of something, it doesn't follow that the criticism is valid. Let us take a look at his "standard criticisms."

Yes, it is certainly true that there is a danger of "catastrophic nuclear accident." But what counts as "catastrophic"? And more important, how high is the probability of the catastrophe occurring? Consider Winner's own example, Three Mile Island (TMI). Regarding his claim that the reactor at Diablo "pose(s) the danger(s) of catastrophic nuclear accident similar to the one at Three Mile Island," how many TMIs have there been?

One accident shows that such occurrences can happen in those circumstances in which they did happen. It does *not* show that there is an equal probability that the same accident will happen in any similar such set of circumstances. Nor does it allow for the possibility of people learning from their mistakes, thereby correcting for and eliminating the problems that caused the first situation.

Second, what does he mean by "catastrophic"? TMI did not result in any provable loss of human life. The accident at Chernobyl did. (Granted, Chernobyl occurred after Winner's book was written.) TMI *could* have been a catastrophic disaster, but compared to Chernobyl it was merely an accident. The problem here is that if you are already opposed to nuclear energy, then it is not difficult to see TMI as the embodiment of all your worst fears. But calling an accident a catastrophe doesn't make it one.

Third, it is misleading to assert that "certainly it will produce routine releases of low-level radiation." It is misleading because Winner provides no evidence to support this claim and asserts it as if it were incontrovertible, which it is not. The manner in which this claim is presented suggests that every nuclear plant has been tested and that it can be shown that this in fact happened. First, this is not true. Second, it ignores the existence of low levels of normal radiation in the general environment, suggesting that low-level radiation represents a novel situation, which it does not. Likewise, it is false to assert that no coherent plan has been developed for storing waste. There is at least the plan to use deep storage in salt caves. Winner may not like the plan, and he may have his own reasons for objecting to it, but the flat assertion that no such plan exists is simply false.

If we turn away from the false and/or misleading factual claims and turn to the rhetoric, the ideological stance becomes more obvious. It is clear that this is not an unbiased account, but, of course, it is not intended as such. The language is designed to stir certain feelings in the reader and elicit specific reactions. Consider again the first selection quoted above. This time I have italicized some of the more suggestive phrases.

> *Feelings of anticipation swelled* in me as the bus rolled to the top of the last hill separating us from our view of the Diablo Canyon site. As it reached the summit of a small plateau, I looked out over a *vista that sent me reeling*. Below us, *nestled on the shores of a tiny cove*, was the *gigantic* nuclear reactor, still under construction, a huge brown rectangular block and two white domes. In tandem the domes looked slightly *obscene, like breasts protruding from some oversized goddess* who had been carefully buried in the sand by the *scurrying* bulldozers. A string of electric cables suspended from high-energy towers ran downhill, awaiting their eventual connection to the power plant. In the waters just off shore lay two large rocks surrounded by a *blanket of surf, as elegant in appearance* as any that one can find along the Pacific coast. One of them, Diablo or "Devil's" Rock, loomed as a jagged pinnacle. Next to it, not too far away, was a smaller, but even *more finely sculptured* piece of stone, Lion Rock, which looked *very* much like a lion at rest or, more accurately, like the Sphinx itself reclining on its haunches, *paws outstretched on the surface of the ocean, silently asking its eternal question*. At precisely that moment another sight caught my eye. *On a line with the reactor and Diablo Rock but much farther out to sea, a California grey whale suddenly swam to the surface, shot a tall stream of vapor from its blow hole into the air, and then disappeared beneath the waves. An overpowering silence descended over me.*

There are two different sorts of things going on in this passage. First, there is the pitch to the emotions. To see this, we need only focus on such phrases as "anticipation swelled in me" and "vista sent me reeling" or the final two sentences. The second thing Winner is attempting to do in this passage is to invoke an image of the contrast between the serenity and dignity of nature and the obscenity and alien nature of the human artifact, the reactor and the power lines. Unfortunately, he ruins his own effect by invoking the image of the goddess and coupling it with the obscenity of the reactor. The goddess image is one that has been nicely tied to the mythology of nature and the nourishing image of the mother.[6]

In the first instance, where Winner's choice of language is clearly rhetorical, it is safe to say that he is making a series of explicit value judgments. In the second case, where he is trying to contrast man and nature, with the objective of stressing the offensive aspects of human action, he is pushing an ideology. His ideological stance can be seen again at the end of the long section quoted earlier, when he talks about how the existence of nuclear plants leads to our being well policed.

Let us consider the questions of ideology and values separately. First I look at some of the problems ideological positions present, then I consider the role of values in Section 3.

With regard to attacking or defending technology from an ideological basis, the problem is that we can never make philosophical headway by taking an ideological stance. To do so precludes our ability to resolve whatever disagreement may be at issue, as well as our ability to understand the artifact or system involved.

6. C.f. Camille Paglia, *Sexual Personae* (1990). In this case either Winner has made a mistake by identifying the reactor with the goddess, or perhaps his subconscious is telling us something other than what he appears to be trying to say, namely that nuclear energy is not so unnatural.

The notion of an ideology is somewhat slippery. To characterize an idea or a social phenomenon as an expression of an ideology of some kind is already to take an adversarial role with respect to that phenomenon. More precisely, it is to assess that phenomenon as a product of a value system to which you are opposed. In other words, if your opponent is a capitalist, you see his complaints as nothing more than so much ideological hogwash, while your point of view is, of course, merely good common sense. In the broad sweep of ideas this can be expressed by saying that an ideology is essentially a conceptual scheme for interpreting and making sense of events. This is sort of like wearing a special pair of glasses that are sensitive to infrared and allow you to see the world in a way you would not otherwise. The major difference between ideological glasses and a conceptual scheme is their uses. In a certain sense we *require* a conceptual scheme to comprehend the world *at all* and to act in it. Perhaps "comprehend" is too strong, but we at least need such a framework to make sense of what we see and do. For example, we have to be taught that this is a chair and that is a cow and not to hit your baby sister.

What counts as a chair is not obvious. Chairs do not scream out at you "I am a Chair!" The items we identify as chairs are so considered because over a period of time our culture has evolved a set of criteria that provide us with the conceptual equipment and language to identify this as a chair and that as a cow. The criteria are not always obvious; we learn them at our mothers' and fathers' knees as we learn the language, and they find their way into the language by an informal process of interaction and negotiation among various players arguing about the world and what is in it. When we identify an object as a chair, we are employing the results of that process as well as demonstrating that we have learned this language and know how to use it properly—meaning by that that we have mastered the rules of the language and its various criteria for identifying objects. To have accomplished this is to have command of a conceptual scheme.

To call an ideology a conceptual scheme does not by itself take us very far. There are different kinds of conceptual schemes and not all are adequately characterized as ideologies unless, that is, a particular conceptual scheme, seen as a specific interpretation of some feature or features of the world, is itself being attacked by an ideology. For example, there is a sense in which the theories, facts, and explanations of science can be described as the results of a particular kind of conceptual scheme, namely one in which the major grouping of concepts—call them categories—are designed to (or perhaps simply evolved so as to) capture fundamental features of nature like space, time, causation, etc. When using the conceptual scheme of science, we employ these categories to structure perceptions and understandings of the natural world.

Science, described as such a conceptual scheme, is not thereby an ideology. But it *can* be so *described*. (Of course, the fact that it can be described as an ideology does not make it one. Likewise for all descriptions, for the fact that we describe the world in a certain way does not mean that the world is necessarily that way.) Consider an attack on the conceptual scheme of science based on feminist thought, where the claim is that the categories of science represent a specifically *male* perspective on how to carve the world at its joints.[7] If the case can be made that science does indeed embody such a male perspective, then the feminist would be well on his or her way to successfully characterizing science as an ideology. Why is this so?

It would seem that the ideological character of science would derive from the (alleged) fact that since its categories represent an exclusively male point of view, it is not a universal perspective, as some claim it to be. The fact that it claims to be universal and may not be so is not the crucial point here. What is crucial is that if science cannot represent a universal (perhaps "objective") point of view, then the categories that form the basic constituents of its framework must not be obvious or correspond to the ways things really are and, hence, must be the results of decisions based on certain contaminated assumptions. The heart of these assumptions is the adoption of a certain perspective, just as the heart of Marxism is historical materialism and the heart of a modest feminism is the vision of total equality for women and men.

The adoption of a certain perspective by itself is not enough to differentiate conceptual schemes from ideologies. And it just may be the case that in terms of their semantic structure they cannot be differentiated. Nevertheless, we can still distinguish between them in terms of their *use*. In particular, it is the quasi-pathological use of a conceptual scheme that turns it into an ideology. Thus, despite the crucial importance of its basic assumption that women and men ought to be treated equally in all matters, feminism is misused and indeed perverted when its defenders find the cause of each and every evil that befalls women to be the result of male concerns with their subjugation. Likewise, science is misused when its methods and discoveries are declared to be the final arbiter of truth, no matter what. And when this happens, whatever intellectual authority that particular perspective on the world initially may have had rightly dissipates.

There is another equally important aspect of ideologies that captures another facet of the quasi-pathological misuse of conceptual schemes. (And here it is important to remember that it isn't the conceptual scheme that is being faulted, but rather the people who are misusing it.) That is the ability of an adherent of the ideology to explain all relevant events

7. For a small sample of the different female feminist criticisms of science, see Haraway 1991 (esp. chaps. 1-5); Harding 1986; Longino 1990.

exclusively in terms of the basic assumptions of the ideology. Thus, from a creationist perspective, all natural events are to be understood in the light of their particular interpretation of the Bible. The mark of a successful ideology is that not only can it explain all relevant events in its own terms, it can also resist and possibly even be seen to refute alternative explanations based on other perspectives. This is done by either rejecting the formulation of the attack or reinterpreting the issue in its own terms. In short, the mark of a quasi-pathological ideology is that its claims cannot be shown to be false.

So, if such ideologically based claims are not falsifiable, how do you resolve a debate between adherents of two different ideologies? You can't. And if our concern is to deal with technology from a philosophical perspective, one that permits debate and allows for alternative analyses, then the moral is that talk of technology couched in ideological terms renders philosophical discussion impossible.

"But," you may argue, "that is very fine and dandy for you to say, yet how are we to avoid taking an ideological stance if, as you said earlier, conceptual schemes are essential for thinking about the world?" Good question. One way to answer it is to ask another: How does an otherwise innocent conceptual scheme turn into an ideology? We already know part of the answer: by the way in which it is used. But that just leads to another question: What is it that makes it possible for conceptual frameworks to be used or misused in this way? The answer here is basically simple, but it takes a bit of explaining.

In order to make our way around in the world, we use a *number* of conceptual schemes. Together they constitute a conceptual *framework*. Each conceptual scheme is domain-specific, that is, its concepts and categories are used to reason about a specific domain of objects or concerns. For example, the scientific scheme is concerned with the natural world; our aesthetic scheme gives us the resources with which to discuss beauty, proportion, and style; our moral scheme establishes the mechanisms we use to create and evaluate social relations. Unlike the conceptual schemes, which are all domain-specific, our conceptual *framework*, being composed of the sum total of our conceptual schemes, has no one specific domain. Conceptual frameworks evolve over time and they form a close interactive relationship with language. We reason in a language, and the vocabulary of that language provides the names for the concepts and the grammar for formulating our thoughts in that framework. As such, conceptual frameworks are the products of social interactions and they are transmitted from one person to another through the teaching and learning of language, which entails both knowing how to use a language and how to criticize its misuse. By retaining and using terms in specific ways, conceptual frameworks also embody a certain kind of knowledge about the world generated by the group in whose language it is formulated. For that group, in that language, that knowledge is seen as common sense. The development of any specific conceptual scheme will, therefore, occur in the context of the principles of common sense. This is not to say that the result will be commonsensical; indeed we are currently exploring how it is that from a commonsense basis a conceptual scheme gets misused. Hence science is an outgrowth of common sense, a refined approach to empirical experience of the world (Pitt 1981). But eugenics, as a specific type of science, may be a misuse of the principles and goals of science as a whole.

Once we see how conceptual schemes function to deal with specific domains of concerns within the larger conceptual framework, we can then see how the concerns of one scheme can sometimes form the basis on which to use another scheme. First, from the fact that each conceptual scheme has its own domain of concern, it doesn't follow that that domain is its exclusive concern. Thus the relations among objects in the world may be the legitimate concern of science, but they also can be the concern of art. Second, the results of the applications of a conceptual scheme may themselves become the object of another scheme. This is what happens when we criticize the results of science from a moral point of view.

If this account is correct, then I propose that a conceptual scheme becomes an ideology when it becomes subordinate to a *particular moral* scheme, for the key item in an ideology is the normative force it brings with its perspective. Ideologies are ways of asserting what the *proper* relations between and among people and the world *ought to be*. In this sense they are fundamentally moral schemes, but in their intermediate form they take the shape of political agendas. By that I mean nothing more than that an ideology expresses a certain perspective on the power relations among people from a given moral point of view; in particular, one that will not tolerate any competitors.

The answer, then, to our question of how to avoid using ideologies as the basis for understanding the philosophical issues surrounding analyses of technology is: *avoid casting all concerns about technology as political issues.* And the justification for this claim is that there is no general principle or rule in our conceptual framework that gives us the license to subordinate any conceptual scheme to any other.[8] This is not to deny that conceptual schemes are in fact appropriated for various uses; it is merely to say there is no obvious philosophical justification for such appropriations.

8. For an elaboration of this view of the relations between conceptual schemes, see Pitt 1981, chap. 5.

"But," it might be argued, "while your advice to avoid approaching the discussion of technology from an ideological stance seems reasonable, since we don't want to find ourselves in a position where we can't agree on what to do, might it not be the case that the technology itself is an expression of an ideology. For example, isn't Langdon Winner correct when he points out that power plants are constructed by individuals deliberately concerned to disenfranchise the masses or ordinary people by forcing them into a position of dependence on the power company? Hence, are we not forced to deal with this technology in equally ideological terms if we are to control it? After all, the political domain is concerned with the exercise of power, and the control of technology involves just that."

If we are to avoid being ideological about ideology, surely we can't dismiss this objection out of hand. Nevertheless, it is not at all clear what it means to say that technology is ideological. If, for example, we consider Winner's nuclear reactor as "an inherently political ideology" (Winner 1986, 175), what does that say about the technology itself?

Consider what's at issue here. If we want to know the respect in which a technology is inherently ideological, we could be asking one of two questions, or possibly both. (1) What are the intentions of the people who designed and brought the reactor on line? For example, are they concerned with providing a necessary service, or are they concerned with controlling people? (2) What is the best interpretation, *after the fact*, of the consequences of implementing such a complex system? Both of these questions are important. But they are fundamentally different. In the first, the assumption is that the system is ideological if we can show that it was constructed for the *ideological* purpose of controlling people in specified ways. In the second, given the system and given *our ideological concerns*, how can we best explain the impact of that system on our lives in terms of our own ideological ends? In the case of the first question, we might be able to claim that the power plant is inherently ideological if we can show that the people who planned it and paid for it really had evil intentions such as Winner suggests. For the second, we need to show how *the effect* of having this system on line is only to keep the masses subjugated. These questions are important not because they give us a clue as to whether or not a given innovation of system of tools and artifacts is the expression of an ideology, but because these questions point us toward something more fundamental, namely, the direction of important philosophical questions about technology. These questions concern, first, the procedures and factors that were at work in the decisions and the options that led to the development and use of, e.g., the Diablo Canyon reactor. In addition, there is the question of assessing the consequences of using nuclear reactors to generate electricity.

It would appear that, at best, ideology enters at the point of assessment. For it seems almost unavoidable to assess the effects of a given set of tools in ideological terms. However, and here's the rub, for any given ideologically based assessment, it is possible to provide an alternative in terms of a different ideology. Thus, on Winner's account, the use of nuclear reactors "requires authoritarian management" and, consequently, our being policed. But, I would argue, isn't the alternative equally unacceptable? No plant, no electricity; no electricity, there go the benefits of modern society. But the benefits of modern society are what make human growth possible. Thus to be free from the daily drudgery of having to provide basic services for oneself and one's family is what allows for science, art, music, and even philosophy. Arguing in this fashion invokes yet another ideology, one that extols the benefits of technology and its liberating consequences. More to the point, it is an ideology based on certain values, e.g., that reflective thought and its expression are very important to my way of life.

But irrespective of which ideology is being employed, the important point for our analysis is this: despite the fact that Winner posed the questions in his unique polemical manner, he got the key issues right. That is, the interesting questions about such complex systems are the questions about how they came to be constructed in the manner in which they did and how best to assess their merits.

If we are concerned with assessing the consequences of employing a complex system such as the electric power generating system, then an analysis of the intentions of the individuals involved in developing and employing that technology is beside the point, since those worries should be part of our analysis of the decision structure used to design and implement the system. There are occasions when it would appear reasonable to address the question of whether or not the system did what it was designed to do. But while that kind of question is reasonable, it does not entail that the *only* way to answer it is in ideological terms. So, while it is possible that one aspect of assessment might involve uncovering an ideological component to the original intentions of the designers and decision-makers behind the technology, it does not follow that assessment must proceed in those terms alone. In the case of Langdon Winner's reactor, I doubt that the motive of those who built it was to control people's lives. I suspect financial gain and a demonstrated demand for electricity were at issue.

On the other hand, one objective of an assessment might be to determine whether or not the ideological aims of the decision-makers (assuming there are such) who developed the system were met. Thus we might try to determine if the implementation of certain technological devices and systems have imposed ideologically driven constraints on the individuals using those devices and systems. That is, by using electricity generated by nuclear reactors owned by large electric companies, are we being ideologically constrained in an ideologically desirable way? That is an important question in assessing the merits of the system from the perspective of its designers, should they have ideological axes to grind. But even here it is important to note that it is not the system that is being assessed for its ideological purity but, rather, *the effects* of the system. Furthermore, it seems fairly obvious that, no matter what the device or system is, if it is put to different uses with different ends in mind, the consequences of using it will be different. This suggests that even if a tool is used by individuals committed to a particular ideological stance, it is not the tool that is ideological. I conclude, therefore, that technology, tools, and systems of tools are ideologically neutral.

Section 3. Technology and Values

From our analysis in Section 1, it is increasingly clear that important philosophical questions about technology are concerned with (a) the *decisions* people make when developing and implementing innovations, and (b) *assessing the consequences* of using tools and social systems. Both of these issues involve making *judgments*. If we turn to the decision processes that lead to the establishment or implementation of certain innovations, there are two separate kinds of issues to address. The first concerns understanding the decision-making processes themselves. In examining this issue, we need to distinguish values from ideologies.

The second problem concerns the empirical question of what actually is going on, i.e., who is deciding what to do and why? This, however, does not reduce to merely an empirical question of identifying the specific individuals involved. It is a philosophical question, at least the "why" part. The heart of the matter is: Where do values enter into deliberations that eventuate in new tools and ways of doing things? Deliberations eventuate in judgments—judgments assert values. They enter at any point where a decision is being made. They enter at the point, for example, where we decide to use one decision-making process to resolve a question rather than another. They also enter at the point where we decide to allocate resources to resolve a problem by developing some technique and when the person charged with devising the technique decides to use one hypothesis as a basis for his project rather than another. This point is an old one and it was driven home by Richard Rudner in his analysis of the role of values in scientific decision making (Rudner 1953). Judgments are *ipso facto* value judgments. The making of a judgment is a determination

of the importance, priority, or relative merit of a given point of view, all or any of which invoke values.

But to invoke values is not necessarily to invoke ideology. Rather, to invoke values is to appeal to priorities, goals, and objectives. Part of the problem behind assuming that all value questions are ideological derives from an equally generally unstated assumption—namely, that all values are moral values. But that is simply not so. In addition to moral values, there are aesthetic values and cognitive values, just to name two other kinds. The role of cognitive values is often overlooked when technology is viewed only in ideological terms. Thus when we assert that technology is ideologically laden, we imply that the only values that enter in or that are relevant to the assessing of discreet innovations and systems of such or to their implementation are values that are associated with some ideology, hence, with political philosophy, hence, in some derivative fashion, with morals. This need not be the case.

There is a domain of inquiry equally laden with values that is not ultimately moral but rather concerned with the *cognitive* dimensions of human life, that is, with those aspects of our lives that are involved in the generation, assimilation, and use of *knowledge*. Thus the decision to employ a certain system could be made on the basis of cognitive concerns rather than values associated with the moral domain, e.g., our decisions to build space-faring probes and to explore the solar system because we have "knowledge" as a cognitive value. By overlooking or ignoring cognitive values, we bypass the *epistemological* questions associated with inquiries into technology. And, I suggest, in so doing, we miss the opportunity to bring these inquiries into the broader philosophical discussion.

In sum, there seem to be two basic problems associated with approaching the philosophy of technology from an ideological stance. First, there is the false assumption that the value-laden dimensions of areas of discourse associated with technology are overshadowed by ideological considerations and can have no other dimensions beyond those.

Second, approaching the analysis of technology ideologically eliminates the possibility that claims of ideological import can be tested empirically. If this is the case, it may be all well and good and even interesting to some, but the important question now is: Of what consequence? It is important for the following reasons. We need to know a number of things about our tools and their delivery systems. We need to know how it came to be that a given innovation arose. What were the factors, political, scientific, engineering, economic, that resulted in the building of the Space Shuttle, for example? Second, we need to know the effect of implementing a given system. How, for example, does the increasing bureaucratization of government affect our freedom or our individuality? There are many kinds of questions we need answered, some of which can be answered by empirical research. Others demand further philosophical analysis and clarification. The value of de-ideologizing the philosophy of technology is that it allows the empirical questions to be sorted out from the questions of values.

A consequence of taking this approach is that it strips away the romanticism that we have built into some of our discussions concerning technology. For example, we can no longer talk about "technology taking over our lives," since our attention has been directed to the decisions men and women have made with respect to developing, building, etc., a satellite system. It forces us once again to shoulder the burden of responsibility for the decisions that result in the construction of systems and the construction and marketing of new products, and for assessing the impact of the results of such developments. It leads away from talk of impersonal and indeterminable forces governing the evolution of technology, and once again asks the question: "To what extent do the accidents that are the normal produce of human commerce affect our attempts to increase the quality of life?"

I return to a theme I have been elaborating here: if we are to understand the world, we must begin with the assumption that it is people who are involved in the creation and the alteration of the environment. To be sure, there are man-made disasters. There are also natural disasters. But to the extent that human beings respond to the environment, be it the natural environment or the environment they created, and to the extent that human beings attempt to change or control or alter that environment by the building of dams or the implementing of governmental regulations, then we must start with the decisions individuals make, and not with a mysticism that clouds our ability to improve upon those techniques that we have decided are not to our advantage.

Turning to the question of the tool or a system of tools and techniques itself, we have already begun to explore the view that any particular tool or system is neutral with respect to ideological concerns. Unfortunately, this claim is ambiguous. It might be interpreted to mean that the individuals involved in designing the tool or system have no ideological axes to grind. But surely this is false. It seems perfectly reasonable to assume that some tools are designed with specific ideological concerns in mind. By way of example I would suggest that the First Amendment to the U.S. Constitution might be viewed as securing the development of a free press because of a commitment to the idea that such an institution is the best safeguard of democracy. This also could be an example of the most uninformed kind of assessment, but I submit that it is of the same kind as most ideological claims. More damaging is the acknowledgment that the concerns of those responsible for the development of any given tool are beyond our ability to recreate with any degree of certitude. That is, can we ever be sure of the intentions of the authors of the First Amendment, and furthermore, is our knowledge of their intentions really relevant to our current concerns?

A second interpretation of the idea that any given tool or system is ideologically neutral is the following somewhat more complex view. Whatever the ideologically motivated intentions of the originators of an innovative system, the mechanisms of both the decision-making process and then the system itself have the effect of neutralizing those initial presumptions. Consider the situation in which *what* an individual wants to accomplish can't be done under the given circumstances, but "if we give a little here and push a little there, then we can get *most* of what you want." This particular scene can be filled out in many different ways—products can't be produced according to the designer's vision because of cost, but if we just adjust here a bit, . . . etc.

The final point is the case in which the idealized perception of the system has a bearing on the changing attitudes of the participants in the decision process. One place to see how this works is in the Supreme Court of the United States. Lest there be objection to using the courts in the context of technology, I remind the reader that the judicial system is a tool for adjudicating social conflict, a technology if ever there was one!

In the case of understanding judicial decisions, we cannot underestimate the extent to which the values of the judges themselves are affected by their participation in the decision-making process (Schubert 1965). The case of our courts of law is a good one, for it points out a number of features. The Supreme Court has no enforcement powers. The acceptability of a decision by lower courts is a matter of individual judges deciding to abide by the decision of the Supreme Court. So to begin with, a decision of the Supreme Court will be tempered by the realization that the decision must be couched in acceptable terms. Second, assuming that the judges have individual ideological agendas to enact, having the Court produce a pure ideological manifesto will be impossible if only because it will be the product of the forge of compromise among the members of the Court. In addition, individual judges may discover that, in the process of hammering out a stand on a variety of other issues, previously privileged views on some other matters may have to be abandoned. That is, the realities that confront the judges on specific cases may force them to consider as impractical other beliefs they may have about the way the system ought to function.

Now if, under circumstances such as these, it is claimed that the decision-making process is inherently ideological—so be it. In this system, values, seen as an expression of unactualized but highly desired ideal states of affairs, are confronted by the realities of the world around us. It is in such confrontations that both the values and the world change, pushing and shoving on one another, testing for weak spots. But if in the process of attempting to implement certain values, the values are themselves changed, then it is hard to determine where the ideological bent is to be located. If the process defuses the ideological bomb by the way it forces compromise and change, then the process itself cannot be seen as ideological—hence, we would do well to consider it neutral.

CHAPTER SIX

The Autonomy of Technology

It might seem that it is but one step from the view that technology is ideologically neutral to the view that technology is autonomous. If, as we noted in Chapter 5, a tool or system can contribute to the decision-making process by forcing changes in values, then surely, it might be suggested, the system itself becomes an independent actor in the process. Maybe so, but probably not. But the view that technology is autonomous is a popular one. Consider what Jacques Ellul has to say on the subject:

> –Technique is autonomous with respect to economics and politics –Technique elicits and conditions social, political and economic change. It is the prime mover of all the rest, in spite of any appearance to the contrary and in spite of human pride, which pretends that man's philosophical theories are still determining influences and man's political regimes are decisive factors in technical evolution. (Ellul 1964, 133)

Ellul may be right about the role philosophical theories and political regimes play in technical evolution, but his claims also sound somewhat exaggerated. More important, the kind of claim he makes for the autonomy of technology makes it sound as if it were unfalsifiable, especially given assertions such as "in spite of any appearance to the contrary."

Unfortunately, claims like Ellul's have become commonplace. They amount to treating technology as a kind of "thing," and in so doing they reify it, attributing causal powers to it and endowing it with a mind and intentions of its own. In addition to the fact that it is empirically false that *Technology* has these characteristics, reifying Technology moves the discussion, and hence any hope of philosophical progress, down blind alleys. The profit in treating Technology in this way, to the extent there is any, is only negative. It lies in removing the responsibility from human shoulders for the way in which we make our way around in the world. Now we can

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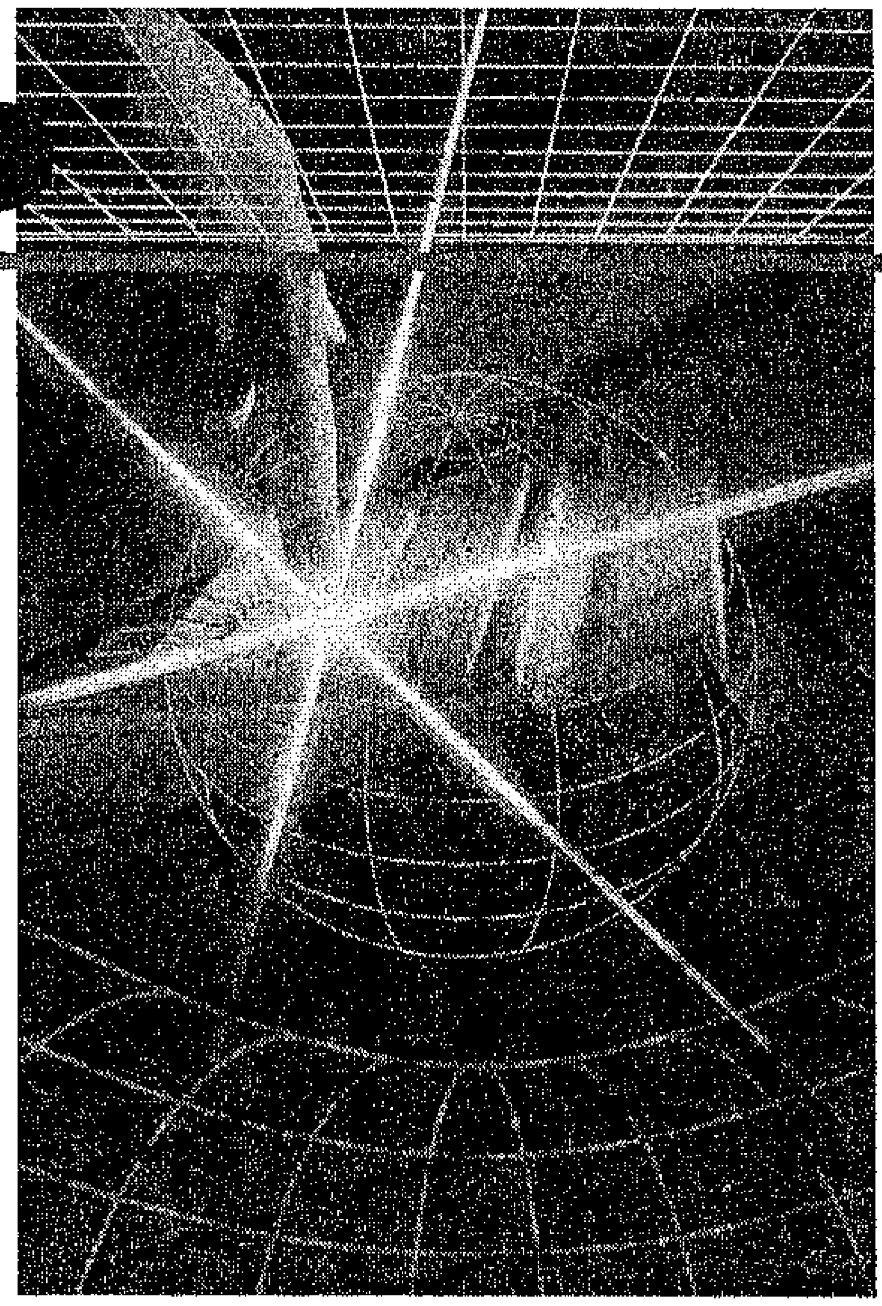
CHAPTER TWO

Regulating and Governing the Internet



Although there has been much written about the perils of overexposing children and teenagers to the Internet, a headline in *The New York Times* sounded especially ominous: "A Seductive Drug Culture Flourishes on the Internet." The article explained how the Internet is now rife with web sites that endorse illegal drugs or provide explicit instructions for making, growing, and consuming such drugs. Many of these web sites make drugs sound exciting and alluring, and never even hint about the risks of addiction. Also, the problem is compounded because "the Internet lacks a quality control mechanism to separate fact from hyperbole or from outright falsehood, even in discussions that may ultimately encourage an activity that remains illegal for Americans of all ages."[1]

This is a disturbing but certainly not a surprising development, and for some it does not augur well for the future of this ubiquitous technology. But from its earliest origins a free-wheeling spirit has dominated the rules of discourse in cyberspace. According to Jonathan Katz, "it is the freest community in America."[2] Hence one of the most formidable issues faced by public policy makers throughout the world is whether or not to impose some limits on this free and unencumbered flow of information in cyberspace—to restrict, for example, the dissemination of pornography or perhaps to ban these nefarious web sites that promote illicit drug use. Even if a decision were made to do so, implementation of that decision would be quite challenging given the Internet's complexity and its vast global reach.

The debate about pornography on the Internet or about web sites advocating illicit activities reflects deeper questions about how the Internet should be regulated or governed. Although the Internet's anarchy and lack of structure has led to some excesses, many users are loath to see it replaced by tighter, centralized controls. Most civil libertarians, for example, contend that the Internet thrives precisely because there is no central governing authority. Consequently, they favor the continuation of decentralization and self-governance instead of any form of government intervention, believing that traditional forms of regulation would interfere with electronic interactions and the free flow of ideas. They argue that the Internet should be able to develop its own unique political structure, set appropriate standards, and even handle its own disputes.

Civil libertarians, however, are slowly losing this struggle. During the last decade there have been many regulations imposed on the Internet such as the Can-Spam law in the United States. Europeans have been particularly active with their extensive data protection policies and an international treaty on cybercrime. As these regulations proliferate, the haze of legal ambiguity in cyberspace will steadily dissipate.

Nonetheless, the residual confusion and anarchy can expose users to legal landmines and potentially costly liabilities. Take the case of the Blue Note jazz club in Greenwich Village versus the Blue Note nightclub in Missouri. While the Blue Note club in New York has a federal trademark for its name, the Blue Note in Missouri obtained "the right to use the trade name locally in Missouri"—what is known in trademark law as a "geographical carve-out." But when this Blue Note designed its own web page the Blue Note in New York protested, claiming that its trademark had been violated by the Missouri club's worldwide presence on the Internet. As a result of this and similar cases the legal system is still trying to decide whether business on the Internet "falls under the laws of some, all, or any of the jurisdictions from which that Internet site can be reached."[3]

Can governments begin to resolve the numerous jurisdictional problems created by the Internet? What will happen when different sovereignties begin to assert their authority in cyberspace? Will increased regulation stifle the Internet's innovative spirit? Is there an alternative to a cyberspace that is burdened by more rules and restrictions?

Before plunging into a discussion of these complex matters it is instructive to review the history and technology of the Internet, and so we devote a portion of this chapter to that purpose. It is important to understand the architectures of the Internet to appreciate the various possibilities for regulation and government intervention. This overview includes a cursory treatment of the World Wide Web and the recent surge in electronic commerce along with some of its attendant social problems. It is also instructive at this point to consider the separate but related issue of governance, that is, managing of mundane tasks such as assignment of domain names. This process too has triggered ethical controversies that are considered in later chapters.

Our primary purpose in this chapter, however, is to discuss the appropriate regulatory response to the social problems that have emerged in the online world. Can market forces handle these problems or is government intervention essential? What about the possibility of a more decentralized bottom-up approach? Perhaps the optimal approach is finding the right interaction of policy and technology?

This discussion sets the stage for the more in-depth treatment of speech, property, privacy, and security in the remaining chapters. For each of these broad issues it is necessary to evaluate how underlying technologies change our ability to establish and enforce policy.

A Short History of the Internet

This summary of the Internet's creation is not a mere indulgence in nostalgia. We investigate the past to understand the present—by looking at the Internet's technological evolution we can better appreciate its present architecture and perhaps uncover some clues about its future.

The origin of the Internet's basic architecture can be traced back to the search for a "survivable communications" system. During the late 1950s the U.S. Department of Defense (DOD) was concerned about the need for a failure-resistant communications method. In 1961 Paul Baran developed such a method, which has become known as *packet switching*. Baran admits that "the origin of packet switching itself is very much Cold War."[4] Package switching (originally called "message switching") works by breaking up a message into fixed-sized units or "packages"; each package is "labeled with its origin and destination and is then passed from node to node through the network."[5] This technology was also being separately developed by Donald Davies, a British expert on computer security, who was the first to use the term "packet" in reference to data communications. Davies also built an experimental packet switching network in the mid-1960s.

The first large scale packet switching network that was developed based on the insights of Baran and Davies was the work of the Advanced Research Projects Agency (ARPA), a research agency of the DOD, which financed high-tech research. In the late 1960s, the DOD provided generous grants to universities and corporations to establish a communications network between major research centers in the U.S., including universities such as MIT and Stanford. It recruited Lawrence Roberts of MIT's Lincoln Laboratory to oversee the construction of the ARPANET, the first incarnation of what is now known as the Internet.

The basic infrastructure of the ARPANET consisted of several time-sharing host computers, packet switching interface message processors (IMPs), and leased telephone lines. The host computers were already in place at the universities and research centers that would be part of the network; AT&T provided the telephone lines. The IMPs were needed to perform key network functions such as sending and receiving data, error checking, and message routing. The responsibility for building these systems was delegated to Bolt, Beranek and Newman (BBN) a research and consulting firm in Cambridge, Massachusetts.

By the end of 1971, the primitive ARPANET was up and running. Its primary goal was supposed to be resource sharing, that is, enabling connected sites to share hardware processing power, software, and data. But the network's users soon discovered another function: electronic mail. Instead of using the network primarily to leverage remote hardware resources, users began sending huge volumes of e-mail. As a result, this popular application soon began to dominate traffic on this fledgling network. According to Abbate, "Network users challenged the initial assumptions, voting with their packets by sending a huge volume of electronic mail but making relatively little use of remote hardware and software. Through grassroots innovations and thousands of individual choices, the old idea of resource sharing that had propelled the ARPANET project forward was gradually replaced by the idea of the network as a means of bringing people together."[6]

In the early 1980s, this system was subdivided into two networks, the ARPANET and Milnet. Furthermore, connections were developed so that users could communicate between the two networks. The interaction between these networks came to be known as the *Internet*. *Internet* was actually first used in a research paper written by Cerf and Kahn in 1974; that paper described a "network of networks" that would eventually link together computers all over the world. In the late 1980s, the National Science Foundation network (NSFNET), which relied on five supercomputers to link university and government researchers from across the world, replaced the ARPANET. The NSFNET began to encompass many other lower level networks such as those developed by academic institutions, and gradually the Internet as we know it today, a maze of interconnected networks, was born.

In these early days the federal government generously subsidized the Internet, and as a consequence there were restrictions on any commercial use. The Internet was the exclusive domain of government researchers, scientists, university professors, and others who used it primarily to share their research findings or other academic information.

But the NSF no longer subsidizes the Internet, which has assumed a strong commercial character during the last decade. During the early 1990s the Internet quickly became available to corporate users; e-mail providers such as MCI and Compuserve opened up e-mail gateways. By 1993, 29% of the host computers connected to the Internet belonged to corporations. Commercial use now accounts for the vast majority of all Internet traffic. Management of the network has been transferred to private telecommunications carriers that manage the backbone, that is, the large physical networks that interconnect. Thus, the network's vitality depends on the cooperation and goodwill of these telecom providers.

The global diffusion of Internet usage during this period has been an extraordinary phenomenon. In 1983 there were a mere 500 host computers (computers with unique Internet Protocol addresses) connected to the Internet. That number has grown to over 200 million host computers at the beginning of this new millennium. By 2005, the number of world Internet users was estimated at 1 billion, approximately 15% of the population; the growth rate between 2000 and 2005 has been 160%.[7] Although the rapid development of the global Internet has been extraordinary, there is still a disparity between developed and developing countries. However, in some countries that is also beginning to change. In Latin America, there were fewer than 30 million Internet users in 2000, but that number has grown to over 68 million in 2005.[8]

This global connectivity provided by the Internet is perhaps its most attractive feature. It brings together millions of people and thousands of organizations all over the world, and has helped to achieve what the *Economist* calls "the death of distance," that is, the overcoming of geographic proximity as a barrier for conducting business.

The Internet's Current Architecture

How does this all work? As intimated, there is actually little physical substance to the Internet. There are a few dedicated computers at key connection junctures, but "like a parasite, the Internet uses the multi-billion dollar telephone network as its hosts and lets them carry most of the cost."[9] Data is fluidly transferred over this network by means of a network protocol called TCP/IP. The TCP/IP protocol allows for complete interoperability on the Internet so that computers can communicate with one another even if they have different operating systems or applications software. TCP/IP therefore makes the network virtually transparent to end users no matter what system they are using, and it allows the Internet to function as a single, unified network.

TCP/IP consist of two elements: the IP or Internet Protocol, which establishes a unique numeric address (four numbers in the form **nnn.nnn.nnn.nnn** ranging from 0 to 255) for each system connected to the Internet. IP is a means of labeling data so that it can be sent to the proper destination in the most efficient way possible. If a user connects to the Internet through an Internet Service Provider (ISP), that user is normally assigned a temporary IP address, but users which connect from a local area network (LAN) in their organizations are more likely to have a permanent IP address.

The second piece, TCP, or Transmission Control Protocol, enables network communication over the Internet. As discussed, the data are broken up into pieces called "packets," with the first part of each packet containing the address where it should go. The packets are then sent to their destination by a system of routers, that is, servers on the Internet that keeps track of Internet addresses. These packets can take completely different routes to reach their goal. Once all the packets arrive, the message or data will be reconstructed, based on the sequence numbers in the headers to each packet, and redirected to the appropriate application.

The Internet's physical infrastructure is composed of many large, interconnected networks which are known as Network Service Providers (NSPs). NSPs include IBM, SprintNet, and PSINet as well as several others. According to Hafner, these backbone providers "adhere to what are known as peering arrangements, which are essentially agreements to exchange traffic at no charge."[10] Each NSP connects to three network access points, and at those points packet traffic may be transferred from one NSP backbone to another. NSPs also sell bandwidth to smaller network providers and to ISPs.

Routers, also known as "packet switches," perform much of the work in getting data transmitted over the Net to its ultimate destination. When a packet arrives at a router, the router looks at the IP address and checks the routing table, and if the table contains the network included in the IP address the message is sent to that network. If not, the message is sent along on a default route (usually to the next router in the backbone hierarchy). If the address is in another NSP, the router connected to the NSP backbone sends the message to the correct backbone where it is sent along by other routers until it reaches the correct address.[11]

As we survey the Internet's technical and social evolution, the most distinctive features of its network architecture should be apparent. Perhaps the Internet's most important characteristic is its *openness*, thanks to an open-ended network architecture the Internet has supported an extraordinary level of innovation: e-mail, blogs, instant messaging, and MP3 music files are just some of the many applications this technology has enabled. According to Castells, "the openness of the Internet's architecture was the source of its main strength: its self-evolving development, as users became producers of the technology and shapers of the whole network."[12]

Second, the Internet is *asynchronous*. Unlike telephone communication, there is no need for coordination between the sender and recipient of a message. An e-mail message, for example, can be sent to a mailbox that can be accessed at any time by its owner. Third, the Internet permits a *many-to-many format of communications*[13]: many users can interact with many other users through electronic mail, bulletin boards, web sites, and other vehicles. Unlike traditional media such as newspapers the Net is interactive; users can speak back. Fourth, the Internet is a *distributed* network instead of a centralized one, whereby data can take any number of routes to their final destination. There is no center to the Internet, that is, there is no central server or single controlling authority, because information can travel from one location to another without being transmitted through a central hub. This gives users more control over the flow of information. Because it is a decentralized, packet-based network, it is more difficult to censor that information. Also, this resilient design makes the Internet's structure more durable. As Hafner points out, "that deceptively simple [packet-switching] principle has, time and again, saved the network from failure."[14] When a train fire in Baltimore damaged a critical fiber optic loop, Internet data easily circumvented the problem. Finally, the Internet is highly *scalable*, that is, it is not directly affected when new computer links are added or deleted. Thus, it allows for much more flexible expansion or contraction than many other proprietary network technologies. Its basic architecture encourages universal access and participation.

The Internet, then, should really be conceptualized as a flexible and open infrastructure. It is designed to maximize interoperability, that is, to be completely independent of software programs, hardware platforms, and other protocols. As a result, it is well suited to new applications and can easily accommodate revolutionary developments in both software and hardware. Because of its malleability, however, it is naïve to assume that the Internet of today will be the Internet of the future. The architectures of cyberspace could conceivably undergo a major transformation in the next few years. As we pointed out in Chapter 1, if the state chose to influence those architectures by mandating digital identity or otherwise controlling access through ISPs, cyberspace could become a very different place.

The World Wide Web

The most recent surge in the Internet's popularity can be attributed to the emergence of the World Wide Web. The web is a collection of multimedia documents that can be easily accessed through the Internet. The web was developed at the European Particle Physics Lab as a means of exchanging data about high-energy physics among physicists scattered throughout the world. This group developed a standard known as Hypertext Markup Language (HTML) that supports a procedure whereby "tags" or triggers are attached to a word or phrase that links it to another document located anywhere on the Internet. The documents created by HTML are stored on computers known as servers and can include straight text, visual images, streaming video, and audio clips. Documents belong to a web site that has a specific address such as "www.avemaria.edu." The last three letters represent a "top level" identification (for example, "edu" stands for education and "com" stands for a commercial enterprise) and the middle part of the name designates the actual site (Ave Maria University).

Net browsers such as Navigator provided by Netscape (based on the original Mosaic model) or Microsoft's Internet Explorer enable users to "explore" the web rather effortlessly. They are highly versatile navigational tools that enable users to access, display, and print documents; they also give users the ability to link to other documents at any location on the web. Hyperlinks can create a maze of interconnected documents and web sites that can sometimes confuse users but also greatly expand opportunities for research and investigation.

The web has transformed the Internet into a user-friendly medium because the web page is an intuitively obvious interface for even the most novice user. More significantly, according to Samuelson and Varian, "the back-end protocols for authoring and distributing web pages (HTML and HTTP) were easy to understand and use as well, facilitating the rapid deployment of web servers."[15] The diversity and heterogeneity of current web sites is evidence of the accuracy of this assessment.

Despite its brief history, the World Wide Web itself has already become a vast, tangled network. Web sites were first deployed at major universities and research centers, but now proliferate throughout cyberspace at schools, hospitals, corporations, and many other organizations. According to the Internet Systems Consortium, there were approximately 400 million active domains operating on the web in 2005.[16] Even individuals or small businesses have established their own web pages. These web pages will undoubtedly be the vehicle for the acceleration of electronic commerce and many other network-based activities like education or fund raising. Web-based marketing is beginning to show significant results, and as a consequence ad banners and commercial messages can be found now in almost every region of cyberspace.

The plethora of web sites has created a density of information that can make it difficult for users to locate a particular site. Search engines such as those provided by Microsoft or Google can help in this process, but even they are sometimes ineffectual in the face of such voluminous data. Part of the problem, of course, is that the web is just too large and too volatile to index properly, but these search engines have made great strides in this regard.

Regardless of the difficulties that users encounter trying to navigate their way through cyberspace, the web continues to rapidly gain in popularity. It is quickly becoming its own unique institution, taking the place of libraries, print catalogs, and even traditional news media for many users. It can be a rich source of research, news and information, and entertainment. And as more and more users develop their own sites, it has helped bring about the democratization of information predicted by many Internet visionaries.

Finally, there are predictions that we will soon witness the birth of a more sophisticated next-generation web thanks once again to the work of Berners-Lee and his colleagues. This is being called the *Semantic Web,* because it will be able to understand human languages, thanks in part to the extensive use of XML, a language that can tag words and phrases so that computers know what they mean. For example, if a bot travels to a site and sees an 11:05 AM departure time the bot does not know what 11:05 means unless it is accompanied by a tag <departure time>. The ultimate objective is to transform the web into a giant intellect so that "every computer connected to the Internet would have access to all the knowledge that humankind has accumulated in science, business, and the arts since we began painting the walls of caves 30,000 years ago."[17]

Electronic Commerce

Electronic commerce (or e-commerce) refers to trade that occurs on the Internet. Thanks to the infamous dot.com debacle in 2000, euphoria about e-commerce and the Net has faded, as we have come to appreciate that many e-commerce ventures were no more than phantom edifices. But no one is dismissing the likelihood that this global network will be a main thoroughfare of commerce in the near future. In fact, some business experts predict a "new wave of disruption" as the web transforms industries such as jewelry, hotels, and real estate. Amazon.com has already jumped into the jewelry business, buying diamonds wholesale for as little as $500 and reselling them for $575.[18]

What are some of the general benefits of e-commerce? First, it eliminates the constraints of time and space and thereby provides extraordinary convenience for consumers. As noted, the Net is a fundamentally asynchronous technology so users can do their browsing and shopping at any time. Second, the Internet is a low-cost communications technology so it can greatly reduce overhead and transaction costs. According to Mandel and Hof, "the Internet is a tool that dramatically lowers the cost of communication, [and] that means it can radically alter any industry or activity that depends heavily on the flow of information."[19] It is, of course, much less expensive to operate one virtual book store (amazon.com) than a chain of physical stores. And the more digitizable the product, the lower the cost structure, because those products do not require an infrastructure for distribution. It is even more advantageous for a company such as Monster.com to provide an online exchange for jobs than it is for amazon.com to sell books; the online exchange does not have to worry about warehousing a physical product and delivering that product to its customers. The fewer the service requirements and the lower the logistic requirements, the more scalable the online business, that is, the easier one can grow the business without additional costs.

A third advantage of online commerce is the ability to customize sales and advertising to each individual consumer. A web shopper's every move in cyberspace can be traced and this allows vendors to compile a profile of a consumer's preferences. According to the *Economist*, "With this feedback, online merchants can further differentiate themselves from their physical world competitors by customizing their shop or service for each customer."[20] For example, Amazon uses collaborative filtering technology that enables it to analyze a customer's purchases and to suggest other books the customer might like based on what people with similar purchase histories have bought.

The e-business landscape is complicated, but it is useful to follow Applegate's helpful distinctions. She categorizes some companies as digital infrastructure providers including IBM, Cisco, AT&T, and Microsoft; they provide the servers or physical networks that make electronic commerce possible. In a second category she includes companies that operate in the Internet's distribution channel: focused distributors and portals. Focused distributors provide products and services primarily on the web and portals serve as gateways to the Net.[21] Under the category of focused distributors there are four basic digital business models: business to consumer (B2C), consumer to business (C2B), business to business (B2B), and consumer to consumer (C2C).

The B2C model involves direct sales to consumers and includes companies such as Amazon.com. With 1 billion million people already online, the potential here is obviously vast. For the consumer, the big attraction is convenience—with a single click of the mouse an order for clothes, books, fine wine, or groceries can be placed at a web site. For the retailer a key advantage is lower costs. Hence the B2C model allows for quick scalability of one's business. Only one web site is needed to service customers all over the world. There may be a high initial investment for a computer system, but unlike traditional retailers there is no need to continually invest in new stores and other physical assets in order to increase revenues.

The C2B model is epitomized by Priceline, the company founded by Jay Walker that allows customers to name their price for various objects such as airline tickets or hotel rooms. According to Priceline's founder, Jay Walker, "In the traditional model of commerce, a seller advertises a unit of supply in the marketplace at a specified price, and a buyer takes it or leaves it. Priceline turns that model around. We allow a buyer to advertise a unit of demand to a group of sellers. The sellers can then decide whether to fulfill that demand or not. In effect, we provide a mechanism for collecting and forwarding units of demand to interested sellers."[22]

The third model is C2C, and the prime example is eBay, the online auction service that acts as an intermediary for customers who want to auction off various goods to other customers. The eBay operation illustrates how online commerce can function with extraordinary efficiency. The buyers and sellers do all the work: sellers pay a fee to eBay for the opportunity to auction their wares, and when the auction ends the seller and buyer negotiate over the payment and shipping. For its role as an intermediary eBay

normally receives between 7% and 18% of the sale price. Because its customers do most of the work and take most of the risk, some have concluded that eBay is the perfect virtual business.

Finally, B2B refers to electronic commerce between two organizations and includes procurement, inventory management, sales service and support, and so forth. Perhaps the greatest potential in the B2B market is the remarkable growth of trading sites that range in complexity from online catalogs to public exchanges where buyers and sellers come together to exchange goods. Ventro, formerly known as Chemdex, was a public exchange for the medical equipment industry. These exchanges are open to a much larger group of buyers than a private network, and this greatly enhances the potential market for the sellers.

In addition to focused distributors we find *portals. Horizontal portals* such as Yahoo and Netscape function as gateways to the web by providing an initial point of access from which users can connect to various sites. *Vertical portals* such as Quicken.com in the area of financial services provide "deep content" in one area. The boundaries between portals and focused distributors have become increasingly murky. According to Applegate, many portals now "serve not only as gateways but also as destinations where people stop and conduct business."[23]

Despite the success of companies like Amazon.com, eBay, and Expedia, some consumers are still reluctant to embrace electronic commerce. Some fear becoming the victims of fraud or scams that are easier to execute thanks to the anonymous nature of Internet transactions. Others are concerned about the tenuous security of the Internet and worry that the price of convenience may be a loss of privacy. The accretion of social trust will be accelerated by "trustworthy" systems that are secure and respectful of privacy rights. These systems go a long way to inspiring more confidence in web-based transactions.

Although electronic commerce web sites have made the greatest progress in the United States, they are also proliferating in many other countries such as China. The Chinese government has encouraged the private sectors to develop web-based businesses, and entrepreneurs are responding enthusiastically. As these sites gain in popularity they could transform China's outdated retail business and enable manufacturers to automate purchases from suppliers. According to Einhorn, "the global implications of this are enormous—as web-based e-commerce spreads, traders around the world could link directly with suppliers and retailers across China."[24] Chinese-language portals such as sina.com and china.com are also emerging to serve as gateways to the Net for Chinese citizens.

The Internet can never return to its halcyon days when it was frequented only by technology buffs and academic researchers who formed an intimate and knowledgeable online community. As electronic commerce intensifies, the Net will continue to evolve, and to a large extent its future is in the hands of many different stakeholders who were not involved in the Internet's early days and who have a much more pragmatic and profit-oriented attitude about the Net than its early founders. We turn now to a few remarks about the downside of this phenomenon.

Social Problems and Social Costs

The Internet's popularity and commercialization has led to some familiar social problems and frictions in cyberspace. The erosion of privacy, the emergence of perverted forms of speech, and illegitimate copying of music and video files represent just some of these problems. At the same time, e-commerce vendors have been victimized by fraud and attacks by hackers. In the remaining chapters of this book we diagnose and analyze these problems, and review some equitable resolutions.

At this stage, however, it would be instructive to consider broad philosophical differences for dealing with these difficulties. In Lessig's terms, is the optimum solution to be found in law, the market, code, or social norms? It is naïve to think that any one of these four modalities of regulation such as law can constrain a problem such as privacy erosion in cyberspace. For complex problems the proper solution will undoubtedly be found in the interplay of law, code, and the market. The question becomes which of these forces should have primacy? Which one should generally take the lead in controlling the Net? One's answer to this query depends on one's faith in the market forces or on one's ideological assumptions about the efficacy of government regulation.

In economic terms, some of these frictions in cyberspace can be described as *social costs* or *negative externalities.* Coase explains that social costs are generated by "those actions of business firms which have harmful effects on others."[25] Certain social harms we have been discussing can be viewed from this perspective, that is, as harmful byproducts of certain Internet transactions. For example, the erosion of privacy, which often results when information is exchanged between two parties, or the transmission of disruptive forms of speech like spam, would fall into this category. Social costs represent failures of the market system or "market imperfections"; they are costs borne involuntarily by others that are not reflected in the price of the good whose production created those costs. In the case of privacy, the sale of personally identifiable data to third parties is an externality because the cost is imposed on the individual whose data are sold, and hence that cost is ignored by the seller. When regarded from an economist's viewpoint, the issue becomes one of weighing the economic benefits of the sale of this data against the social costs of privacy erosion.

Consider the problem of unsolicited electronic e-mail (spam). The production and distribution of spam messages advertising some product or service are minimal, but the real costs are shifted to other parties in cyberspace such as ISPs and even the recipients of those messages. Because the true costs of spam are not internalized by its "producers" spam is overproduced resulting in a lack of allocative efficiency, or efficiency in the allocation of society's economic resources.

But what should be done about these market failures, these externalities that now plague cyberspace just as they plague real space? Let us review several ideologies for how best to deal with market imperfections and those social harms we find on the Net.

The Invisible Hand

The vast majority of users agree that spam is a menace, but when it comes to doing something about spam opinions diverge. Do we need more government intervention, public polices, to contain the flood of junk mail and restore economic efficiency? Economists such as Ronald Coase of the Chicago School are skeptical of the government and tend to put more faith in the invisible hand of the marketplace to solve problems like spam. The impersonal forces of the market can often do a better job of fixing market imperfections than the vested interests of other marketplace participants (such as government regulators). Much of Coase's work has drawn attention to the limitations of government regulation as a solution to the problem of negative externalities. The government's regulatory agencies often do not understand the industries they are trying to regulate, a problem that could be exacerbated in contexts where sophisticated technologies are involved. Coase and others have also frequently noted the inefficiencies of large, centralized bureaucracies and the persistence of organizational inertia. Finally, there is always the potential for *capture,* a process whereby those being regulated influence regulators so that they no longer act in the public interest. According to Coase, there are "few more unpleasant sights than an unholy alliance between the regulators and the regulated industry to solve the problem of competition by suppressing it."[26]

What Coase and others favor as an alternative is greater reliance on the marketplace. Consider, for example, the problem of privacy erosion in cyberspace. We can certainly enact laws to deal with this problem but maybe the markets will effect a more efficient, welfare-enhancing solution. Those who favor this approach presume that market pressures will force vendors to respect privacy rights at a level consistent with the needs and interests of consumers. According to Reidenberg, the U.S. approach to privacy relies in part on just such a market-based solution; data protection in the U.S. is a "question of economic power rather than political right."[27]

But the marketplace has often proved to be an inadequate forum for addressing social problems. The market's reaction to those problems is often reactive and inequitable. Lessig, for one, sees the invisible hand threatening "liberty and openness" in cyberspace.[28] Economists like Pigou categorically reject the viability of market-based solutions to these externality problems: "No 'invisible hand' can be relied upon to produce a good arrangement of the whole from a combination of separate treatments of the parts. It is, therefore, necessary that an authority of wider reach should intervene and should tackle [society's] collective problems. . . ."[29] According to this view, the marketplace always functions as an important constraint on behavior, but it should not take priority over other regulatory forces such as law, norms, and code.

Regulating the Net: The Visible Hand

As Pigou suggested, the alternative to the market as primary regulator is the greater reliance on policy constraints imposed by government. But can the Net be regulated—is it really "regulable" in the same way that the physical world can be subjected to rules and regulations of local sovereigns? Can the unrestricted freedom of cyberspace be reined in by government forces?

The Internet defies regulation for several key reasons. First, its distributed architecture and resilient design makes the Net hard to control. Packet-switching technology, for example, has meant that it's not so easy to stop the flow of information. As John Gilmore puts it, "Information can take so many alternative routes when one of the nodes of the network is removed that the Net is almost immortally flexible. . . . The Net interprets censorship as damage and routes around it."[30] The Internet's lack of a physical center means that it has no moral center that can be held accountable for information flowing over the network.

Second, there is the Internet's content, digital information, 1s and 0s that can be transmitted through cyberspace with ease and stored on the recipient's hard drive. As Negroponte observed, "The information superhighway is about the global movement of weightless bits at the speed of light."[31] All forms of information including images and voice can be digitized, and a digital file is especially difficult to contain. One consequence of this is that digital file sharing technologies such as those developed by KaZaA and Gnutella are threatening to undermine the economics of the music and movie industries.

Finally, governments that seek to control or regulate the Net face an array of jurisdictional conundrums. As we have seen, a fundamental problem with a particular sovereignty imposing its will on the Internet is that laws and regulations are based on geography—they have force only within a certain territorial area, for example, a state, county, or nation. As one jurist put it: "All law is prima facie territorial."[32] Moreover, because the Internet is a borderless global technology, it is almost impossible for any country to enforce the laws or restrictions it seeks to impose on this sprawling region of cyberspace. If the U.S. decides to outlaw pornography, it can only effectively enforce this restriction among U.S. purveyors of pornography. It cannot restrict vendors located in Europe or the Caribbean from making pornography available on the Internet for everyone to see. It can, of course, put the burden on Internet providers and hold them liable for transmitting the illicit material no matter where its source is located. But this seems to be an unfair and unworkable solution because it is expensive and difficult for ISPs to detect and properly filter out all communications with pornographic elements.

Despite these obstacles, local sovereignties will not be deterred from regulating the Net. Consider France's efforts to prevent Yahoo from allowing Nazi memorabilia to be sold on its auction web sites, despite the fact that the server hosting these sites is located in the U.S. Those bringing the suit against Yahoo claimed that the company violated local French law. But to what extent should the global Internet be subjected to local law? The potential problem, according to Zittrain, is that "anyone posting information on the Internet is unduly open to nearly any sovereign's jurisdiction, since that information could have an effect around the world."[33]

In addition to the control of content, governments may pursue other forms of Internet regulation, such as the regulation of the information infrastructure or regulation of e-commerce. For example, a particular sovereignty might be concerned with preserving open and equitable access on the Internet, but give free reign to content providers along with the focused distributors and portals engaged in e-commerce.

Governments that do seek to regulate e-commerce might do so by regulating privacy or data protection or by insisting on certain security standards for a web site. The European Union Privacy Directive, for example, lays out strict privacy rules for companies doing business within the European Union (E.U.). In the U.S., however, the preferred solution has been self-regulation.

All sovereignties must make decisions about the scope of Internet regulations. Should they aspire to developing regulations to protect the infrastructure or focus on content controls? Once the appropriate scope is defined, sovereignties must decide whether they should apply existing laws or craft new ones. For example, should the U.S. apply existing intellectual property laws to the web or is it necessary to develop new ones? According to Samuelson, "Although some commentators have suggested that copyright law is outmoded in the Internet environment, the general view in the U.S. and the EU is that copyright law can be applied and adapted to protect expressive works in digital form."[34]

Some countries, unfortunately, have been overly aggressive in Internet regulations. Despite its encouragement of web-based business, the Chinese government remains exceedingly anxious about the Internet, and they have made it quite clear that "by linking with the Internet, we do not mean the absolute freedom of information."[35] Chinese officials use a firewall to block access to pornographic and other objectionable web sites, such as those operated by human rights groups. China's iron grip on political discourse has been tested by Internet access, but this country has responded with its usual heavy-handed and repressive tactics.

Finally, as we have implied, there are perils in having each local jurisdiction impose its own laws on the Net. Different privacy laws, for example, could disrupt the flow of e-commerce or impede other information exchanges. If this borderless global technology is to be properly regulated, shouldn't there be a set of international standards? Don't we need a global law for this global technology?

There has been some effort made to harmonize laws pertaining to the Internet. Consider, for example, the WIPO Copyright Treaty, which stipulates how copyright laws will be applied to digital works. In addition, countries outside the E.U. have begun to embrace its Privacy Directive. Argentina, Australia, Canada, Switzerland, and New Zealand have either adopted the E.U. Directive or they are working on a set of rules that are heavily influenced by that Directive.[36] Some in the U.S. see this trend toward convergence as a threat to national sovereignty, but others believe that a simple global standard is the only way to ensure that privacy rights are recognized and enforced throughout the world.

Although harmonization is sound in theory, it will be immensely difficult to accomplish in practice thanks to deeply embedded cultural and legal differences between most countries. Given this difficulty, Samuleson recommends that nations should instead strive for "policy interoperability" instead of full harmonization, that is, "agreeing on goals a policy should achieve, while recognizing that nations may adopt somewhat different policy means to implement goals."[37]

A "Bottom-Up" Approach: The Sovereignty of Code

In Chapter 1, we alluded to the Net's empowerment of the individual through its code. Thanks to strong encryption programs, for instance, it is more difficult for the state to conduct surveillance on confidential electronic communications. Similarly, filtering technologies give individuals the power to limit content or format the information they wish to receive. Electronic anonymity also frustrates lawmakers' efforts to hold individuals accountable for their online actions. The Net empowers individuals through technology. It is shifting control from the state to the individual, and this is a source of great consternation for many government leaders.

The individual's empowerment through code makes possible a more bottom-up approach to regulation that some users and civil libertarians favor. But can a case be made for letting the Internet organize and moderate itself as much as possible? According to David Post, "there are some problems on the Internet best solved by these messy, disordered, semi-chaotic, unplanned, decentralized systems, . . . and the costs that necessarily accompany such unplanned disorder may sometimes be worth bearing."[38] This messy bottom-up approach Post describes is not a panacea for the Internet's various externalities, but it may be an adequate means of regulating conduct and addressing some aspects of the social problems described in the chapters ahead.

There is surely much to be said for reliance on the constraints imposed by technology in the hands of individuals. In some ways it seems preferable to the regulatory regime of government. It's nonintrusive, simpler, less expensive, and gives users the ultimate choice about what they want to see or not see. Bottom-up constraints also avoid the expensive government infrastructure that inevitably accompanies a regulatory scheme. In addition, this approach fits with the cultural shift now taking place in countries like the U.S. whose citizens are increasingly anti-bureaucratic. Instead of reliance on bureaucracy and public policy to solve society's ills, they favor individual empowerment and local control whenever possible.

As we observed in Chapter 1, however, some legal scholars have perceptively made the case that technical solutions implemented by private parties can sometimes be more restrictive than actions taken by a democratic state. As Seth Finkelstein writes, "because of a perspective that might be rendered 'government action bad, private action good' there's great unwillingness to think about complicated social systems, or private parties acting as agents of censorship."[39]

In his critique of filtering systems such as PICS, Lawrence Lessig has made similar observations. PICS, which stands for Platform for Internet Content Selection, is a labeling standard that provides a way of labeling and blocking online material. It can be used by parents or schools to block access to a web site with pornographic material or one filled with virulent hate speech. According to Lessig, the widespread deployment of this technology can yield a "tyranny of the code" as those in positions of authority impose their own standards on unsuspecting users.[40]

The power and potential of blocking software like PICS has not been lost on civil libertarians who have begun to better appreciate how these technologies can undermine the free flow of information far more effectively than government-imposed censorship. The threat to freedom may be more subtle and dispersed, but the end result is still the sort of social domination, now effected by private parties, that the Net is designed to resist.

The French philosopher Michel Foucault appreciated the import of this difference as well. In his writings on the nature of power, he differentiated between explicit state commands emanating from the sovereign power and a more covert and implicit exercise of domination. The latter normally has taken the form of surveillance, but it can take other forms as well. According to Foucault, "we have the emergence or rather the invention of a new mechanism of power possessed of a highly specific procedural technique. It is a type of power which is constantly exercised by means of surveillance rather than in a discontinuous manner by means of a system of levies or obligations distributed over time."[41] This clearly echoes Lessig's concern about the "tyranny of the code," a tyranny that can come from different and nonobvious sources.

We are left then with a provocative but seminal question—should control and regulation of the Internet for the most part be left in the hands of private parties and the corrective technologies that they create and distribute in the marketplace? Or should we embrace a more top-down approach? Should the Internet be regulated more directly to contain its social costs without the collateral damage that can accompany the bottom-up approach? Are the sinews of Internet stability best found in the rational laws and regulations emanating from a sovereign power or an international body? Or are they found in the architectures of the Net responsibly deployed by individuals?

Internet Governance

Although there is some disagreement on how the Internet should be regulated through government intervention, no one questions the need for some type of governance and technical coordination. No matter how opposed one is to regulatory oversight, the Net cannot survive without this type of coordination. There must be governing bodies that handle ordinary and routine technical matters such as the determination of technical standards and the management of domain names and IP addresses. For our purposes, *governance* refers to managing these matters rather than regulating the Net through content controls or other mechanisms.

Two major policy groups that provide such governance are the World Wide Web Consortium, an international standards setting body, and the Internet Engineering Task Force (IETF), which develops technical standards such as communications protocols. According to the *Economist*, a culture of "cautious deliberation" prevails within the IETF, which strives to be democratic in its decision-making processes. Anybody can join the IETF and any member can propose a standard "and so start a process that is formal enough to ensure that all get a hearing, but light enough to avoid bureaucracy."[42]

The Domain Name System (DNS) also needs coordination. The DNS maps the domain names of organizations such as eBay to the actual numeric Internet Protocol address (e.g., 709.14.3.26). The DNS is a hierarchical system divided into separate domains. When a domain name is

invoked by a browser the request is forwarded to the DNS server, which is normally operated by an ISP, and that server locates the databases for each subdomain. If the domain name is www.loyola.edu, the DNS server first locates the server for ".edu," which is the Top Level Domain (TLD); it then finds the server for "loyola," the Second Level Domain, and so forth. Using this method the web page is found and transmitted back to the recipient.

This system was formerly administered by a small private company called Network Solutions International (NSI), which charged $50 for the registration of a domain name and usually awarded the name on a first-come, first-served basis. As the Internet became commercialized, disenchantment with the NSI arrangement escalated. As a result, after some political maneuvering, the domain name system is now in the hands of the Internet Corporation for Assigned Names and Numbers (ICANN). ICANN is an international, nonprofit organization with full responsibility for the DNS. ICANN itself does not actually distribute domain names. That task is delegated to domain name registrars such as VeriSign. ICANN determines the policies for domain name distribution, and it has the final say for selecting firms that qualify as registrars.

Domain names were introduced to impose some order on the Net, and originally there were six TLDs: .com, .net, .org, .edu, .gov, and .mil. ICANN has recently decided to create several new TLDs, such as, .aero. (air transport companies), .coop (cooperatives), .biz (business), .museum (museums), .name (individuals), .pro (professionals such as lawyers), and .info (nonrestricted use). The purpose of these new extensions is to handle the overusage of popular TLDs such as .com and .org. It remains to be seen whether these new extensions (like .biz) will be embraced by the public and become as popular as the original TLDs such as .com.

To its credit, ICANN has acted swiftly and deliberately to deal with the issue of cybersquatting and other domain name disputes. In October, 1999, it established the Uniform Dispute Resolution Policy for adjudicating such disputes and protecting legitimate trademarks. That policy is discussed in more detail in Chapter 4, in the context of the treatment of trademark law and the Lanham Act.

ICANN is currently governed by a board of eighteen members; nine of those members are elected by the at-large membership. Critics of ICANN contend that despite its claims to represent an international constituency, Americans dominate ICANN. Moreover, they insist that its structures are not democratic enough and that it does not give average users enough say in its governing procedures. Whether these criticisms will undermine ICANN's authority is anyone's guess at this point, but its supporters say that ICANN has the potential to emerge as a model of consensus building and international cooperation the global Internet community demands.

Internet Regulation and Ethics

At this stage of the Internet's rapid evolution, it would be presumptuous to predict which, if any, of the regulatory approaches described here might actually prevail. There will undoubtedly be some mixture of bottom-up controls combined with top-down regulations. The real question is how expansive a role the government will end up playing in regulating the Internet. There is a case to be made that this role should be substantial given the importance of cyberspace for the future of commerce and for many other social interactions. There is also understandable wariness about the unpredictability of trusting the Internet to regulate itself. Without the government's sustained efforts to ensure a level playing field, companies like Microsoft and Google could exert undue influence on e-commerce and monopolize essential facilities. Also, supporters of more extensive government regulations raise legitimate concerns about the poor state of efforts in the U.S. to handle online privacy through self-regulation.

However, if the state does intend to expand its regulatory role in the recalcitrant region of cyberspace, it will confront at least two formidable challenges. First, it must try to apply its own territorially based laws to a global entity. For example, anti-Semitic hate speech is illegal in Germany, but purveyors of neo-Nazi web sites have relocated their servers to the U.S. to avoid German jurisdiction. Second, it must contend with code that has radically empowered the individual—individuals have at their disposal programs like anonymizer.com which can block IP address tracking. These obstacles appear to have weakened the state's sovereignty and given the individual the upper hand.

It would be premature, however, to underestimate the power of the state and to toll the death knell for its sovereignty. As Michel Foucault writes, "wherever there is power, there is resistance."[43] The state will certainly resist this state of affairs and seek to retrieve its lost dominance and diminished sovereignty. It may, for instance, use its vast power to tightly regulate ISPs or to demand that other private surrogates carry out its regulatory regime. Public policy makers too recognize the power of code as a constraint in cyberspace and might be willing to mandate the use of certain codes (such as filtering and IP address tracking) to counteract the difficulties of regulating cyberspace through fiat alone. As Lessig observes, the state will work to increase the very regulability of cyberspace by exercising control over its code.[44]

What we are left with, then, is a power struggle between a frustrated state and a newly empowered Internet community. At the epicenter of that struggle is the code of cyberspace. In many respects, the code is a far more effective constraint than law, norms, or the marketplace. One can envision many possibilities on both sides for using that code to gain control. For example, the architectures of the Internet currently facilitate electronic anonymity, but the state could respond by requiring that ISPs use code that mandates digital identity and the traceability of all Internet transactions.

What makes this struggle so perilous is the facility with which the code of the Internet can be manipulated. Andrew Shapiro describes the Internet's capacity for empowering individual users as the "control revolution." He argues that the state's resistance to that revolution will "become more refined as governments become more adept at influencing code without running afoul of constitutional limitations or public opposition."[45]

Code is such a powerful regulator in the hands of the state or individuals because of its malleability and obscurity, its flexible ability to regulate or shape behavior gradually and inconspicuously. Code does not always constrain or influence behavior openly and directly, in a way that is transparent to those it affects. This contrasts sharply with the constraint of law, because the process of crafting laws through democratic procedures is subject to considerable public scrutiny.

Hence the paramount importance of ethics in all of this. Although we do not take a stand on the preferability of a bottom-up or a top-down regulatory philosophy, we contend that whatever approach becomes dominant, there must be careful attention paid to basic human values such as autonomy, privacy, and security. Informal social controls abetted by technology may have the potential to provide effective and fair-minded regulations of cyberspace conduct, but only if those stakeholders involved are committed to responsible behavior. This will help to minimize any negative effects on human rights that these corrective technologies (such as filtering) can bring about if they are carelessly deployed.

Likewise, a top-down legislative process must be guided by these same core values. Governments must not overreact to the control revolution with restrictive laws or bypass the democratic process and manipulate Internet architectures to curtail basic human freedoms and rights merely for the sake of greater order and stability in cyberspace. They too must behave responsibly in their attempts to regulate cyberspace.

As we argued in Chapter 1, what is of primary and utmost significance is the preservation in cyberspace of those transcendent human goods and moral values, which are so basic for the realization of human flourishing. *Moral values must be the ultimate regulator of cyberspace, not the code of engineers.* This orientation helps to ensure that abuses of the code are kept to a minimum. If Internet stakeholders, including public policy makers, software developers, educators, and corporate executives, act prudently and responsibly, they will be vigilant and conscientious about respecting these values. As a result, they will find themselves guided by a moral wisdom that encourages care for others and a sense of measure concerning the public affairs of the Internet. This will also help to achieve a reasonable equilibrium between the state and other Internet stakeholders.

In the next several chapters we discuss what constitutes responsible approaches to cyberspace regulation. In the course of that discussion we consider how code can be responsibly designed, developed, and utilized. We also focus on how the core moral values can be applied to some of the troubling dilemmas now emerging in cyberspace. To be sure, the application of those values is not an exact science and there will often be room for reasonable people to disagree. But if there is a shared conviction that the Internet must be governed by these broad moral standards, it will be easier to equitably resolve these inevitable conflicts.

Discussion Questions

1. Discuss the pros and cons of extensive government regulation of the Internet either by a local sovereign government or by an international body specifically constituted for this purpose.
2. Evaluate the "bottom-up" approach to regulation as it was presented in this chapter.
3. In what ways does the structure and present architecture of the Internet affect the choice of an optimal regulatory structure?
4. What is ICANN and what does it do?

Case Studies

L'Affair Yahoo!

Company Background

Yahoo! was founded in 1994 by David Filo and Jerry Yang, two Ph.D. students at Stanford University. It was originally developed as a portal, that is, a gateway or guide to the web and as a way to keep track of web site addresses. It also incorporated search functionality. This fashionable guide to available web sites quickly evolved into a commercial site and thriving business. In 1995 Yahoo took on Tim Koogle as its CEO. From the outset, Yahoo under Koogle's guidance saw itself as a media company and not just as a search engine. During 1996 and 1997, Yahoo added considerable content and communication facilities as it evolved into a full-fledged Internet portal. Yahoo's primary services are called *properties*. These properties included *navigational services*, which help users find web sites and other information more easily. It also includes *community properties*, which help users communicate with one another. For example, users could access the Yahoo Address Book, which allowed them to use an address book from any connected system. There were also e-commerce properties for shopping or making travel arrangements. Millions of people now use Yahoo for e-mail, instant messaging, scheduling, personal web pages, chat rooms, job searches, and auction sites.

Yahoo generates most of its revenues through advertising and deals with e-commerce partners. The company reaches 60% of all Net users worldwide, and it tracks the visits of 166 million users. Yahoo has also expanded mightily into overseas markets. Foreign users now amount to 40% of Yahoo's customer base. Yahoo has the biggest global reach of any Internet brand—it offers 23 local versions in 12 different languages. Yahoo has prided itself on good relations with foreign governments. According to Forbes, Yahoo devotes much energy to "hitting the international conferences and meeting heads of state to talk Internet policy and plead Yahoo's local interests."[46]

Thus, Yahoo provides a variety of means by which people from all over the world can communicate and interact over the Internet. Yahoo's auction site allows anyone to post an item for sale and solicit bids from any computer user around the world. Yahoo sends an e-mail notification to the highest bidder and seller with the respective contact information. Yahoo is never a party to the transaction, and the buyer and seller are responsible for payment and shipment of goods. Yahoo informs sellers that they must comply with company polices and may not offer items to buyers in jurisdictions in which the sale of such item violates the jurisdiction's applicable laws. Yahoo, however, does not actively regulate the content of each posting and individuals have posted offensive material including Nazi-related propaganda and material.[47]

The French Resistance

During the spring of 2000, Yahoo's relations with the French government ran into serious problems. In April, two French associations, the French Union of Jewish Students and the International League against Racism and Anti-Semitism (La Ligue Contre Racise et L'Antisemitisme [LICRA]), filed suit against Yahoo, demanding that they remove swastika flags and other Nazi memorabilia from their American web site. French law expressly prohibits the display or sale of objects that incite racial hatred and this includes any World War II Nazi memorabilia. The French Court cited 1,000 Nazi and Third Reich–related objects for sale on Yahoo auction sites including Hitler's autobiography, *Mein Kampf*, and *The Protocol of the Elders of Zion*, an infamous anti-Semitic book. Any French citizen could access these materials on Yahoo.com directly or through a link on Yahoo.fr. (Yahoo's regional web sites such as Yahoo! France [http://www.yahoo.fr] use the local region's primary language, targets the local citizens, and operate under local laws.)

In May 2000, Judge Jean-Jacques Gomez of the Tribunal de Grande Instance de Paris ruled in favor of these two groups. He concluded that Yahoo had violated French law and offended the "collected memory" of France. He ordered Yahoo to make it impossible for French users to access any auction site that contained illegal Nazi items such as relics, insignia, and flags. He also ordered Yahoo "to eliminate French citizens' access to web pages on Yahoo.com displaying text, extracts, or quotations from *Mein Kampf* and *The Protocol of the Elders of Zion*."[48]

Yahoo's lawyers claimed that the company was powerless to obey this order, maintaining that it would not be technically feasible to accomplish the task of identifying web users by national origin and blocking access to the contested sites. Yahoo also claimed that the French court lacked jurisdiction, because its principal place of business was in Santa Clara, California. The Judge dismissed the latter claim, and he assembled a panel of three experts to determine whether or not Yahoo's assessment regarding technical feasibility was correct.

The panel, consisting of three individuals representing France, Europe, and the U.S., was charged with answering this question: is it technically possible for Yahoo to comply with the court order, and, if not, to what extent can compliance be achieved? The panel concluded that foolproof 100% compliance was impossible. But it also concluded that Yahoo could block up to 90% of French users by using several levels of detection. Over 60% could be blocked by the same technology that Yahoo used to customize the site for French users, that is, by providing French users with French banner ads. This entailed tracking their IP address, which in most cases reveals the physical location of the user. This would not work, however, for the subscribers of some ISP services (such as AOL customers), because the ISPs assign temporary IP addresses. However, it was estimated that another 20% to 30% could be identified by requiring users to fill out a "declaration of nationality."

Of course, each method of detection could be easily circumvented. One could employ an anonymizer such as www.anonymizer.com to prevent the IP address from being revealed. And one could also lie about one's nationality on the declaration form.

But Judge Gomez was satisfied that Yahoo could identify most of the users logging on from France. Hence, in November 2000, the judge reissued the preliminary injunction (*Ordinance en reféré*) against Yahoo that he had first issued in May. Yahoo was ordered to install a filtering system (or equivalent technology) to block French citizens from these problematic sites that auction Nazi objects or that present any Nazi sympathy or holocaust denial. Yahoo was informed that it had 90 days to comply with the court order or face a fine of up to 100,000 francs (about $13,000) per day. In his ruling the judge referred to Yahoo's ability to detect French web users because it already preselects them for its French-language banner ads. The judge also pointed to Yahoo's other restrictions, citing its policy "of not allowing the sale of drugs, human organs or living animals on its auctions sites."[49]

This unique case triggers many difficult jurisdictional issues. On one hand, France has the right to assert jurisdiction over its citizens and to enforce its own laws. But how can it enforce its laws against a company located in the U.S.? One of Yahoo's lawyers predicted "that any effort by French authorities to enforce Judge Gomez's judgement in a United States court against Yahoo's United States assets would fail because of the First Amendment, which protects hate speech."[50] Other commentators such as the Center for Democracy and Technology in the United States immediately criticized the decision as a grave threat to freedom of expression on the Internet.

Yahoo's Dilemma

Yahoo officials must now decide whether or not to comply with the French Court's order. They had several options. They could adopt a defensive posture: ignore the Court order and continue to allow its auctions sites with these controversial items to be made available to French citizens. The company might combine this strategy with an appeal of the French Court's decision. Or it could take blocking measures to shut out French residents from the contested sites to ensure compliance even if they are not fully effective. It also has the option of banning hate material including these Nazi-related items from all of its auction web sites. This might be accomplished by using software that scans the items before they are made available for sale. This course of action would be the most drastic; it would be a departure from Yahoo's longstanding policy against the monitoring of its web properties.

As the November decision began to sink in, Koogle and his colleagues realized that they faced an insuperably difficult decision. How could it balance the interests of its diverse stakeholders without getting embroiled in a protracted legal battle with the French government?

Questions

1. In your opinion, what should Yahoo do about this situation? Should it make concessions to the French Government?
2. Do you agree with the French court's efforts to enforce local laws against anti-Semitic hate speech against Yahoo?
3. What are the broader implications of this case for the future of free speech on the Internet?

A Case of Libel?

Mr. Joseph Gutnick, a prominent Australian business man, was quite shocked when he came across some unflattering remarks about himself in an online article in *Barron's*:

> Some of Gutnick's business dealings with religious charities raise uncomfortable questions. A *Barron's* investigation found that several charities traded heavily in stocks promoted by Gutnick. Although the charities profited, other investors were left with heavy losses. . . . In addition, Gutnick has had dealings with Nachum Goldberg, who is currently serving five years in an Australian prison for tax evasion that involved charities.[51]

Gutnick decided to file suit for libel. *Barron's* is owned by Dow Jones & Company, publisher of the *Wall Street Journal*, which has corporate headquarters in the U.S. But Mr. Gutnick and his lawyers wanted to file the libel suit in his home state of Victoria where the libel laws are quite strict.

Dow Jones, on the other hand, sought to have the case heard in the U.S., where *Barrons online* is written and disseminated. The company feared the precedent that would be set if the case were heard in Australia. In the future, posting material online could leave them open to multiple law suits in many different jurisdictions. Accordingly, Dow Jones' lawyers argued that the U.S. jurisdiction was the fairest place to hear this dispute.

But the High Court of Australia ruled that Gutnick could sue in his home state of Victoria, reasoning that this "is where the damage to his reputation of which he complains in his action is alleged to have occurred, for it is there that the publications of which he complains were comprehensible by readers."[52] According to Zittrain, the Australian High Court dismissed Dow Jones' "pile on" argument "that Gutnick could next sue the company in Zimbabwe, or Great Britain, or China," or where ever he read the allegedly libelous remarks.[53] The Court observed that Gutnick lived in Victoria and this was where the alleged harm occurred. It also noted that Dow Jones profited from the sale of *Barrons Online* to Australians.

Nonetheless, the Australian court's ruling was unsettling for many in the publishing world. According to one lawyer for the publishing industry, "The problem is that rogue governments like Zimbabwe will pass laws that will effectively shut down the Internet."[54]

Question

Do you agree with the ruling in this case? Why or why not? Are Dow Jones' fears unfounded or do they have some merit?

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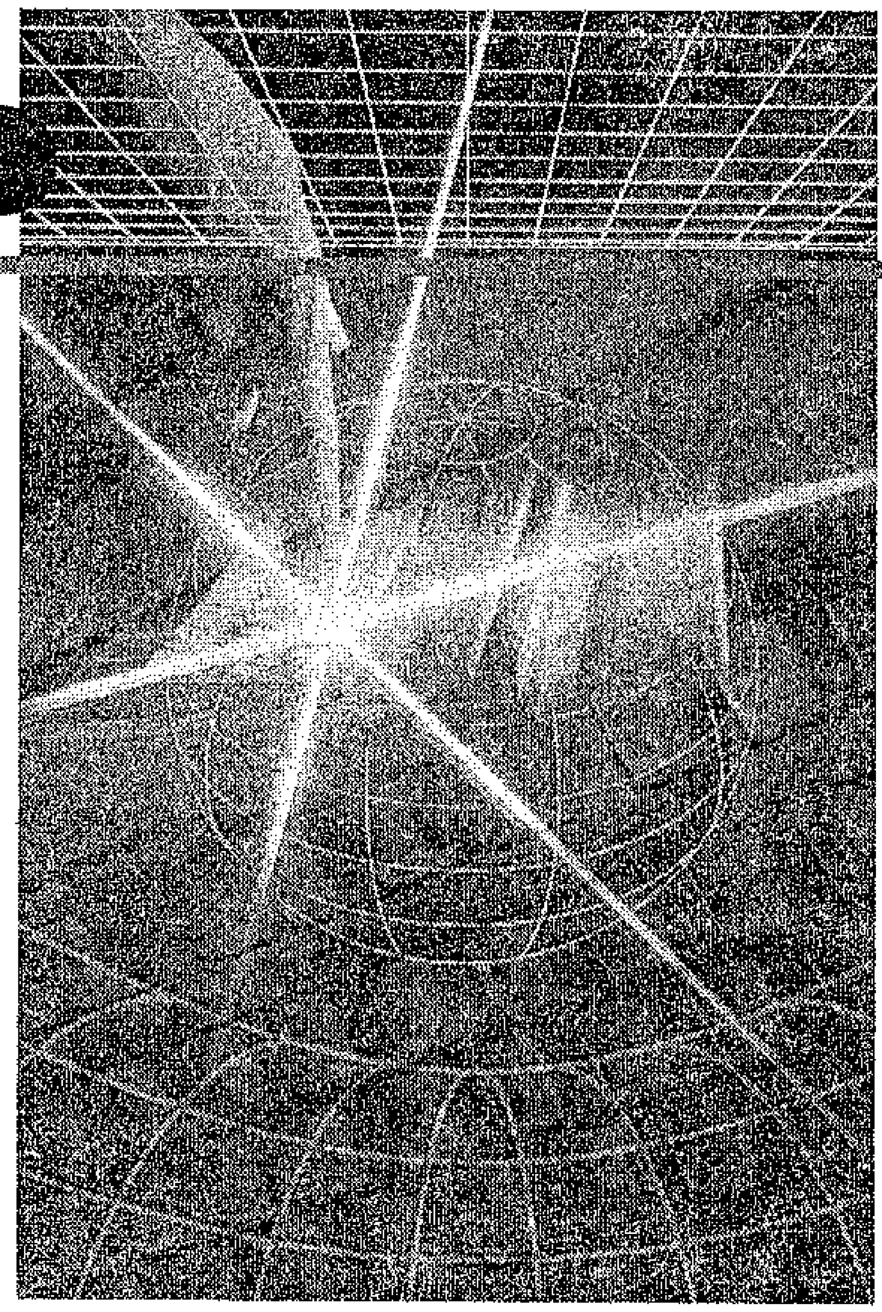
CHAPTER THREE

Free Speech and Content Controls in Cyberspace



The Internet has clearly expanded the potential for individuals to exercise their First Amendment right to freedom of expression. The Net's technology bestows on its users a vast expressive power. They can, for instance, disseminate their own blogs, publish electronic newsletters, or establish a home page on the Web. According to Michael Godwin, the Net "puts the full power of 'freedom of the press' into each individual's hands."[1] Or as the Supreme Court eloquently wrote in its *Reno v. ACLU* decision, the Internet enables an ordinary citizen to become "a pamphleteer, . . . a town crier with a voice that resonates farther than it could from any soapbox."[2]

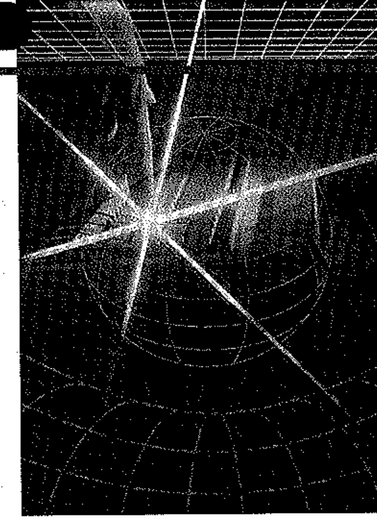
But some forms of expression, like pornography or venomous hate speech, are offensive. They provoke a great sense of unease along with calls for limited content controls. Many resist this notion, however, insisting that the state should not interfere with unfettered access to online content.

As a result, the issue of free speech and content controls in cyberspace has emerged as arguably the most contentious moral problem of the nascent Information Age. Human rights such as free speech have taken a place of special prominence in the past century. In some respects these basic rights now collide with the state's inclination to rein in this revolutionary power enjoyed by Internet users. Whereas the U.S. has sought to suppress online pornography, the target of some European countries such as France and Germany has been mean-spirited hate speech.

In addition, speech is at the root of most other major ethical and public policy problems in cyberspace including privacy, intellectual property, and security. These three issues are discussed in Chapters 4, 5, and 6, where the free speech theme continues to have considerable saliency, but it is instructive at this point to consider how these issues are interconnected.

CHAPTER ONE

The Internet and Ethical Values



The end [of ethics] is action, not knowledge.
—Aristotle[1]

More than three decades have passed since the first communications were transmitted over a fledgling global network, which would later be called the *Internet*. At the time, few would have predicted the Internet's explosive growth and persistent encroachment on our personal and professional lives. This radically decentralized network has been described in lofty terms as empowering and democratizing. It has lived up to this ideal by creating opportunity for many new voices with extraordinary reach. Although the claim that the Internet will revolutionize communications may be hyperbole, there is no doubt that the Internet has the potential to magnify the power of the individual and fortify democratic processes.

Many governments, however, are clearly threatened by some of this decentralized power and they have sought to impose some centralized controls on this anarchic network. The United States has attempted to regulate speech through the ill-fated Communications Decency Act and to restrict the use of encryption technology through its key recovery scheme. More draconian regulations have been imposed by countries like Iran and Saudi Arabia. The Net and its stakeholders have steadfastly resisted the imposition of such controls, and this has led to many of the tensions and controversies we consider throughout this book.

Although the control of technology through law and regulation has often been a futile effort, "correcting" technology with other technology has been more effective. The regime of law has had a hard time suppressing the dissemination of pornography on the Internet, but blocking software systems that filter out indecent material have been much more successful. This reflects the net's paradoxical nature—it empowers individuals and allows them to exercise their rights such as free speech more vigorously, but it also makes possible effective technical controls that can undermine those rights.

Although the primary axis of discussion in this book is the ethical issues that surface on the Internet, we must devote attention to these related matters of cyber-governance and public policy. Thus, we explore in some detail the tensions between the radical empowerment that the Net allows and the impulse to tame this technology through laws and other mechanisms.

Because this is a book about ethics, about *acting* well in this new realm of cyberspace, we begin by reviewing some basic concepts that will enrich our moral assessment of these issues. Hence, in this introductory chapter our purpose is to provide a concise overview of the traditional ethical frameworks that can guide our analysis of the moral dilemmas and social problems that arise in cyberspace.

More important, we also elaborate here on the two underlying assumptions of this work: (a) the *directive* and architectonic role of moral ideals and principles in determining responsible behavior in cyberspace and (b) the capacity of free and responsible human beings to exercise some control over the forces of technology (technological realism). Let us begin with the initial premise concerning the proper role of cyberethics.

Cyberethics and the "Law of the Horse"

An ethical norm such as the imperative to be truthful is just one example of a constraint on our behavior. In the real world, there are other constraints including the laws of civil society or even the social pressures of the communities in which we live and work. There are many forces at work limiting our behavior, but where does ethics fit in?

This same question can be posed about cyberspace and to help us reflect on this question we turn to the framework of Larry Lessig. In his highly influential book, *Code and Other Laws of Cyberspace*, Lessig first describes the four constraints that regulate our behavior in real space: law, norms, the market, and code.

Laws, according to Lessig, are rules imposed by the government which are enforced through *ex post* sanctions. There is, for example, the complicated IRS tax code, a set of laws that dictates how much taxes we owe the Federal government. If we break these laws, we can be subjected to fines or other penalties levied by the government. Thanks to law's coercive pedagogy, those who get caught violating tax laws are usually quick to reform.

Social norms, on the other hand, are expressions of the community. Most communities have a well-defined sense of normalcy, which is reflected in their norms or standards of behavior. Cigar smokers are not usually welcome at most community functions. There may be no laws against cigar smoking in a particular setting, but those who try to smoke cigars will most likely be stigmatized and ostracized by others. When we deviate from these norms, we are behaving in a way that is socially "abnormal."

The third regulative force is the market. The market regulates through the price it sets for goods and services or for labor. Unlike norms and laws, market forces are not an expression of a community and they are imposed immediately (not in *ex post* fashion). Unless you hand over $2 at the local Starbucks you cannot walk away with a cup of their coffee.

The final modality of regulation is known as architecture. The world consists of many physical constraints on our behavior—some of these are natural (such as the Rocky Mountains) whereas others are human constructs (such as buildings and bridges). A room without windows imposes certain constraints because no one can see outside. Once again "enforcement" is not *ex post* but at the same time the constraint is imposed. Moreover, this architectural constraint is "self-enforcing"—it does not require the intermediation of an agent who makes an arrest or who chastises a member of the community. According to Lessig, "the constraints of architecture are self-executing in a way that the constraints of law, norms, and the market are not."[2]

In cyberspace we are subject to the same four constraints. Laws, such as the ones that provide copyright and patent protection, regulate behavior by proscribing certain activities and by imposing *ex post* sanctions for violators. It may be commonplace to download and upload copyrighted digital music, but this activity breaks the law. There is a lively debate about whether cyberspace requires a unique set of laws or whether the laws that apply to real space will apply here as well with some adjustments and fine tuning. Judge Frank Easterbrook has said that just as there is no need for a "law of the horse," there is no need for a "law of cyberspace."[3]

Markets regulate behavior in various ways—advertisers gravitate to more popular Web sites, which enables those sites to enhance services; the pricing policies of the Internet Service Providers determine access to the Internet; and so forth. It should be noted that the constraints of the market are often different in cyberspace than they are in real space. For instance, pornography is much easier and less expensive to distribute in cyberspace than in real space, and this increases its available supply.

The counterpart of architectural constraint in the physical world is software "code," that is, programs and protocols that make up the Internet. They too constrain and control our activities. These programs are often referred to as the "architectures of cyberspace." Code, for example, limits access to certain Web sites by demanding a username and password. Cookie technology enables e-commerce, but compromises the consumer's privacy. Sophisticated software is deployed to filter out unsolicited commercial e-mail (or spam). In the long run, code may be more effective than law in containing spam, which rankles many users.

Finally, there are norms that regulate cyberspace behavior, including Internet etiquette and social customs. For example, flaming is considered "bad form" on the Internet and those who do it will most likely be disciplined by other members of the Internet community. Those who misrepresent themselves in a chat room also violate those norms and they too will be reproached if their true identity is revealed. Just as in real space, in cyberspace communities rely on shame and social stigma to enforce cultural norms.

But what role does ethics play in this neat regulatory framework? Lessig apparently includes ethical standards in the broad category he calls "norms," but in our view cultural norms should be segregated from ethical ideals and principles. Cultural norms are nothing more than variable social action guides, completely relative and dependent upon a given social or cultural environment. Their validity depends to some extent on custom, prevalent attitudes, public opinion, and a myriad of other factors. Just as customs differ from country to country the social customs of cyberspace could be quite different from the customs found in real space. Also, these customs will likely undergo some transformation over time as the Internet continues to evolve.

The fundamental principles of ethics, however, are metanorms; they have universal validity. They remain the same whether we are doing business in Venezuela or interacting in cyberspace. Like cultural norms they are prescriptive, but unlike these norms, they have lasting and durable value because they transcend space and time. Ethics is about (or should be about) intrinsic human goods and the moral choices that realize those goods. Hence the continuity of ethical principles despite the diversity of cultures.

Our assumption that ethics and customs (or cultural norms) must be kept distinct defies the popular notion of ethical relativism, which often equates the two. A full refutation of that viewpoint is beyond the scope of our discussion here. But consider this reflection of the contemporary philosopher Phillippa Foot:

> Granted that it may be wrong to assume identity of aim between people of different cultures; nevertheless there is a great deal all men have in common. All need affection, the cooperation of others, a place in community, and help in trouble. It isn't true to suppose that human beings can flourish without these things—being isolated, despised or embattled, or without courage or hope. We are not, therefore, simply expressing values that we happen to have if we think of some moral systems as good moral systems and others as bad.[4]

None of this by any means invalidates Lessig's framework. His chief insight is that "code and market and norms and law together regulate in cyberspace as architecture and market and norms and law regulate in real space."[5] Also, according to Lessig, "Laws affect the pace of technological change, but the structures of software can do even more to curtail freedom. In the long run the shackles built by programmers could well constrain us more."[6] This notion that private code can be a more potent constraining force than public law has significant implications. The use of code as a surrogate for law may mean that certain public goods or moral values once protected by law will now be ignored or compromised by those who develop or utilize this code. Moreover, there is a danger that government itself will regulate the architectures of cyberspace to make it more controllable. It could, for instance, mandate the traceability of all Internet transactions, and thereby increase its capacity for surveillance or oversight of all interactions in cyberspace. In the hands of the private or public sector the architectures of cyberspace can have extraordinary regulatory power.

Thus, Lessig's model is quite instructive and we rely on it extensively in the pages to come. However, I would argue that the model would be more useful for our purposes if greater attention were given to the role of fixed ethical values as a constraining force. But how do these values fit with the other regulatory forces?

Before we can answer this question we must say something about the nature of those values. The notion that there are transcendent moral values grounded in our common human nature has a deep tradition in the history of philosophy. It is intuitively obvious that there are basic human goods that contribute to human well-being or human flourishing. Although there are several different versions of what these goods might be, they do not necessarily contradict each other. Some versions of the human good are "thin," while others are "thick." James Moor's list of core human goods includes life, happiness, and autonomy. According to Moor, *happiness* is "pleasure and the absence of pain," and *autonomy* includes those goods that we need to complete our projects (ability, security, knowledge, freedom, opportunity, reason). Individuals may rank these values differently but all human beings attribute value to these goods or "they would not survive very long."[7]

Oxford philosopher, John Finnis, offers a thicker version of the human good. He argues persuasively for the following list of intrinsic goods: life, knowledge, play (and skillful work), aesthetic experience, sociability, religion, and practical reasonableness (which includes autonomy). According to Finnis, participation in these goods allows us to achieve genuine human flourishing. They are opportunities for realizing our full potential as human beings, for being all that we can be. Hence the master principle of morality: one's choices should always be open to *integral human fulfillment*, the fulfillment of all persons and communities. None of our projects or objectives provides sufficient reason for setting aside or ignoring that responsibility.

For both Moor and Finnis, then, the ulitmate source of moral normativity is these intelligible, authentically *human* goods, which adequately explain the reasons for our choices and actions, and overcome the presumption of subjectivism. Morality can begin to claim objectivity because this collection of basic human goods is not subjective, that is, subject to cultural differences or individual whims.

The ultimate good, the human flourishing of ourselves and of others, should function as a prescriptive guidepost of enduring value, serving as a basis for crafting laws, developing social institutions, or regulating the Internet. Because this moral ideal is rather lofty, its application to policy making can be difficult. As a result, we are also guided by intermediate ethical principles, such as the Golden Rule, which states that "whatever you wish that men would do to you, do so to them" (Matthew 7:12). Similarly one could be guided by Kant's second version of the categorical imperative: "Act so that you treat humanity always as an end and never as a means."[8] From these principles one can derive more *specific core moral values* about murder, theft, or lying. These principles can function as more practical guidelines for moral decision making and enable us to pursue the basic human goods in a way that respects our fellow humanity. According to Finnis, our fundamental responsibility is to respect each of these human goods "in each person whose well-being we choose to affect."[9]

We contend, therefore, that these intelligible goods, intrinsic to human persons and essential for human flourishing, along with basic moral principles (such as the Golden Rule) should play an architectonic or *directive role* in the regulation of cyberspace. They should guide and direct the ways in which code, laws, the market, and social norms exercise their regulatory power. The value of human flourishing is the ultimate constraint on our behavior in real space and in cyberspace. Accordingly, we have enhanced Lessig's model as depicted in Figure 1-1.

To illustrate our point about the role of these supreme ethical values and how they can be translated into the actual world of our experience, let us consider the regulatory impact of code. There are responsible and irresponsible ways of developing code that constrains behavior. As we will see in Chapter 3, blocking software systems have become a common way of protecting young children from pornography. Those who write this code have developed proprietary blocking criteria and as a rule they do not reveal these criteria or the specific sites that are blocked. In some cases sex education or health-related sites are filtered out along with the pornography. If this is done inadvertently, the software should be fixed; if it is done deliberately, parents should be informed that the scope of the filtering mechanism is broader than just pornography. One could certainly make the case that parents should know what the blocking criteria are in order to make an informed judgement about the suitability of this software. Failure to reveal this information is tantamount to disrespecting parental autonomy.

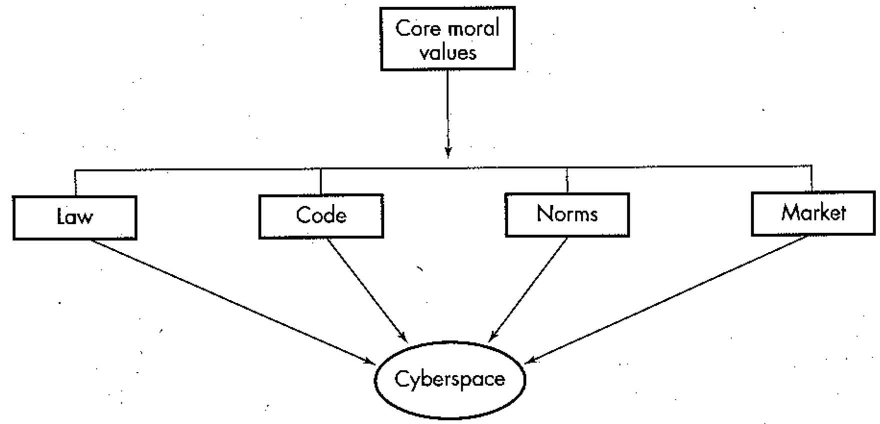


FIGURE 1-1 Constraints on cyberspace activities. (Adapted from Professor Lessig's Framework.)

As a result, one could argue that when the criteria are obscured for some ulterior agenda, the code is not being deployed in a responsible manner that is consistent with the core good of autonomy.

I am not suggesting that this is a clear-cut matter or that moral principles can provide all the answers to proper cyberspace regulations. And I am not making a judgment about whether law or code is the more effective constraint for cyberporn. I am simply claiming that those who write these programs or formulate laws to regulate cyberspace should rely on ethics as a guide. Code writers must be responsible and prudent enough to incorporate into the new architectures of cyberspace structures that preserve basic moral values such as autonomy and privacy. Further, government regulations of cyberspace must not yield to temptation to impose excessive controls. Regulators too must be guided by high moral standards and respect for basic human values such as freedom and privacy. The code itself is a powerful sovereign force and unless it is developed and regulated appropriately it will surely threaten the preservation of those values.

The role of morality should now be quite evident: it must be the ultimate regulator of cyberspace that sets the boundaries for activities and policies. It should direct and harmonize the forces of law, code, the market, and social norms so that interactions and dealings there will be measured, fair, and just.

Iron Cage or Gateway to Utopia?

Although most of us agree that some constraints will need to be imposed on the technologies of networking and computing that have come to pervade the home and workplace, there is legitimate skepticism about anyone's ability to control the ultimate evolution and effects of these technologies. Are our attempts to regulate cyberspace merely a chimera? Are we too trammeled by the forces of technology, or are we still capable of exercising sovereignty over the code that constitutes the inner workings of the Internet?

As we observed in the preface, some philosophers have long regarded technology as a dark and oppressive force that menaces our individuality and authenticity. These technology determinists see technology as an independent and dehumanizing force beyond humanity's capacity to control it. The French philosopher Jacques Ellul presents a disturbing vision of technology in his seminal work, *The Technological Society*. His central argument is that *technique* has become a dominant and untranscendable human value. He defines 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."[10] According to Ellul, technique is beyond our control; it has become autonomous and "fashioned an omnivorous world which obeys its own laws and which has renounced all tradition."[11] For Ellul, modern technology has irreversibly shaped the way we live, work, and interact in this world.

Ellul was not alone in advancing such a pessimistic outlook on technology. Max Weber coined the term *iron cage* to connote how technology locks us in to certain ways of being or patterns of behavior. And Martin Heidegger saw technology not merely as a tool that we can manipulate but as a way of "being in the world" that deeply affects how we relate to that world. But is it really so that technology forces us into this "iron cage," and into a more fragmented, narrow-minded society dominated by a crude instrumental rationality?

In contrast to the bleak outlook of Ellul and Heidegger we find technology neutralists who argue that technology is a neutral force, completely dependent on human aims and objectives. According to this viewpoint, technologies are free of bias and do not promote one type of behavior over another. Technology *is* only a tool, and it does not compromise our human freedom or determine our destiny in any appreciable way—it is up to us whether this powerful force is used for good or ill purposes.

Some go even further and embrace a sort of "technological utopianism" that regards certain technologies as making possible an ideal world with improved lifestyles and workplaces. This optimistic philosophy assumes that humanity can eradicate many of technology's adverse effects and manipulate this tool effectively to improve the human condition.

The philosophy of technological neutralism (or, for that matter, utopianism) seems problematic for several reasons. Technology does condition our choices with certain "givens" that are virtually impossible to fully overcome. Langdon Winner describes this as a process of reverse adaptation or

"the adjustment of human ends to match the character of the available means."[12]

However, in our view, it is also an exaggeration to claim that computer and network technology locks us into a virtual but inescapable iron cage. The middle ground between these extreme positions is *technological realism*, which holds that "although technology has a force of its own, it is not independent of political and social forces."[13] Technological realism acknowledges that technology has reconfigured our political and social reality and that it does influence human behavior in particular ways. To some extent, this notion is echoed in Lessig's work. He argues that we fail to see sometimes how code is an instrument of social and political control. Code is not neutral. Most often, embedded within code are certain value decisions that define the set of options for policy problems.

Nonetheless, although technology determines to some degree how we live and work, we still have the capacity to redirect or subdue it when necessary. In effect, we can still shape and dictate how certain technological innovations will be deployed and restrained, particularly when there is a conflict with the common good or core human goods. Our human freedom is undoubtedly attenuated by technology's might and its atomizing tendencies, but it is not completely effaced. We can still choose to implement systems and develop code in ways that protect fundamental human rights such as autonomy or privacy. We can be liberated from the thralldom of privacy-invading code by developing new code that enhances privacy.

In this postmodern age such a position may also seem simplistic and outdated. Although social psychologists talk about the "social construction of the self" and French psychoanalysts like Jacques Lacan refer to the unconscious as the controlling center of the self, we still presume that beneath it all is a conscious, thinking self or moral agent responsible for its actions *and* responsible for making choices about the deployment of various technologies.

Beyond any doubt, technology and its counterpart instrumental rationality are dominant forces in this society that exert enormous pressures on us to make choices and behave in certain ways. But as Charles Taylor points out, one can find throughout history pockets of concerted opposition to oppressive technologies. Further, the chances for such successful resistance are greatly enhanced when there is some common understanding about a particular threat or imperilment, such as the threat to our ecology that occupied us during the 1970s. Perhaps the same common consciousness will emerge about the threat to personal privacy, and this will provide yet another impetus for human choice to trump the dominating forces of information technology. Although we should not be overly optimistic about our freedom and our capacity for resisting infatuation with new technology, we must recognize that we still have *some* degree of freedom in this world. Thus, we agree with Taylor's assessment: "We are not, indeed, locked in. But there is a slope, an incline in things that is all too easy to slide down."[14]

How then do we avoid this fatal slide? This brings us to our next topic of discussion in this introduction—the importance of cultivating and sustaining a moral point of view as one deliberates about how to constrain behavior on the Internet through market forces, code, norms, or law.

Ethical Values and the Digital Frontier

We avoid this slide and its accompanying perils only if we conscientiously adopt the moral point of view as we evaluate technological capabilities and make decisions about the ground rules of the digital frontier. How can we characterize this moral point of view? According to Kenneth Goodpaster, it can be seen "as a mental and emotional standpoint from which all persons have a special dignity or worth, from which the Golden Rule derives its worth, and from which words like *ought* and *duty* derive their meaning."[15] This is quite consistent with our earlier claim that the fundamental moral imperative is the promotion of human flourishing both in ourselves and in others.

Several distinct types of ethical reasoning have been associated with the moral point of view, and they provide us with the basic principles that serve as a moral yardstick or "compass" that can assist us in making normative judgements. Our discussion here is concise; for the interested reader it can certainly be amplified by many other books on ethical theory or on applied ethics.[16] We consider several models of ethical reasoning based on moral frameworks emphasizing the maximization of social utility, natural rights, contract rights, and moral duties.

The fact that there are several different theories embodying the moral point of view does not contradict our assumption regarding the core human goods that form the basis of a unifying moral framework. All of these theories recognize such goods in one form or another. Kant embraces the principle that we must respect humanity in all our choices and actions, although he might define *humanity* differently from Finnis. And rights-based theories discuss core human goods in terms of protection of human rights such as the rights to life, liberty, and the pursuit of happiness. The utilitarian approach emphasizes happiness and, although it may have a hard time standing on its own, it can be complemented by other theories to form a more comprehensive framework.

All of these theories are worth our careful consideration. Each represents a valuable perspective from which complex moral issues can be assessed and reflected upon. They help us to engage in the critical moral analysis necessitated by the thorny dilemmas that are beginning to surface all over the Internet.

Before we discuss these theories, it is worth pointing out that modern ethical frameworks fall under two broad categories: teleological or deontological. *Teleological* derives from the Greek *telos*, which means *goal* or *end*. These theories argue that the rightness or wrongness of an action depends on whether or not they bring about the end in question (such as happiness). *Deontological* theories, on the other hand, consider actions to be intrinsically right or wrong—their rightness or wrongness does not depend in any way on the consequences which they effect. These frameworks emphasize duty and obligation (*deon* is the Greek word for *duty*).

Utilitarianism

Utilitarianism is a teleological theory, and it is by far the most popular version of consequentialism. Classic utilitarianism was developed by two British philosophers, Jeremy Bentham 1748–1832 and John Stuart Mill 1806–1873. According to this theory, the right course of action is to promote the general good. This general good can also be described in terms of "utility," and this principle of utility is the foundation of morality and the ultimate criterion of right and wrong. *Utility* refers to the net benefits (or good) created by an action. According to Frankena, utilitarianism is the view that "the sole ultimate standard of right, wrong and obligation is the *principle of utility* or *beneficence*, which says quite strictly that the moral end to be sought in all that we do is *the greatest possible balance of good over evil* (or the least possible balance of evil over good)."[17] Thus, an action or policy is right if it produces the greatest net benefits or the lowest net costs (assuming that all of the alternatives impose some net cost).

It should be emphasized that utilitarianism is quite different from ethical egoism. An action is right not if it produces utility for the person performing that action but for all parties affected by the action. With this in mind we might reformulate the moral principle of utilitarianism as follows: persons ought to act in a way that promotes the maximum net expectable utility, that is, the greatest net benefits or the lowest net costs, for the broadest community affected by their actions.

On a practical level, utilitarianism requires us to make moral decisions by means of a rational, objective cost/benefit analysis. In most ethical dilemmas there are several possible alternatives or courses of action. Once one has sorted out the most viable and sensible alternatives, each one is evaluated in terms of its costs and benefits (both direct and indirect). Based on this analysis, one chooses the alternative that produces the greatest net expectable utility, that is, the one with the greatest net benefits (or the lowest net costs) for the widest community affected by that alternative.

A concrete example illustrates how cost/benefit analysis might work. Let us assume that a corporation has to make a policy decision about random inspection of employee e-mail. This might be done as a routine part of a performance review as a means of checking to make sure that workers are using e-mail only for work-related purposes and are not involved in any untoward activities. This practice is perfectly legal, but some managers wonder if it's really the right thing to do; it seems to violate the privacy rights of employees. Rightness in the utilitarian ethical model is determined by consequences that become transparent in a cost-benefit analysis. In this case, the managers might face three options: e-mail messages are not inspected on a routine basis and are kept confidential (unless some sort of malfeasance or criminal activity is suspected); e-mail messages are inspected regularly by managers, but employees are informed of this policy and reminded of it every time they log in to the e-mail system, so that there is no expectation of privacy; or e-mail is regularly but surreptitiously perused by managers with employees uninformed of the company policy. Which of these alternatives promotes the general good, that is, produces the greatest net expectable utility?

Table 1-1 provides an idea of how this analysis might work out. It becomes clear from this exercise that it's difficult to objectively calculate the diffuse consequences of our actions or policies and to weight them appropriately. And herein lies a major obstacle in using this approach. Nonetheless, there is value in performing this type of analysis; it induces us to consider the broad consequences of our actions and to take into account the human as well as the economic costs of implementing various technologies.

Although this theory does have certain strengths it is also seriously flawed in some ways. Depending on the context, utilitarianism could be used to justify the infliction of pain on a small number of individuals for the sake of the happiness or benefits of the majority. There are no intrinsically unjust or immoral acts for the utilitarian, and this poses a problem. What happens when human rights conflict with utility? Can those rights be suppressed on occasion for the general good? There is nothing in utilitarianism to prevent this from happening, as long as a cogent and objective case is made that the benefits of doing so exceeds the costs. The primary problem then is that this theory lacks the proper sensitivity to the vital ideals of justice and human rights.

Contract Rights (Contractarianism)

Another mode of reasoning that exemplifies the moral point of view is rights-based analysis, which is sometimes called *contractarianism*. Unlike utilitarianism, contractarianism is a deontologic theory. It looks at moral issues from the viewpoint of the human rights that may be at stake. A *right* is an entitlement or a claim to something. For instance, thanks to the Fourth Amendment, American citizens are entitled to protection from unwarranted search and seizures in the privacy of their homes. In contrast to the utilitarian view, the consequences of an action are morally irrelevant for those who support contractarianism. Rights are unequivocally enjoyed by

	Costs	Benefits
1. Confidential e-mail	Lack of control over employees; difficult to prevent misuses of e-mail; e-mail could be used for various personal reasons without company knowledge.	Maintains morale and an environment of trust and respect for workers; protects personal privacy rights.
2. Inspect e-mail with employees informed of policy	Violates privacy rights; diminishes trust and impairs morale; workers less likely to use e-mail if communications are not confidential—instead they will rely on less efficient modes of communication.	Prevent misuse along with inappropriate comments about superiors and fellow workers via e-mail; workers know the risks of using e-mail; they are less likely to use e-mail for personal purposes.
3. Inspect surreptitiously	Same as option 2, but even more loss of trust and morale if company policy is uncovered.	Better chance to catch employees doing something wrong such as transmitting trade secrets; perfectly legal.

TABLE 1-1 Illustrative Cost/Benefit Analysis

all citizens, and the rights of the minority cannot be suspended or abolished even if that abolition will maximize social welfare.

An important distinction needs to be made between positive and negative rights. Possession of a *negative right* implies that one is free from external interference in one's affairs. Examples of negative rights include the right to free speech, the right to property, and the right to privacy. Because all citizens have a right to privacy in their homes, the state cannot interfere in their affairs by tapping their phone calls unless it has demonstrated a strong probability that laws are being broken.

A *positive right*, on the other hand, implies a requirement that the holder of this right be provided with whatever one needs to pursue one's legitimate interests. The rights to medical care and education are examples of positive rights. In the United States the right to universal health care is rather dubious but the right to education is unequivocal. Therefore the state has a duty to educate children through the twelfth grade. If everyone had a "right" to Internet access, there would be a correlative duty on the part of the government to provide that access for those who could not afford it.

Rights can be philosophically grounded in several ways. Some traditional philosophers such as Locke and Rousseau and the contemporary social philosopher John Rawls claim that we have basic rights by virtue of an implicit social contract between the individual and civil society. Individuals agree to a contract outside of the organized civil society that stipulates the fundamental principles of their association including their rights and duties. Rights are one side of a quid pro quo—we are guaranteed certain rights (e.g., life, liberty, and the pursuit of happiness) as long as we obey the laws and regulations of civil society. This contract is not real but hypothetical. According to Kelbley, "we are not discussing facts but an ideal which rational individuals can embrace as a standard to measure the moral nature of social institutions and efforts at reform."[18]

According to this perspective, moral reasoning should be governed by respect for these individual rights and by a philosophy of fairness. As Ken Goodpaster observes, "fairness is explained as a condition that prevails when all individuals are accorded equal respect as participants in social arrangements."[19] In short, then, this rights-based approach to ethics focuses on the need to respect an individual's legal, moral, and contractual rights as the basis of justice and fairness.

The problem with most rights-based theories is that they do not provide adequate criteria for resolving practical disputes when rights are in conflict. For example, those who send spam (unsolicited commercial e-mail) over the Internet claim that they are exercising their right to free speech, but many recipients argue that spam is intrusive, maybe even a form of trespass. Hence they claim that the transmission of spam is an invasion of their property rights. The real difficulty is how we adjudicate this conflict and determine which right takes priority. Rights-based theories are not always helpful in making this determination.

Moral Duty (Pluralism)

The next framework for consideration is not based on rights, but on duty. The moral philosophy of Immanuel Kant (1724–1804), which can be found in his short but difficult masterpiece on ethics, *Fundamental Principles of the Metaphysics of Morals*, is representative of this approach. It assumes that the moral point of view is best expressed by discerning and carrying out one's moral duty. This duty-based, deontological ethical framework is sometimes referred to as *pluralism*.

Kant believed that consequences of an action are morally irrelevant: "an action performed from duty does not have its moral worth in the purpose which is to be achieved through it but in the maxim by which it is determined."[20] According to Kant, actions only have moral worth when they are done for the sake of duty. But what is our duty and how is it derived? In Kant's systematic philosophy our moral duty is simple: to follow the moral law which, like the laws of science or physics, must be rational. Also, like all rational laws, the moral law must be universal, because, universality represents the common character of rationality and law. And this universal moral law is expressed as the categorical imperative: "I should never act except in such a way that I can also will that my maxim should become a universal law."[21] The imperative is "categorical" because it does not allow for any exceptions.

A *maxim* as referred to in Kant's categorical imperative is an implied general principle or rule underlying a particular action. If, for example, I usually break my promises, then I act according to the private maxim that promise breaking is morally acceptable when it is in my best interests to do so. But can one take this maxim and transform it into a universal moral law? As a universal law this particular maxim would be expressed as follows: "It is permissible for everyone to break promises when it is in their best interests to do so." Such a law, however, is invalid because it entails both a pragmatic and a logical contradiction. There is a pragmatic (or practical) contradiction because the maxim is self-defeating if it is universalized. According to Korsgaard, "your action would become ineffectual for the achievement of your purpose if everyone (tried to) use it for that purpose."[22] Consider this example. An individual borrows some money from a friend and he promises to pay her back. However, he has no intention of keeping that promise. But this objective, that is, getting some money from her without repaying it, cannot be achieved by making a false promise in a world where this maxim has been universalized. As Korsgaard puts it, "The efficacy of the false promise as a means of securing money depends on the fact that not everyone uses promises that way."[23]

Universal promise breaking also implies a logical contradiction (like a square circle); if everyone broke promises, the entire institution of promising would collapse; there would be no such thing as a "promise" because in such a climate anyone making a promise would lack credibility. A world of universalized promise breaking is inconceivable. Thus, in view of the contradictions involved in universalizing promise breaking, we have a perfect duty to keep all of our promises.

Kant strongly implies that *perfect duties*, that is, duties that we are always obliged to follow such as telling the truth or keeping a promise, entail both a logical and pragmatic contradiction. Violations of imperfect duties, however, are pragmatic contradictions. Korsgaard explains that "perfect duties of virtue arise because we must refrain from particular actions *against* humanity in our own person or that of another."[24] *Imperfect duties*, on the other hand, are duties to develop one's talents where the individual has the latitude to fulfill this duty using many different means.

Kant's categorical imperative is his ultimate ethical principle. It is the acid test of whether an action is right or wrong. According to Kant, then, any self-contradictory universalized maxims are morally forbidden. The categorical imperative functions as a guide, a "moral compass" that gives us a reliable way of determining a correct and consistent course of action. According to Norman Bowie, "the test of the categorical imperative becomes a principle of fair play—one of the essential features of fair play is that one should not make an exception of oneself."[25]

Also, from the categorical imperative we can derive other duties such as the duty to keep contracts, to tell the truth, to avoid injury to others, and so forth. Kant would maintain that each of these duties is also categorical, admitting of no exceptions, because the maxim underlying such an exception cannot be universalized.

How might we apply Kant's theory to the mundane ethical problems that arise in cyberspace? Consider the issue of intellectual property. As Korsgaard observes, "property is a practice,"[26] and this practice arguably makes sense for both physical property as well as intellectual property. But a maxim that permitted stealing of such property would be self-defeating. That maxim would say, "It's acceptable for me to steal the intellectual property validly owned by the creators or producers of that property." Such a universalized maxim, permitting everyone to take this intellectual property, is self-defeating precisely because it leads to the destruction of the entire "practice" of intellectual property protection. Because the maxim allowing an individual to freely appropriate another's intellectual property does not pass the universalization test, a moral agent is acting immorally when he or she engages in acts such as the unauthorized copying of a digital movie or music file.[27]

At the heart of Kant's ethical system is the notion that there are rational constraints on what we can do. We may want to engage in some action (such as downloading copyrighted files) but we are inconsistent and hence unethical unless we accept the implications of everyone doing the same thing. According to Kant, it is unethical to make arbitrary exceptions for ourselves. In the simplest terms, the categorical imperative suggests the following question: What if everybody did what you are doing?

Before concluding this discussion on Kant it is worth restating his second formulation of the categorical imperative: "Act in such a way that you treat humanity, whether in your own person or in the person of another, always at the same time as an end and never simply as a means."[28] For Kant as well as for other moralists (such as Finnis), the principle of humanity as an end in itself serves as a limiting condition of every person's freedom of action. We cannot exploit other human beings and treat them exclusively as a means to our ends or purposes. This could happen, for example, through actions that deceive one's fellow human beings or actions that force them to do things against their will. According to Korsgaard,

> According to [Kant's] Formula of Humanity, coercion and deception are the most fundamental forms of wrongdoing to others—the roots of all evil. Coercion and deception violate the conditions of possible assent, and all actions which depend for their nature and efficacy on their coercive or deceptive character are ones that others cannot assent to. . . . Physical coercion treats someone's person as a tool; lying treats someone's reason as a tool.[29]

If we follow this categorical imperative we will make sure that our projects and objectives do not supercede the worth of other human beings. This principle can also be summed up in the notion of *respect*. One way to express universal morality is in terms of the general principle of respect for other human beings, who deserve that respect because of their dignity as free and rational persons.

One of the problems with Kant's moral philosophy is its rigidity. There are no exceptions to the moral laws derived from the absolute categorical imperative. Hence lying is *always* wrong even though we can envision situations where telling a lie (e.g., to save a human life) is a reasonable and proper course of action. In cases like this there is a conflict of moral laws: the law to tell the truth and the law to save a life in jeopardy, and we have no alternative but to admit an exception to one of them. As A. C. Ewing points out,

> In cases where two laws conflict it is hard to see how we can rationally decide between them except by considering the goodness or badness of the consequences. However important it is to tell the truth and however evil to lie, there are surely cases where much greater evils can still be averted by a lie, and is lying wrong then?[30]

Ewing's argument that it is difficult to avoid an appeal to consequences when two laws conflict poses problems for Kant's moral philosophy, despite its powerful appeal.

An alternative duty-based philosophy proposed by William D. Ross (1877–1940), a contemporary English philosopher, attempts to obviate the difficulties posed by Kant's inflexibility. Ross argues in his book *The Right and the Good*[31] that we are obliged to follow several basic *prima facie* duties that each of us can intuit through simple reflection. These duties are *prima facie* in the sense that they are conditional and not absolute. This means that under normal circumstances we must follow a particular duty, but in those unusual situations where duties conflict with one another, one duty may be overridden by another duty that is judged to be superior, at least under these specific circumstances. According to Ross, moral rules or principles are not categorical as they are for Kant, so they can have exceptions. Thus, a moral principle can be sacrificed or overridden, but only for another moral principle, not just for arbitrary, selfish, or even utilitarian reasons.

According to Ross, the seven *prima facie* moral duties that are binding on all moral agents are the following:

1. One ought to keep promises and tell the truth (*fidelity*);
2. One ought to right the wrongs that one has inflicted on others (*reparation*);
3. One ought to distribute goods justly (*justice*)
4. One ought to improve the lot of others with respect to virtue, intelligence, and happiness (*beneficence*);

5. One ought to improve oneself with respect to virtue and intelligence (*self-improvement*);
6. One ought to exhibit gratitude when appropriate (*gratitude*); and
7. One ought to avoid injury to others (*noninjury*).

Ross makes little effort to provide any substantial rationalization or theoretical grounding of these duties. We might just say that they are common rules of morality, obvious to all rational humans because they have the general effect of reducing harm or evil to others.

The Achilles' heel of Ross's theory can be isolated by examining two specific problems: (1) his list of duties seems arbitrary because it is not metaphysically or even philosophically grounded, and (2) the list seems incomplete—where, for example, is the duty not to steal property from another? It may be included under the duty to avoid injury to others, but that is not altogether clear. Moreover, is it really true that all human beings (even those in different cultures) simply "intuit" these same principles? Finally, *The Right and the Good* provides little help for resolving situations where two prima facie duties do conflict. Ross offers few concrete criteria for determining when one obligation is more stringent and compelling than another.

Despite these shortcomings, however, Ross's framework, like the others we have considered, is not without some merit. A focus on one's moral duty (or even conflicting duties) in a particular situation is a worthy starting point for moral reasoning about some dilemma or quandry. Further, for many moral conundrums, a sincere and rational person can develop sound, objective reasons for determining which duty should take priority.

New Natural Law

The natural law tradition has been neglected in most books on business and computer ethics. Detractors claim that it's too "impractical" and too closely associated with the theistic philosophy of St. Thomas Aquinas. MacIntyre, however, makes the case that the natural law ethic is superior to the "theories of those imprisoned within modernity [that] can provide only ideological rationalizations [such as] modern consequentialism and modern contractarianism."[32]

The new natural law, developed by John Finnis and Germain Grisez, remains faithful to the broad lines of natural law theory found in the philosophy of Aquinas. But it also attempts to make some necessary modifications demanded by the complexity of contemporary moral problems. Like Aquinas, Finnis and Grisez claim that the starting point of moral reflection is the first practical principle: "Good should be done and evil avoided," where *good* means what is intelligibly worthwhile. For the most part, human beings behave rationally and pursue what is good for them, what perfects their nature and makes them better off. But what is the good? Recall Finnis' argument that there are seven basic human goods that are the key to human flourishing: life and health, knowledge of the truth, play (and some forms of work), aesthetic experience, sociability (including friendship and marriage), religion, and practical reasonableness. All of our choices ultimately point to one of these intelligible goods. For example, if someone asks Paul why he plays golf so much he could answer that he enjoys the game or that he likes the exercise. The first answer points to the basic human good of play and the second to the good of health.

Each one of us participates in these basic goods, though we may participate in some goods more than others, and we do so to achieve "fullness of life." Practical reasonableness, which includes the value of authenticity, shapes one's participation in the other basic goods. And one requirement of practical reasonableness is that it is unreasonable to choose directly against any basic value, "whether in oneself or in one's fellow human beings."[33]

But how do we get from these basic human goods to specific moral norms and human rights? Our practical reason grasps that each of these basic human goods is an aspect of human flourishing and that a good in which any person shares also fulfills other persons. Whenever one intentionally destroys, impedes, or damages one of these goods which should be allowed to be, there is moral evil. Thus, we can stipulate the First Principle of Morality: *keep one's choices open to integral human fulfillment*, the fulfillment of all persons and communities.[34]

This principle, however, is too general and so we also need intermediate principles to specify the primary moral principle. Grisez calls these *modes of responsibility*, which include the Golden Rule (or the universalizability principle), "for a will marked by egoism or partiality cannot be open to integral human fulfillment."[35] These modes also include the imperative to avoid acting out of hostility or vengeance and never to choose evil as the means to a good end. The good or the end of my actions does not justify the use of unjust means that damage a basic good. According to this principle, for example, one could not justify telling a lie that damages the truth to advance a friendship. In this case, one is exercising favoritism with regard to these goods, which are incommensurable and all deserving of the same respect.

Specific moral norms can be deduced from those basic human goods with the help of the intermediate principles such as the Golden Rule. For example, because human life is a basic human good, certain acts such as the taking of innocent life are forbidden as a matter of natural law. Finnis states this natural law (or absolute moral norm) as follows: "every act which is intended, whether as end or means, to kill an innocent human being and every act done by a private person which is intended to kill any human being" is prohibited.[36] This precludes necessary acts of self-defense. And from the basic good of knowledge of the truth, we can we can deduce the moral imperative of veracity and "the right not to be positively lied to in any situation in which factual communication is reasonably expected."[37]

The new natural law provides a different vantage point from which to judge ethical conundrums in cyberspace. The value of this approach is its unwavering fidelity to the role of basic human goods such as life, health, and knowledge of the truth. It compels us to consider whether certain policies or actions are consistent with human flourishing, that is, with the realization of these basic human goods identified by Finnis and Grisez. It is difficult to argue, for instance, that deceptive spamming has any moral legitimacy; by undermining the truth in factual Internet communications, this form of spam deserves to be classified as morally reprehensible. The natural law framework allows us to appreciate why this is so wrong by focusing on its true negative impact.

Although Finnis and Grisez have tried to disengage the natural law framework from the metaphysics of Aquinas, critics claim that they do not succeed. According to Lisska, "One intuits the basic goods and it just happens that set of goods correspond to human well being. But what establishes the causal relationship?"[38] Nonetheless, according to Grisez, this theory attempts to combine the strengths of teleology and deontology. It grounds morality in human goods, "the goods of real people living in the world of experience," and it protects each person's dignity with intermediate principles and moral absolutes.[39]

Postscript on Moral Theory

As we have seen, none of these theories are without flaws or contradictions, but they do represent viable avenues for reasoning about moral issues, especially when those issues go beyond the level of moral common sense. They also have certain elements in common, particularly an orientation to "the other"—along with the need to consider the interests and perspectives of the affected parties in assessing alternative action plans, the other's moral and legal rights, and our duty to treat the other as an end and not as a means. And they all stand in opposition to the dangerous and myopic philosophy of ethical egoism, which is blind to the rights and aspirations of others.

Before concluding this material on ethical theory we can summarize how they can be applied to some of the moral quandaries that arise in the electronic frontier of cyberspace. Table 1-2 provides a concise framework for putting these four basic theories into action.

In some cases these four frameworks converge on the same solution to an ethical quandry. At other times, they suggest different solutions to the

Theory Type	Operative Questions
Consequentialism/utilitarianism	Which action or policy generates the best overall consequences or the greatest net expectable utility for all affected parties?
Duty-based morality	Can the maxim underlying the course of action being considered be universalized? Is the principle of fair play being violated? If there appears to be conflicting duties which is the stronger duty?
Rights-based morality	Which action or policy best protects the human and legal rights of the individuals involved?
New natural law	Does the proposed action or policy promote the basic requirements of human flourishing? Does it impede, damage, or destroy basic human goods?

TABLE 1-2 Summary of Ethical Frameworks

problem and one must decide which framework should "trump" or override the others. Should one respect the rights of some group or individual, even though following that alternative will be less beneficial to all affected parties than other alternatives? Resolving such questions requires careful and objective reasoning, but responsible behavior sometimes requires that this extra step be taken. To be sure, the Internet presents unique ethical challenges that could never have been envisioned by Aquinas, Kant, or Mill, but these frameworks still provide a general way of coming to terms with these tough questions.

Normative Principles

For those who find ethical theory too abstract, they can turn to an approach known as *principilism.* It is commonly used in biomedical ethics and has become popularized through the work of Beauchamp and Childress.[40] These moral principles are derived from and compatible with all of the moral theories articulated here. They constitute *prima facie* duties that are always in force but may conflict on occasion. The four principles proposed by Beauchamp and Childress are autonomy, nonmaleficence, beneficence, and justice. Those who advocate this approach also prescribe certain "prudential requirements" that determine when one prima facie principle should be given more weight than another. These include "being sure that there is a realistic prospect of achieving the moral objective one has chosen to honor; no alternative course of action is possible that would honor both conflicting obligations; and we minimize the effects of infringing on the prima facie duty."[41] A brief sketch of these four principles follows.

Autonomy

Kant and other philosophers have consistently argued that a defining element of personhood is one's capacity to be autonomous or self-determining. According to Gary Doppelt, "the Kantian conception of personhood ties the moral identity of persons to the supreme value of their rational capacities for normative self-determination."[42] All rational persons have two key moral powers or capacities: they possess the ability to develop and revise a rational plan to pursue their conception of the good life, and they possess the capacity to respect this same capacity of self-determination in others. Thus, autonomy is not only a necessary condition of moral responsibility, it is also through the exercise of autonomy that individuals shape their destiny according to their notion of the best sort of life worth living. When someone is deprived of their autonomy, their plans are interfered with and they are not treated with the respect they deserve. Of course, respect for autonomy must be balanced against other moral considerations and claims.

Nonmaleficence

The principle of nonmaleficence can best be summarized in the moral injunction: "above all, do no harm." According to this core principle, one ought to avoid unnecessary harm or injury to others whenever possible. This negative injunction against doing injury to others is sometimes called the "moral minimum." However, one may choose to develop a moral code of conduct, this injunction must be given a preeminent status. Most moral systems go well beyond this minimum requirement, as we have seen in the theories already discussed, but that does not detract from the central importance of this principle. According to Jon Gunneman and his co-authors,

> We know of no societies, from the literature of anthropology or comparative ethics, whose moral codes do not contain some injunction against harming others. The specific notion of *harm* or *social injury* may vary, as well as the mode of correction and restitution but the injunctions are present.[43]

Beneficence

This is a positive duty and has been formulated in may ways. In the simplest terms it means that we should act in such a way that we advance the welfare of other people when we are able to do so. In other words, we have a duty to help others. But what does this really mean? When am I duty bound to help another person or even an institution? It is obvious that we cannot help everyone or intervene in every situation when someone is in need. Hence some criteria are necessary for determining when such a moral obligation arises. In general, it can be argued that we have a duty to help others under the following conditions:

1. the need is serious or urgent;
2. we have knowledge or awareness of the situation; and
3. we have the capability to provide assistance ("ought assumes can" is the operative principle).

If, for instance, one is an Olympic swimmer and sees someone drowning at the beach one has an obligation to attempt a rescue of that person, especially if this is the only recourse and there is little risk to one's own life. This principle has some relevance when we evaluate society's questionable duty of beneficence to provide universal Internet service.

Justice

Although theories of justice have their differences most have in common adherence to this basic formal principle: "Similar cases ought to be treated in similar ways." Above all else justice requires fair treatment and impartiality. This is a formal procedural principle of justice and needs to be supplemented by the criteria for determining "similar" cases. This leads into theories of distributive justice, which attempt to formulate an underlying principle for how we should distribute the benefits and burdens of social life. Some theories emphasize equality, that is, all goods should be distributed equally. John Rawls, for example, adopts an egalitarian approach, though he does argue that an unequal distribution of goods is acceptable when it works for the advantage of everyone especially the least advantaged (the difference principle).[44] Other theories emphasize contribution and effort as formulated in this maxim: Benefits or resources should be distributed according to the contribution each individual makes to the furtherance of society's goals. And still another theory of justice that has typically been associated with socialism argues for justice based on need: "From each according to his ability, to each according to his needs."[45]

Our purpose here is not to defend one of these theories against the other, but to illustrate that moral judgements should be based in part on the formal principle of justice and take into account some standard regarding how the benefits and burdens should be fairly distributed within a group or society at large.

There is no reason that these formal moral principles cannot be applied to some of the controversial problems that we consider in this book. They are certainly general enough to have applicability in the field of computer and Internet ethics as well as bioethics. A person who makes choices and develops policies attentive to the core human goods and to these more practical principles which generally promote those goods would surely be acting with the care and prudence that is consistent with the moral point of view.

Discussion Questions

1. Do you agree with the philosophy of technological realism?
2. Explain the basic elements of Lessig's framework. What does he mean when he says that in cyberspace "the code is the law"?
3. Explain and critically analyze the essentials of Kant's moral theory.
4. In your estimation, which of the moral frameworks presented in this chapter has the most promise for dealing with the moral dilemmas that arise in cyberspace?

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Are Computer Hacker Break-ins Ethical?*

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Abstract

Recent incidents of unauthorized computer intrusion have brought about discussion of the ethics of breaking into computers. Some individuals have argued that as long as no significant damage results, break-ins may serve a useful purpose. Others counter with the expression that the break-ins are almost always harmful and wrong.

This article lists and refutes many of the reasons given to justify computer intrusions. It is the author's contention that break-ins are ethical only in extreme situations, such as a life-critical emergency. The article also discusses why no break-in is "harmless."

1 Introduction

On November 2, 1988, a program was run on the Internet that replicated itself on thousands of machines, often loading them to the point where they were unable to process normal requests. [1, 2, 3] This *Internet Worm* program was stopped in a matter of hours, but the controversy engendered by its release raged for years. Other recent incidents, such as the "wily hackers"[1] tracked by Cliff Stoll [4], the "Legion of Doom" members who are alleged to have stolen telephone company 911 software [5], and the growth of the computer virus problem [6, 7, 8, 9] have added to the discussion. What constitutes improper access to computers? Are some break-ins ethical? Is there such a thing as a "moral hacker"?[10]

It is important that we discuss these issues. The continuing evolution of our technological base and our increasing reliance on computers for critical tasks suggests that future incidents may well

[1] I realize that many law-abiding individuals consider themselves *hackers* — a term formerly used as a compliment. The press and general public have co-opted the term, however, and it is now commonly viewed as a pejorative. Here, I will use the word as the general public now uses it.

have more serious consequences than those we have seen to date. With human nature as varied and extreme as it is, and with the technology as available as it is, we must expect to experience more of these incidents.

In this article, I will introduce a few of the major issues that these incidents have raised, and present some arguments related to them. For clarification, I have separated a few issues that often have been combined when debated; it is possible that most people are in agreement on some of these points once they are viewed as individual issues.

2 What is Ethical?

Webster's Collegiate Dictionary defines ethics as: "The discipline dealing with what is good and bad and with moral duty and obligation." More simply, it is the study of what is *right* to do in a given situation—what we *ought* to do. Alternatively, it is sometimes described as the study of what is *good* and how to achieve that good. To suggest whether an act is right or wrong, we need to agree on an ethical system that is easy to understand and apply as we consider the ethics of computer break-ins.

Philosophers have been trying for thousands of years to define right and wrong, and I will not make yet another attempt at such a definition. Instead, I will suggest that we make the simplifying assumption that we can judge the ethical nature of an act by applying a deontological assessment: regardless of the effect, is the act itself ethical? Would we view that act as sensible and proper if **everyone** were to engage in it? Although this may be too simplistic a model (and it can certainly be argued that other ethical philosophies may also be applied), it is a good first approximation for purposes of discussion. If you are unfamiliar with any other formal ethical evaluation method, try applying this assessment to the points I raise later in this paper. If the results are obviously unpleasant or dangerous in the large, then they should be considered unethical as individual acts.

Note that this philosophy assumes that *right* is determined by actions and not by results. Some ethical philosophies assume that the ends justify the means; our current society does not operate by such a philosophy, although many individuals do. As a society, we profess to believe that "it isn't whether you win or lose, it's how you play the game." This is why we are concerned with issues of due process and civil rights, even for those espousing repugnant views and committing heinous acts. The process is important no matter the outcome, although the outcome may help to resolve a choice between two almost equal courses of action.

Philosophies that consider the results of an act as the ultimate measure of good are often impossible to apply because of the difficulty in understanding exactly what results from any arbitrary activity. Consider an extreme example: the government orders a hundred cigarette smokers, chosen at random, to be beheaded on live nationwide television. The result might well be that many hundreds of thousands of other smokers would quit "cold turkey," thus prolonging their lives. It might also prevent hundreds of thousands of people from ever starting to smoke, thus improving the health and longevity of the general populace. The health of millions of other people would improve as they would no longer be subjected to secondary smoke, and the overall impact on the environment would be very favorable as tons of air and ground pollutants would no longer be released by smokers or tobacco companies.

Yet, despite the great good this might hold for society, everyone, except for a few extremists, would condemn such an *act* as immoral. We would likely object even if only one person was executed. It would not matter what the law might be on such a matter; we would not feel that the act was morally correct, nor would we view the ends as justifying the means.

Note that we would be unable to judge the morality of such an action by evaluating the results, because we would not know the full scope of those results. Such an act might have effects favorable or otherwise, on issues of law, public health, tobacco use, and daytime TV shows for decades or centuries to follow. A system of ethics that considered primarily only the results of our actions would not allow us to evaluate our current activities at the time when we would need such guidance; if we are unable to discern the appropriate course of action prior to its commission, then our system of ethics is of little or no value to us. To obtain ethical guidance, we must base our actions primarily on evaluations of the actions and not on the possible results.

More to the point of this paper, if we attempt to judge the morality of a computer break-in based on the sum total of all future effect, we would be unable to make such a judgement, either for a specific incident or for the general class of acts. In part, this is because it is so difficult to determine the long-term effects of various actions, and to discern their causes. We cannot know, for instance, if increased security awareness and restrictions are better for society in the long-term, or whether these additional restrictions will result in greater costs and annoyance when using computer systems. We also do not know how many of these changes are directly traceable to incidents of computer break-ins.

One other point should be made here: it is undoubtedly possible to imagine scenarios where a computer break-in would be considered to be the preferable course of action. For instance, if vital medical data were on a computer and necessary to save someone's life in an emergency, but the authorized users of the system cannot be located, breaking into the system might well be considered the right thing to do. However, that action does not make the break-in ethical. Rather, such situations occur when a greater wrong would undoubtedly occur if the unethical act were not committed. Similar reasoning applies to situations such as killing in self-defense. In the following discussion, I will assume that such conflicts are not the root cause of the break-ins; such situations should very rarely present themselves.

3 Motivations

Individuals who break into computer systems or who write *vandalware* usually use one of a few rationalizations for their actions. (See, for example, [11] and the discussion in [12].) Most of these individuals would never think to walk down a street, trying every door to find one unlocked, then search through the drawers of the furniture inside. Yet, these same people seem to give no second thought to making repeated attempts at guessing passwords to accounts they do not own, and once on to a system, browsing through the files on disk.

These computer burglars often present the same reasons for their actions in an attempt to rationalize their activities as morally justified. I present and refute some of the most commonly used ones in what follows; motives involving theft and revenge are not uncommon, and their moral nature is simple to discern, so I shall not include them here.

3.1 The Hacker Ethic

Many hackers argue that they follow an ethic that both guides their behavior and justifies their break-ins. This hacker ethic states, in part, that all information should be free.[10] This view holds that information belongs to everyone, and there should be no boundaries or restraints to prevent anyone from examining information. Richard Stallman states much the same thing in his GNU Manifesto.[13] He and others have further stated in various forums that if information is free, it logically follows that there should be no such thing as intellectual property, and no need for security.

What are the implications and consequences of such a philosophy? First and foremost, it raises some disturbing questions of privacy. If all information is (or should be) free, then privacy is no longer a possibility. For information to be free to everyone, and for individuals to no longer be able to claim it as property, means that anyone may access the information if they please. Furthermore, as it is no longer property of any individual, that means that anyone can alter the information. Items such as bank balances, medical records, credit histories, employment records, and defense information all cease to be controlled. If someone controls information and controls who may access it, the information is obviously not free. But without that control, we would no longer be able to trust the accuracy of the information.

In a perfect world, this lack of privacy and control might not be a cause for concern. However, if all information were to be freely available and modifiable, imagine how much damage and chaos would be caused in our real world by such a philosophy! Our whole society is based on information whose accuracy must be assured. This includes information held by banks and other financial institutions, credit bureaus, medical agencies and professionals, government agencies such as the IRS, law enforcement agencies, and educational institutions. Clearly, treating all their information as "free" would be unethical in any world where there might be careless and unethical individuals.

Economic arguments can be made against this philosophy, too, in addition to the overwhelming need for privacy and control of information accuracy. Information is not universally free. It is held as property because of privacy concerns, and because it is often collected and developed at great expense. Development of a new algorithm or program, or collection of a specialized database, may involve the expenditure of vast sums of time and effort. To claim that it is free or should be free is to express a naive and unrealistic view of the world. To use this as a justification for computer break-ins is clearly unethical. Although not all information currently treated as private or controlled as proprietary needs such protection, that does not justify unauthorized access to it or to any other data.

3.2 The Security Arguments

These arguments are the most common ones within the computer community. One common argument was the same one used most often by people attempting to defend the author of the Internet Worm program in 1988: break-ins illustrate security problems to a community that will otherwise not note the problems.

In the Worm case, one of the first issues to be discussed widely in Internet mailing lists dealt with the intent of the perpetrator — exactly why the worm program had been written and released. Explanations put forth by members of the community ranged from simple accident to the actions of a sociopath. A common explanation was that the Worm was designed to illustrate security defects to a community that would not otherwise pay attention. This was not supported by the testimony during the author's trial, nor is it supported by past experience of system administrators.

The Worm author, Robert T. Morris, appears to have been well-known at some universities and major companies, and his talents were generally respected. Had he merely explained the problems or offered a demonstration to these people, he would have been listened to with considerable attention. The month before he released the Worm program on the Internet, he discovered and disclosed a bug in the file transfer program *ftp*; news of the flaw spread rapidly, and an official fix was announced and available within a matter of weeks. The argument that no one would listen to his report of security weaknesses is clearly fallacious.

In the more general case, this security argument is also without merit. Although some system administrators might have been complacent about the security of their systems before the Worm incident, most computer vendors, managers of government computer installations, and system administrators at major colleges and universities have been attentive to reports of security problems. People wishing to report a problem with the security of a system need not exploit it to report it. By way of analogy, one does not set fire to the neighborhood shopping center to bring attention to a fire hazard in one of the stores, and then try to justify the act by claiming that firemen would otherwise never listen to reports of hazards.

The most general argument that some people make is that the individuals who break into systems are performing a service by exposing security flaws, and thus should be encouraged or even rewarded. This argument is severely flawed in several ways. First, it assumes that there is some compelling need to force users to install security fixes on their systems, and thus *computer burglars* are justified in "breaking and entering" activities. Taken to extremes, it suggests that it would be perfectly acceptable to engage in such activities on a continuing basis, so long as they might expose security flaws. This completely loses sight of the purpose of the computers in the first place — to serve as tools and resources, not as exercises in security. The same reasoning would imply that vigilantes have the right to attempt to break into the homes in my neighborhood on a continuing basis to demonstrate that they are susceptible to burglars.

Another flaw with this argument is that it completely ignores the technical and economic factors that prevent many sites from upgrading or correcting their software. Not every site has the resources to install new system software or to correct existing software. At many sites, the systems are run as turnkey systems — employed as tools and maintained by the vendor. The owners and users of these machines simply do not have the ability to correct or maintain their systems independently, and they are unable to afford custom software support from their vendors. To break into such systems, with or without damage, is effectively to trespass into places of business; to do so in a vigilante effort to force the owners to upgrade their security structure is presumptuous and reprehensible. A burglary is not justified, morally or legally, by an argument that the victim has poor locks and was therefore "asking for it."

A related argument has been made that vendors are responsible for the maintenance of their software, and that such security breaches should immediately require vendors to issue corrections to their customers, past and present. The claim is made that without highly-visible break-ins, vendors will not produce or distribute necessary fixes to software. This attitude is naive, and is neither economically feasible nor technically workable. Certainly, vendors should bear some responsibility for the adequacy of their software,[14] but they should not be responsible for fixing every possible flaw in every possible configuration.

Many sites customize their software or otherwise run systems incompatible with the latest vendor releases. For a vendor to be able to provide quick response to security problems, it would be necessary for each customer to run completely standardized software and hardware mixes to ensure the correctness of vendor-supplied updates. Not only would this be considerably less attractive for many customers and contrary to their usual practice, but the increased cost of such "instant" fix distribution would add to the price of such a system — greatly increasing the cost borne by the customer. It is unreasonable to expect the user community to sacrifice flexibility **and** pay a much higher cost per unit simply for faster corrections to the occasional security breach. That assumes it was even possible for the manufacturer to find those customers and supply them with fixes in a timely manner, something unlikely in a market where machines and software are often repackaged, traded, and resold.

The case of the Internet Worm is a good example of the security argument and its flaws. It further stands as a good example of the conflict between ends and means valuation of ethics. Various people have argued that the Worm's author did us a favor by exposing security flaws. At Mr. Morris's trial on Federal charges stemming from the incident, the defense attorneys also argued that their client should not be punished because of the good the Worm did in exposing those flaws. Others, including the prosecuting attorneys for the government, argued that the act itself was wrong no matter what the outcome. Their contention has been that the result does not justify the act itself, nor does the defense's argument encompass all the consequences of the incident.

This is certainly true; the complete results of the incident are still not known. There have been many other break-ins and network worms since November 1988, perhaps inspired by the media coverage of that incident. More attempts will possibly be made, in part inspired by Mr. Morris's act. Some sites on the Internet have restricted access to their machines, and others were removed from the network; I have heard of sites where a decision has been made not to pursue a connection, even though this will hinder research and operations. Combined with the many decades of person-hours devoted to cleaning up afterwards, this seems to be a high price to pay for a claimed "favor."

The legal consequences of this act are also not yet known. For instance, many bills were introduced into Congress and state legislatures in subsequent years as a (partial) result of these incidents. One piece of legislation introduced into the House of Representatives, HR-5061, entitled "The Computer Virus Eradication Act of 1988," was the first in a series of legislative actions that had the potential to affect significantly the computer profession. In particular, HR-5061 was notable because its wording would have prevented it from being applied to true computer viruses,[2] The passage of similar well-intentioned but poorly-defined legislation could have a major negative effect on the computing profession as a whole.

3.3 The Idle System Argument

Another argument put forth by system hackers is that they are simply making use of idle machines. They argue that because some systems are not used at any level near their capacity, the hacker is somehow entitled to use them.

This argument is also flawed. First of all, these systems are usually not in service to provide a general-purpose user environment. Instead, they are in use in commerce, medicine, public safety, research, and government functions. Unused capacity is present for future needs and sudden surges of activity, not for the support of outside individuals. Imagine if large numbers of people without a computer were to take advantage of a system with idle processor capacity: the system would quickly be overloaded and severely degraded or unavailable for the rightful owners. Once on the system, it would be difficult (or impossible) to oust these individuals if sudden extra capacity was needed by the rightful owners. Even the largest machines available today would not provide sufficient capacity to accommodate such activity on any large scale.

I am unable to think of any other item that someone may buy and maintain, only to have others claim a right to use it when it is idle. For instance, the thought of someone walking up to my expensive car and driving off in it simply because it is not currently being used is ludicrous. Likewise, because I am away at work, it is not proper to hold a party at my house because it is otherwise not being used. The related positions that unused computing capacity is a shared resource, and that my privately-developed software belongs to everyone, are equally silly (and unethical) positions.

3.4 The Student Hacker Argument

Some trespassers claim that they are doing no harm and changing nothing — they are simply learning about how computer systems operate. They argue that computers are expensive, and that they are merely furthering their education in a cost-effective manner. Some authors of computer viruses claim that their creations are intended to be harmless, and that they are simply learning how to write complex programs.

[2] It provided penalties only in cases where **programs** were introduced into computer systems; a computer virus is a segment of code attached to an existing program that modifies other programs to include a copy of itself.[6]

There are many problems with these arguments. First, as an educator, I claim that writing vandalware or breaking into a computer and looking at the files has almost nothing to do with computer education. Proper education in computer science and engineering involves intensive exposure to fundamental aspects of theory, abstraction, and design techniques. Browsing through a system does not expose someone to the broad scope of theory and practice in computing, nor does it provide the critical feedback so important to a good education (cf. [15, 16]). Neither does writing a virus or worm program and releasing it into an unsupervised environment provide any proper educational experience. By analogy, stealing cars and joyriding does not provide one with an education in mechanical engineering, nor does pouring sugar in the gas tank.

Furthermore, individuals "learning" about a system cannot know how everything operates and what results from their activities. Many systems have been damaged accidentally by ignorant (or careless) intruders; most of the damage from computer viruses (and the Internet Worm) appear to be caused by unexpected interactions and program faults. Damage to medical systems, factory control, financial information, and other computer systems could have drastic and far-ranging effects that have nothing to do with education, and could certainly not be considered harmless.

A related refutation of the claim has to do with knowledge of the extent of the intrusion. If I am the person responsible for the security of a critical computer system, I cannot assume that *any* intrusion is motivated solely by curiosity and that nothing has been harmed. If I know that the system has been compromised, I must fear the worst and perform a complete system check for damages and changes. I cannot take the word of the intruder, for any intruder who actually caused damage would seek to hide it by claiming that he or she was "just looking." In order to regain confidence in the correct behavior of my system, I must expend considerable energy to examine and verify every aspect of it.

Apply our universal approach to this situation and imagine if this "educational" behavior was widespread and commonplace. The result would be that we would spend all our time verifying our systems and never be able to trust the results fully. Clearly, this is not good, and thus we must conclude that these "educational" motivations are also unethical.

3.5 The Social Protector Argument

One last argument, more often heard in Europe than the U.S. is that hackers break into systems to watch for instances of data abuse and to help keep "Big Brother" at bay. In this sense, the hackers are protectors rather than criminals. Again, this assumes that the ends justify the means. It also assumes that the hackers are actually able to achieve some good end.

Undeniably, there is some misuse of personal data by corporations and by the government. The increasing use of computer-based record systems and networks may lead to further abuses. However, it is not clear that breaking into these systems will aid in righting the wrongs. If anything, it will cause those agencies to become even more secretive and use the break-ins as an excuse for more restricted access. Break-ins and vandalism have not resulted in new open-records laws, but they have resulted in the introduction and passage of new criminal statutes. Not only has such activity failed to deter “Big Brother,” but it has also resulted in significant segments of the public urging more laws and more aggressive law enforcement — the direct opposite of the supposed goal.

It is also not clear that these are the individuals we want “protecting” us. We need to have the designers and users of the systems — trained computer professionals — concerned about our rights and aware of the dangers involved with the inappropriate use of computer monitoring and record-keeping. The threat is a relatively new one, as computers and networks have become widely used only in the last few decades. It will take some time for awareness of the dangers to spread throughout the profession. Clandestine efforts to breach the security of computer systems do nothing to raise the consciousness of the appropriate individuals. Worse, they associate that commendable goal (heightened concern) with criminal activity (computer break-ins), discouraging proactive behavior by the individuals in the best positions to act in our favor. Perhaps it is in this sense that computer break-ins and vandalism are most unethical and damaging.

4 Concluding Remarks

I have argued here that computer break-ins, even when no obvious damage results, are unethical. This must be the considered conclusion even if the result is an improvement in security, because the activity itself is disruptive and immoral. The results of the act should be considered separately from the act itself, especially when we consider how difficult it is to understand all the effects resulting from such an act.

Of course, I have not discussed every possible reason for a break-in. There might well be an instance where a break-in might be necessary to save a life or to preserve national security. In such cases, to perform one wrong act to prevent a greater wrong may be the right thing to do. It is beyond the scope or intent of this paper to discuss such cases, especially as no known hacker break-ins have been motivated by such instances.

Historically, computer professionals as a group have not been overly concerned with questions of ethics and propriety as they relate to computers. Individuals and some organizations have tried to address these issues, but the whole computing community needs to be involved to address the problems in any comprehensive manner. Too often, we view computers simply as machines and algorithms, and we do not perceive the serious ethical questions inherent in their use.

When we consider, however, that these machines influence the quality of life of millions of individuals, both directly and indirectly, we understand that there are broader issues. Computers are used to design, analyze, support, and control applications that protect and guide the lives and finances of people. Our use (and misuse) of computing systems may have effects beyond our wildest imagining. Thus, we must reconsider our attitudes about acts demonstrating a lack of respect for the rights and privacy of other people’s computers and data.

We must also consider what our attitudes will be towards future security problems. In particular, we should consider the effect of **widely** publishing the source code for worms, viruses, and other threats to security. Although we need a process for rapidly disseminating corrections and security information as they become known, we should realize that widespread publication of details will imperil sites where users are unwilling or unable to install updates and fixes.[3] Publication should serve a useful purpose; endangering the security of other people's machines or attempting to force them into making changes they are unable to make or afford is not ethical.

Finally, we must decide these issues of ethics as a community of professionals and then present them to society as a whole. No matter what laws are passed, and no matter how good security measures might become, they will not be enough for us to have completely secure systems. We also need to develop and act according to some shared ethical values. The members of society need to be educated so that they understand the importance of respecting the privacy and ownership of data. If locks and laws were all that kept people from robbing houses, there would be many more burglars than there are now; the shared mores about the sanctity of personal property are an important influence in the prevention of burglary. It is our duty as informed professionals to help extend those mores into the realm of computing.

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Gene Spafford received a Ph.D. in 1986 from the School of Information and Computer Sciences at Georgia Institute of Technology. In 1987, Professor Spafford joined the faculty of the Department of Computer Sciences at Purdue University. He is an active researcher with the NSF/Purdue/University of Florida Software Engineering Research Center (SERC) there.

Besides a continuing widely-known and respected involvement in the Usenet and other forms of electronic conferencing, Dr. Spafford does research on issues relating to increasing the reliability of computer systems, and the consequences of computer failures. This includes work with computer security, software testing and debugging, and issues of liability and professional ethics.

Professor Spafford's involvement with software engineering and security include positions on the editorial boards of the journals *International Journal of Computer and Software Engineering*, *Computers & Security*, the *Virus Bulletin*, the *Journal of Artificial Life*, *Network Security*, and the *Journal of Information Systems Security*. He is coauthor (with S. Garfinkel) of the books *Practical Unix and Internet Security*, published by O'Reilly and Associates (1991, 1996), and of *Computer Viruses: Dealing with Electronic Vandalism and Programmed Threats*, ADAPSO (now ITAA) (1989); and was contributing editor on *Computer Crime: A Crime-fighter's Handbook* (1995) and *Web Security and Commerce* (1997), both also published by O'Reilly. He has written over 100 papers and reports on his research, and contributed chapters to many other books on computer security and professional ethics, and has spoken internationally at conferences, symposia, and colloquia on these and related issues.

Among many other activities, Dr. Spafford is a member of the Association for Computing Machinery (ACM), where he has served as chair of the ACM Self-Assessment Committee, and as a member of the Technical Standards Committee. He is currently a member of the ACM's U.S. Public Policy Committee. He is also a Senior Member of the IEEE and Computer Society of the IEEE, and a charter recipient of the IEEE Computer Society's *Golden Core* award for service to the profession.

Publication History

This paper originally began as parts of two invited talks: A panel presentation on ethics and security at the Winter 1989 Usenix Conference following the Morris Internet Worm incident, and a presentation by the Harvard Office of Information Technology in November of 1989 on computer rights and responsibilities.

The first written version of these comments appeared in the Harvard INFORMATION TECHNOLOGY QUARTERLY as *Is a Computer Break-in Ever Ethical?*[17]. An expanded version of the paper was then solicited for a special issue of the JOURNAL OF SYSTEMS AND SOFTWARE, where it was published in 1992.[18]

Since then, the article has been widely reprinted in works on computing ethics:

- Reprinted (pp. 125–134) in COMPUERS, ETHICS, & SOCIAL VALUES; D. G. Johnson and

H. Nissenbaum, editors; Prentice-Hall; 1995.

- Reprinted in THE MORAL FOUNDATIONS OF INTELLECTUAL PROPERTY; Adam D. Moore, editor; 1997.
- Reprinted in COMPUTERS, ETHICS AND SOCIETY; M. David Ermann, Mary B. Williams, and Michele S. Shauf, eds.; Oxford University Press; 1997.
- Reprinted in THE ENCYCLOPEDIA OF APPLIED ETHICS; Ruth Chadwick, editor; Academic Press; 1997.
- Reprinted in INTERNET BESEIGED: COUNTERING CYBERSPACE SCOFFLAWS; Dorothy and Peter Denning, editors; Addison-Wesley, 1997.

Copies have been translated into Czech, Russian, German, and Spanish (that I know about) and used in computing group newsletters and university classes that I have not bothered to record.

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HIDING CRIMES IN CYBERSPACE[1]

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Abstract

Criminals have at their disposal a variety of technologies for hiding communications and evidence stored on computers from law enforcement. These include encryption, passwords, digital compression, steganography, remote storage, and audit disabling. They can also hide crimes through anonymity tools and techniques such as anonymous remailers, anonymous digital cash, looping, cloned cellular phones, and cellular phone cards. This paper discusses use of these technologies by criminals and terrorists, and how that use has affected investigations and prosecutions. Options available to law enforcement for dealing with the technologies, especially encryption, are also discussed. Numerous case studies are presented for illustration.

Keywords

encryption, cryptography, crime, law enforcement, cyberspace, anonymity

INTRODUCTION

The growth of telecommunications and electronic commerce has led to a growing commercial market for digital encryption technologies. Business needs encryption to protect intellectual property and to establish secure links with their partners, suppliers, and customers. Banks need it to ensure the confidentiality and authenticity of financial transactions. Law enforcement needs it to stop those under investigation from intercepting police communications and obstructing investigations. Individuals need it to protect their private communications and confidential data. Encryption is critical to building a secure and trusted global information infrastructure for communications and electronic commerce.

Encryption also gives criminals and terrorists a powerful tool for concealing their activities. It can make it impossible for law enforcement agencies to obtain the evidence needed for a conviction or the intelligence vital to criminal investigations. It can frustrate communications intercepts, which have played a significant role in averting terrorist attacks and in gathering information about specific transnational threats, including terrorism, drug trafficking, and organized crime (White House 1995). It can delay investigations and add to their cost.

The use of encryption to hide criminal activity is not new. The April 1970 issue of the *FBI Law Enforcement Bulletin* reports on several cases where law enforcement agencies had to break codes in order to obtain evidence or prevent violations of the law. None of the cases, however, involved electronic information or computers. Relatively simple substitution ciphers were used to conceal speech.

Digital computers have changed the landscape considerably. Encryption and other advanced technologies increasingly are used, with direct impact on law enforcement. If all communications and stored information in criminal cases were encrypted, it would be a nightmare for investigators. It would not be feasible to decrypt everything, even if technically possible. How would law enforcement agencies know where to spend limited resources?

We address here the use of encryption and other information technologies to hide criminal activities. Numerous case studies are presented for illustration. We first examine encryption and the options available to law enforcement for dealing with it. Next we discuss a variety of other tools for concealing information: passwords, digital compression, steganography, remote storage, and audit disabling. Finally, we discuss tools for hiding crimes through anonymity: anonymous remailers, anonymous digital cash, computer penetration and looping, cellular phone cloning, and cellular phone cards.

ENCRYPTION IN CRIME AND TERRORISM

This section describes criminal use of encryption in four domains: voice, fax, and data communications; electronic mail; files stored on the computers of individual criminals and criminal enterprises; and information posted in public places on computer networks.

Voice, Fax, and Real-Time Data Communications

Criminals can use encryption to make their real-time communications inaccessible to law enforcement. The effect is to deny law enforcement one of the most valuable tools in fighting organized crime; the court-ordered wiretap. In March 1997, the director of the Federal Bureau of Investigation, Louis J. Freeh, testified that the FBI was unable to assist with five requests for decryption assistance in communications intercepts in 1995 and twelve in 1996 (US Congress 1997a). Such wiretaps can be extremely valuable as they capture the subjects' own words, which generally holds up much better in court than information acquired from informants, for example, who are often criminals themselves and extremely unreliable. Wiretaps also provide valuable information regarding the intentions, plans, and members of criminal conspiracies, and in providing leads in criminal investigations. Drug cartels and organizations rely heavily on communications networks; monitoring of these networks has been critical for identifying those at the executive level and the organizations' illegal proceeds. Communications intercepts have also been useful in terrorism cases, sometimes helping to avoid a deadly attack. They have helped prevent the bombing of a foreign consulate in the United States and a rocket attempt against a US ally, among other things (*ibid*).

There is little case information in the public domain on the use of communications encryption devices by criminal enterprises. The Cali cartel is reputed to be using sophisticated encryption to conceal their telephone communications. Communications devices seized from the cartel in 1995 included radios that distort voices, video phones which provide visual authentication of the caller's identity, and instruments for scrambling transmissions from computer modems (Grabosky and Smith 1998).

We understand that some terrorist groups are using high-frequency encrypted voice/data links with state sponsors of terrorism. Hamas reportedly is using encrypted internet communications to transmit maps, pictures and other details pertaining to terrorist attacks. The Israeli General Security Service believes that most of the data is being sent to the Hamas worldwide center in Great Britain (IINS 1997).

The lack of universal interoperability and cost of telephone encryption devices – several hundred dollars for a device that provides strong security – has likely slowed their adoption by criminal enterprises. The problems to law enforcement could get worse as prices drop and internet telephony becomes more common. Criminals can conduct encrypted voice conversations over the internet at little or no cost. This impact on law enforcement, however, may be balanced by the emergence of digital cellular communications. These phones encrypt the radio links between the mobile devices and base stations, which is where the communications are most vulnerable to eavesdroppers. Elsewhere, the communications travel in the clear (or are separately encrypted while traversing microwave or satellite links), making court-ordered interception possible in the switches. The advantage to users is that they can protect their local over-the-air communications even if the parties they are conversing with are using phones with no encryption or with incompatible methods of encryption. The benefit to law enforcement is that plaintext can be intercepted in the base stations or switches. Although there are devices for achieving end-to-end encryption with cellular phones, they are more costly and require compatible devices at both ends.

Hackers use encryption to protect their communications on Internet Relay Chat (IRC) channels from interception. They have also installed their own encryption software on computers they have penetrated. The software is then used to set up a secure channel between the hacker's PC and the compromised machine. This has complicated, but not precluded, investigations.

Electronic Mail

Law enforcement agencies have encountered encrypted e-mail and files in investigations of paedophiles and child pornography, including the FBI's Innocent Images national child pornography investigation. In many cases, the subjects were using Pretty Good Privacy (PGP) to encrypt files and e-mail. PGP uses conventional cryptography for data encryption and public-key cryptography for key distribution. The investigators thought this group favoured PGP because they are generally educated, technically knowledgeable and heavy Internet users. PGP is universally available on the internet, and they can download it for free. Investigators say, however, that most child pornography traded on the Internet is not encrypted.

One hacker used encrypted e-mail to facilitate the sale of credit card numbers he had stolen from an Internet service provider and two other companies doing business on the Web. According to Richard Power, editorial director of the Computer Security Institute, Carlos Felipe Salgado Jr. had acquired nearly 100,000 card numbers by penetrating the computers from an account he had compromised at the University of California at San Francisco. Using commonly available hacking tools, he exploited known security flaws in order to go around firewalls and bypass encryption and other security measures. Boasting about his exploits on IRC, Salgado, who used the code name SMAK, made the mistake of offering to sell his booty to someone on the Internet. He conducted on-line negotiations using encrypted e-mail and received initial payments via anonymous Western Union wire transfer. Unknown to him, he had walked right into an FBI sting. After making two small buys and checking the legitimacy of the card numbers, FBI agents arranged a meeting at San Francisco airport. Salgado was to turn over the credit cards in exchange for $260,000. He arrived with an encrypted CD-ROM containing about 100,000 credit card numbers and a paperback copy of Mario Puzo's *The Last Don*. The key to decrypting the data was given by the first letter of each sentence in the first paragraph on page 128. Salgado was arrested and waived his rights. In June 1997, he was indicted on three counts of computer crime fraud and two counts of trafficking in stolen credit cards. In August, he pled guilty to four of the five counts. Had he not been caught, the losses to the credit card companies could have run from $10 million to over $100 million (Power 1997).

We were told of another case in which a terrorist group that was attacking businesses and state officials used encryption to conceal their messages. At the time the authorities intercepted the communications, they were unable to decrypt the messages, although they did perform some traffic analysis to determine who was talking with whom. Later they found the key on the hard disk of a seized computer, but only after breaking through additional layers of encryption, compression, and password protection. The messages were said to have been a great help to the investigating task force. We also received an anonymous report of a group of terrorists encrypting their e-mail with PGP.

Stored Data

In many criminal cases, documents and other papers found at a subject's premises provide evidence crucial for successful prosecution. Increasingly, this information is stored electronically on computers. Computers themselves have posed major challenges to law enforcement and encryption has only compounded these challenges.

The FBI found encrypted files on the laptop computer of Ramsey Yousef, a member of the international terrorist group responsible for bombing the World Trade Centre in 1994 and a Manila Air airliner in late 1995. These files, which were successfully decrypted, contained information pertaining to further plans to blow up eleven US-owned commercial airliners in the Far East (US Congress 1997a). Although much of the information was also available in unencrypted documents, the case illustrates the potential threat of encryption to public safety if authorities cannot get information about a planned attack and some of the conspirators are still at large.

Successful decryption of electronic records can be important to an investigation. Such was the case when Japanese authorities seized the computers of the Aum Shinrikyo cult, the group responsible for gassing the Tokyo subway in March 1995, killing twelve people and injuring 6,000 more (Kaplan and Marshall 1996). The cult had stored their records on computers, encrypted with RSA. Authorities were able to decrypt the files after finding the key on a floppy disk. The encrypted files contained evidence that was said to be crucial to the investigation, including plans and intentions to deploy weapons of mass destruction in Japan and the United States.

In the Aum cult case, the authorities were lucky to find the key on a disk. In other cases, the subjects turned over their keys. For example, the Dallas Police Department encountered encrypted data in the investigation of a national drug ring which was operating in several states and dealing in the drug, Ecstasy. A member of the ring, residing within their jurisdiction, had encrypted his address book. He turned over the password, enabling the police to decrypt the file. Meanwhile, however, the subject was out on bond and alerted his associates, so the decrypted information was not as useful as it might have been. The detective handling the case said that in the ten years he had been working drug cases, this was the only time he had encountered encryption, and that he rarely even encountered computers. He noted that the Ecstasy dealers were into computers more than other types of drug dealers, most likely because they are younger and better educated. They were using the internet for sales, but they were not encrypting electronic mail. The detective also noted that the big drug dealers were not encrypting phone calls. Instead, they were swapping phones (using cloned phones – see later discussion) to stay ahead of law enforcement (Manning 1997).[2]

In many cases, investigators have had to break the encryption system in order to get at the data. For example, when the FBI seized the computers of CIA spy Aldrich Ames, they found encrypted computer files, but no keys. Fortunately, Ames had used standard commercial off-the-shelf software, and the investigator handling the computer evidence was able to break the codes using software supplied by AccessData Corporation of Orem, Utah. The key was Ames's Russian code name, KOLOKOL (bell). According to investigators, failure to recover the encrypted data would have weakened the case. Ames was eventually convicted of espionage against the United States (CSI 1997).[3]

Code breaking is not always so easy. In his book about convicted hacker Kevin Poulsen, Jonathan Littman reported that Poulsen had encrypted files documenting everything from the wiretaps he had discovered to the dossiers he had compiled about his enemies. The files were said to have been encrypted several times using the 'Defense Encryption Standard' (*sic*). According to Littman, a Department of Energy supercomputer was used to find the key, a task that took several months at an estimated cost of hundreds of thousands of dollars. The effort apparently paid off, however, yielding nearly 10,000 pages of evidence (Littman 1997).

A substantial effort was also required to break the encryption software used by the New York subway bomber, Leary. In that case, the result yielded child pornography and personal information, which was not particularly useful to the case. Investigators, however, retrieved other evidence from the computer that was used at the trial. Leary was found guilty and sentenced to 94 years in jail.

Timeliness is critical in some investigations. Several years ago, a Bolivian terrorist organization assassinated four US Marines, and AccessData was brought in to decrypt files seized from a safe house. With only 24 hours to perform this task, they decrypted the custom-encrypted files in 12, and the case ended with one of the largest drug busts in Bolivian history. The terrorists were caught and put in jail (CSA 1997). In such cases, an effort that requires months or years to complete might be useless.

In other cases, the ability to successfully decrypt files proved unessential, as when a Durham priest was sentenced to six years in jail for sexually assaulting minors and distributing child pornography (Akdeniz 1999). The priest was part of an international paedophile ring that communicated and exchanged images over the Internet. When UK authorities seized his computers, they found files of encrypted messages. The encryption was successfully broken, however, the decrypted data did not affect the case.

Even when decrypted material has little or no investigative value, considerable resources are wasted reaching that determination. If all information were encrypted, it would be extremely difficult for law enforcement to decide where to spend precious resources. It would not be practical or even possible to decrypt everything. Yet if nothing were decrypted, many criminals would go free.

Some investigations have been derailed by encryption. For example, at one university, the investigation of a professor thought to be trafficking in child pornography was aborted because the campus police could not decrypt his files. In another case, an employee of a company copied proprietary software to a floppy disk, took the disk home, and then stored the file on his computer encrypted under PGP. Evidently, his intention was to use the software to offer competing services, which were valued at tens of millions of dollars annually (the software itself cost over $1 million to develop). At the time we heard about the case, the authorities had not determined the passphrase needed to decrypt the files. Information contained in logs had led them to suspect the file was the pilfered software.

At Senate hearings in September 1997, Jeffery Herig, special agent with the Florida Department of Law Enforcement, testified that they were unable to access protected files within a personal finance program in an embezzlement case at Florida State University. He said the files could possibly hold useful information concerning the location of the embezzled funds (US Congress 1997b).

Herig also reported that they had encountered unbreakable encryption in a US customs case involving an illegal, world-wide advanced fee scheme. At least 300 victims were allegedly bilked out of over $60 million. Herig said they had encountered three different encryption systems. Although they were able to defeat the first two, they were unsuccessful with the third. The vendor told them that there were no back doors.

> 'Although I have been able to access some of the encrypted data in this case,' Herig said, 'we know there is a substantial amount of incriminating evidence which has not been recovered'.
>
> (*ibid*)

In early 1997, we were told that Dutch organized crime had received encryption support from a group of skilled hackers who themselves used PGP and PGPfone to encrypt their communications. The hackers had supplied the mobsters with palmtop computers on which they installed Secure Device, a Dutch software product for encrypting data with IDEA. The palmtops served as an unmarked police/intelligence vehicles database. In 1995, the Amsterdam Police captured a PC in the possession of one organized crime member. The PC contained an encrypted partition, which they were unable to recover at the time. Nevertheless, there was sufficient other evidence for conviction. The disk, which was encrypted with a US product, was eventually decrypted in 1997 and found to be of little interest.

There have been a few reported cases of company insiders using encryption as a tool of extortion. The employees or former employees threatened to withhold the keys to encrypted data unless payment was made. In these cases, encryption is not used to conceal evidence of crimes, but rather to intimidate the organization. We are not aware of any extortion attempts of this nature that succeeded.

The use of encryption by the victims of crime can also pose a problem for law enforcement. At hearings in June 1997, Senator Charles Grassley told of an 11-year-old boy in the Denver area who committed suicide after being sexually molested. The boy had left behind a personal organizer, which investigators believed might contain information about the man whom his mother believed molested him. The organizer was encrypted, however, and the police had been unable to crack the password. The investigation had been on hold since February 1996.

In April 1998, the FBI's Computer Analysis Response Team (CART) forensics laboratory started collecting data on computer forensics cases handled at headquarters or in one of the FBI's field offices. As of 9 December, they had received 299 examination reporting forms, of which 12 (4 per cent) indicated use of encryption.[4] This is slightly lower than CART's estimate of 5–6 per cent for 1996 (Denning and Baugh 1997). There are at least three possible explanations. One is that the 1996 estimate, which was made before the FBI began collecting hard data, was somewhat high. A second is that as computers have become more common and user friendly, they are increasingly being used by criminals who lack the knowledge or skills to encrypt their files. Hence, the percentage of computer forensics cases involving encryption is staying about the same or decreasing even as the total number of forensics cases (and encryption cases) is growing. A third is that the early reports are skewed; as more come in, the percentage could approach 5–6 per cent.

Public Postings

Criminals can use encryption to communicate in secrecy through open forum such as computer bulletin boards and Internet Web sites. Although many people might see the garbled messages, only those with the key would be able to determine the plaintext.

This technique was used by an extortionist who threatened to kill Microsoft president and chief executive officer Bill Gates in spring 1997.[5] The extortionist transmitted his messages to Gates via letter, but then asked Gates to acknowledge acceptance by posting a specified message on the America Online Netgirl bulletin board. Gates then received a letter with instructions to open an account for a Mr Robert M. Rath in a Luxemburg bank and to transfer $5,246,827.62 to that account. The money was to be transferred by 26 April in order 'to avoid dying, among other things'. Gates was reminded that 26 April was his daughter's birthday. The letter came with a disk, which contained an image of Elvira and the key to a simple substitution cipher. Gates was told to use the code to encrypt instructions for accessing the Rath account via telephone or facsimile. He was then to attach the ciphertext to the bottom of the image and post the image to numerous image libraries within the Photography Forum of America Online (AOL). The graphic image with ciphertext was uploaded to AOL at the direction of the FBI on 25 April. Figure 1 shows the image as posted and translation code.

Although Gates complied with the requests, he did not lose his money. The extortion threat was traced to Adam Quinn Pletcher in Long Grove, Illinois.

TRANSLATION CODE:

Alphabet				Numeric	
A	(Q)	N	(K)	1	(©)
B	(D)	O	(N)	2	(%)
C	(T)	P	(Y)	3	(*)
D	(I)	Q	(U)	4	(@)
E	(O)	R	(G)	5	(/)
F	(H)	S	(V)	6	(<)
G	(X)	T	(M)	7	(~)
H	(L)	U	(R)	8	(-)
I	(E)	V	(W)	9	(#)
J	(S)	W	(J)	0	(>)
K	(Z)	X	(C)		
L	(B)	Y	(F)		
M	(P)	Z	(A)		

NOTE: You may use punctuation marks as they would normally be applied. To ensure that the correct message is relayed, it is extremely crucial that you encode your message precisely!

DQKLIRO XOKOGQBO IR BRCOPDNROX
© > GRO OIJQGI VMOETLOK
B %#/ © , BRCOPDNRGXWEBBO, BRCOPDNRQX
YL > ©© */% @%@% / > > %
> ©© */% @%@% / > / /
GNDOGM VTLBOEPOG
QTTM * > ~ - ©@>/ >~
TNIO IQPERV
GG DEGML / * / ©
NWOGVOQV YGNIRTMENKV
©%@©© GOIPNKI JQF, GOIPNKI, JQ # - > / %

Figure 1 Image and code from Gates' extortion case

On 9 May, Pletcher admitted writing and mailing the threatening letters (there were four altogether) to Gates.

LAW ENFORCEMENT OPTIONS

The majority of investigations we heard about were not stopped by encryption. Authorities obtained the key by consent, found it on disk, or cracked the system in some way, for example, by guessing a password or exploiting a weakness in the overall system. Alternatively, they used other evidence such as printed copies of encrypted documents, other paper documents, unencrypted conversations and files, witnesses, and information acquired through other, more intrusive, surveillance technologies such as bugs. We emphasize, however, that these were cases involving computer searches and seizures, not wiretaps. This section discusses the options available to law enforcement for dealing with encryption.

Getting Key From Subject

In many cases, subjects have co-operated with the police and disclosed their keys or passwords, sometimes as part of a plea bargain. One hacker who had encrypted his files with the Colorful File System confessed to his crimes and revealed his CFS passphrase:

ifyoucanreadthisyoumustbeerikdale—**oragoodcypherpunk

He (Erik) wanted to speed the process along. The decrypted files contained evidence that was important to the case.[6]

A question that frequently arises is whether a court can compel the disclosure of plaintext or keys, or whether the defendants are protected by the 5th Amendment. Philip Reitinger, an attorney with the Department of Justice Computer Crime Unit, studied this question and concluded that a grand jury subpoena can direct the production of plaintext or of documents that reveal keys, although a limited form of immunity may be required (Reitinger 1996). He left open the question of whether law enforcement could compel production of a key that has been memorized but not recorded. He also observed that faced with the choice of providing a key that unlocks incriminating evidence or risking contempt of court, many will choose the latter and claim loss of memory or destruction of the key.

In *People vs. Price* in Yolo County, California Superior Court prosecutors successfully compelled production of the passphrase protecting the defendant's PGP key. In this case, however, the key was not sought for the purpose of acquiring evidence for conviction, but rather to determine whether the defendant's computer should be released from police custody. He had already been convicted of annoying children and wanted his computer back. The police argued it should not be released as there was reason to believe it contained contraband, specifically PGP-encrypted files containing child pornography. This determination was based on the existence of a pair of files named 'Boys.gif' and 'Boys.pgp' (when PGP encrypts a plaintext file, it automatically gives the ciphertext file the same name but with the extension '.pgp').[7]

The defendant was unsuccessful in arguing a 5th Amendment privilege. The prosecution argued that the contents of the file had already been uttered and, therefore, were not protected under the 5th Amendment. As long as prosecutors did not try to tie the defendant to the file by virtue of his knowing the passphrase, no incrimination was implied by disclosing the passphrase.

To handle the passphrase, a court clerk was sworn in as a special master. An investigator activated the PGP program to the point where it prompted for the passphrase. He left the room while the defendant disclosed the passphrase to the special master, who typed it into the computer. The investigator was then brought back into the room to hit the Enter key and complete the decryption process. As expected, child pornography fell out. The judge then ordered the computer, its peripherals, and all diskettes destroyed. The defendant argued that the computer contained research material, but the judge admonished him for commingling it with the contraband.

Getting Access Through a Third Party

Some encryption products have a key recovery system which enables access to plaintext through a means other than the normal decryption process. The key needed to decrypt the data is recovered using information stored with the ciphertext plus information held by a trusted agent, which could be an officer of the organization owning the data or a third party. The primary objective is to protect organizations and individuals using strong encryption from loss or destruction of encryption keys, which could render valuable data inaccessible.

Key recovery systems can accommodate lawful investigations by providing authorities with a means of acquiring the keys needed. If the keys are held by a third party, this can be done without the knowledge of the criminal group under investigation. Of course, if criminal enterprises operate their own recovery services, law enforcement may be no better off. Indeed, they could be worse off because the encryption will be much stronger, possibly uncrackable, and the criminals might not co-operate with the authorities. Moreover, with wiretaps, which must be performed surreptitiously to have value, investigators cannot go to the subjects and ask for keys to tap their lines. Key recovery systems could also encourage the use of encryption in organized crime to protect electronic files, as criminal enterprises need not worry about loss of keys.

Because of the potential benefits of key recovery to law enforcement, the Clinton Administration has encouraged the development of key recovery products by offering an export advantages to companies making such products. Beginning in December 1996, products with key recovery systems could be readily exported with unlimited key lengths. The Administration has retained restrictions on non-recoverable products that use keys longer than 56 bits, but even here export controls have been liberalized to allow ready export under certain conditions.

Breaking the Codes

It is often possible to obtain the key needed to decrypt data by exploiting a weakness in the encryption algorithm, implementation, key management system, or some other system component. Indeed, there are software tools on the Internet for cracking the encryption in many commercial applications.

One site on the World Wide Web lists freeware crackers and products from AccessData Corp. and CRAK Software for Microsoft Word, Excel, and Money; WordPerfect, Data Perfect, and Professional Write; Lotus 1-2-3 and Quattro Pro; Paradox; PKZIP; Symantex Q&A, and Quicken.[8]

Eric Thompson, president of AccessData, reported that they had a recovery rate of 80–85 per cent with the encryption in large-scale commercial commodity software applications. He also noted that 90 per cent of the systems are broken somewhere other than at the crypto engine level, for example, in the way the text is pre-processed (CSA 1997). A passphrase or key might be found in the swap space on disk.

In those cases where there is no shortcut attack, the key might be determined by brute force search, that is, by trying all possible keys until one is found that yields known plaintext or, if that is not available, meaningful data. Keys are represented as strings of 0s and 1s (bits), so this means trying every possible bit combination. This is relatively easy if the keys are no more than 40 bits, and somewhat longer keys can be broken given enough horsepower. In July 1998, John Gilmore, a computer privacy and civil liberties activist, and Paul Kocher, president of Cryptography Research in California, won $10,000 for designing a supercomputer that broke a 56-bit DES challenge cipher in record time, in their case 56 hours or less than three days. The EFF DES Cracker was built by a team of about a dozen computer researchers with funds from the Electronic Frontier Foundation. It took less than a year to build and cost less than $250,000. It tested keys at a rate of almost 100 billion per second (EFF 1998, Markoff 1998).

Unfortunately, criminals can protect against such searches by using methods that take longer keys, say 128 bits with the RC4, RC5, or IDEA encryption algorithm or 168 bits with Triple DES. Because each additional bit doubles the number of candidates to try, a brute force search quickly becomes intractable. To crack a 64-bit key, it would take 10 EFF DES Crackers operating for an entire year. At 128 bits, it is totally infeasible to break a key by brute force, even if all the computers in the world are put to the task. To break one in a year would require, say, 1 trillion computers (more than 100 computers for every person on the globe), each running 10 billion times faster than the EFF DES Cracker. Put another way, it would require the equivalent of 10 billion trillion DES Crackers! Many products, including PGP, use 128-bit keys or longer.

With many encryption systems, for example PGP, a user's private key (which unlocks message keys) is computed from or protected by a passphrase chosen by the user. In that case, it may be easier to brute force the password than the key because it will be limited to ASCII characters and be less random than an arbitrary stream of bits. Eric Thompson reports that the odds are about even of successfully guessing a password. They use a variety of techniques including Markov chains, phonetic generation algorithms, and concatenation of small words (CSA 1997).

Often, investigators will find multiple encryption systems on a subject's computer. For example, PGP might be used for e-mail, while an application's built-in encryption might be used to protect documents within the application. In those cases, the subject might use the same password with all systems. If investigators can break one because the overall system is weak, they might be able to break the other, more difficult system by trying the same password.

To help law enforcement develop the capability to stay abreast of new technologies, including encryption, the Federal Bureau of Investigation proposes to establish a technical support centre. The centre would maintain a close working relationship with the encryption vendors. The Clinton Administration announced support for the centre in its September 1998 update on encryption policy (White House 1998).

One issue raised by the development and use of tools for breaking codes is how law enforcement can protect its sources and methods. If investigators must reveal in court the exact methods used to decipher a message, future use of such methods could be jeopardized.

Finding an Access Point

Another strategy for acquiring plaintext is to find an access point that provides direct access to the plaintext before encryption or after decryption. In the area of communications, a router or switch might offer such access to communications that traverse the switch. If the communications are encrypted on links coming into and going out of the switch, but in the clear as they pass through the switch, then a wiretap placed in the switch will give access to the plaintext communications. We noted earlier how digital cellular communications could be intercepted in this manner, while at the same time offering users considerably greater security and privacy than offered by analog phones that do not use encryption.

Network encryption systems which offer access points of this nature are given an export advantage over those that do not (*ibid*). The approach was initially called a 'private doorbell' approach to distinguish it from one that uses key recovery agents (Corcoran 1998, Cisco 1998). Now it is considered a form of recoverable encryption.

For stored data, Codex Data Systems of Bardonia, New York, advertises a product called Data Interception by Remote Transmission (D.I.R.T.) which is designed to allow remote monitoring of a subject's personal computer by law enforcement and other intelligence gathering agencies. Once D.I.R.T. is installed on the subject's machine, the software will surreptitiously log keystrokes and transmit captured data to a pre-determined Internet address that is monitored and decoded by D.I.R.T. Command Center Software. D.I.R.T. add-ons include remote file access, real-time capture of keystrokes, remote screen capture, and remote audio and video capture. The software could be used to capture a password and read encrypted e-mail traffic and files.

When All Else Fails

The inability to break through encryption does not always spell doom. Investigators may find printed copies of encrypted documents. They may find the original plaintext version of an encrypted file, for example, if the subject forgot to delete the original file or if it was not thoroughly erased from the disk. They may obtain incriminating information from unencrypted conversations, witnesses, informants and hidden microphones. They may conduct an undercover or sting operation to catch the subject. These other methods do not guarantee success, however.

If there is sufficient evidence of some crime, but not the one believed to be concealed by encryption, a conviction may be possible on lesser charges. This happened in Maryland when police encountered an encrypted file in a drug case. Allegations were raised that the subject had been involved in document counterfeiting and file names were consistent with formal documents. Efforts to decrypt the files failed, however, so the conviction was on the drug charges only.[9]

In another case, a 15-year-old boy came to the child abuse bureau of the Sacramento County Sheriff's Department with his mother, who desired to file a complaint against an adult who had met her son in person, befriending the boy and his friends and buying them pizza. The man had sold her son $500–1000 worth of hardware and software for $1.00 and given him lewd pictures on floppy disks. The man subsequently mailed her son pornographic material on floppy disk and sent her son pornographic files over the Internet using America Online. After three months of investigation, a search warrant was issued against a man in Campbell, California and the adoption process of a 9-year-old boy was stopped. Eventually, the subject was arrested, but by this time he had purchased another computer system and travelled to England to visit another boy. Within ten days of acquiring the system, he had started experimenting with different encryption systems, eventually settling on PGP. He had encrypted a directory on the system. There was information indicating that the subject was engaged in serious corporate espionage, and it was thought that the encrypted files might have contained evidence of that activity. They were never able to decrypt the files, however, and after the subject tried unsuccessfully to put a contract out on the victim from jail, he pleaded no contest to multiple counts of distribution of harmful material to a juvenile and the attempt to influence, dissuade, or harm a victim/witness.[10]

If encryption precludes access to all evidence of wrongdoing, then a case is dropped (assuming other methods of investigation have failed as well). Several cases that had been aborted or put on hold because of encryption were noted earlier.

OTHER TECHNOLOGIES FOR HIDING EVIDENCE

The modern day criminal has access to a variety of tools for concealing information besides encryption:

Passwords

Criminals, like law abiding persons, often password protect their machines to keep others out. In one gambling operation with connections to New York's Gambino, Genovese, and Colombo crime families, bookies had password-protected a computer used to cover bets at the rate of $65 million a year (Ramo 1996). After discovering that the password was one of the henchmen's mother's name, the police found 10,000 digital betting slips worth $10 million.

Another gambling enterprise operated multiple sites linked by a computer system, with drop-offs and pick-ups spanning three California counties. The ring leader managed his records with a commercial accounting program, using a password to control access to his files. Although the software manufacturer refused to assist law enforcement, police investigators were able to gain access by zeroing out the passwords in the data files. They found the daily take on bets, payoffs, persons involved, amounts due and paid or owed, and so forth. The printed files showed the results of four years of bookmaking, and resulted in a plea of guilty to the original charges and a sizeable payment of back taxes, both state and federal.[11]

Passwords are encountered much more often than encryption in computer forensics cases. Of the 299 computer examination reports received by the FBI's CART between April and December 1998, 60 (20 per cent) indicated use of passwords. This was five times as many as had indicated use of encryption.[12]

Digital Compression

Digital compression is normally used to reduce the size of a file or communication without losing information content, or at least significant content. The greatest reductions are normally achieved with audio, image, and video data; however, substantial savings are possible even with text data. Compression can benefit the criminal trying to hide information in two ways. First, it makes the task of identifying and accessing information more difficult for the police conducting a wiretap or seizing files. Second, when used prior to encryption, it can make cracking an otherwise weak cipher difficult. This is because the compressed data is more random in appearance than the original data, making it less susceptible to techniques that exploit the redundancy in languages and multimedia formats.

Steganography

Steganography refers to methods of hiding secret data in other data such that its existence is even concealed. One class of methods encodes the secret data in the low-order bit positions of image, sound, or video files. There are several tools for doing this, many of which can be downloaded for free off the Internet. With S-tools, for example, the user hides a file of secret data in an image by dragging the file over the image. The software will optionally encrypt the data before hiding it for an extra layer of security. S-tools will also hide data in sound files or in the unallocated sectors of a disk. Figure 2 shows the effect of using S-tools to hide a seventeen page book chapter inside an image file that is less than four

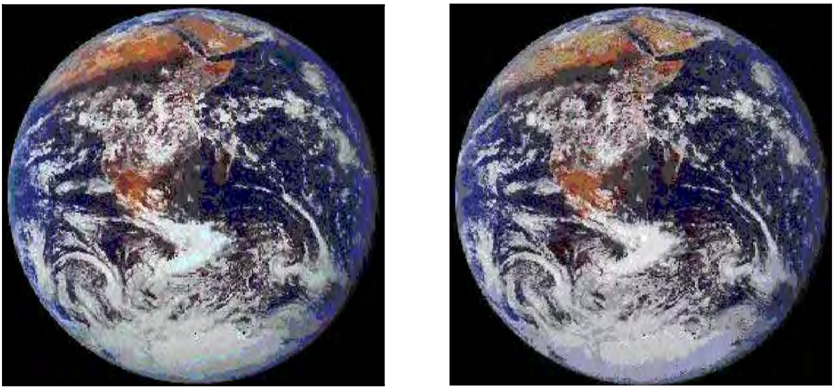

Figure 2 Image on Earth taken from Apollo 17, 7 December 1972 before and after hiding a 74 kilobyte chapter in the image. Both files are 281 kilobytes.

times the size; that is, about a quarter of the file contains a hidden document. The difference between the before and after images is barely noticeable.

There have been a few reported cases of criminals using steganography to facilitate their crimes. One credit card thief, for example, used it to hide stolen card numbers on a hacked Web page. He replaced bullets on the page with images that looked the same but contained the credit card numbers, which he then offered to associates. This case illustrates the potential of using Web images as 'digital dead drops' for information brokering. Only a handful of people need even know the drop exists.

Steganography can be used to hide the existence of files on a computer's hard disk. Ross Anderson, Roger Needham, and Adi Shamir propose a steganographic file system that would make a file invisible to anyone who does not know the file name and a password. An attacker who does not know this information gains no knowledge about whether the file exists, even given complete access to all the hardware and software. One simple approach creates cover files so that the user's hidden files are the exclusive or (XOR) of a subset of the cover files. The subset is chosen by the user's password (Anderson *et al.* 1998).

Remote Storage

Criminals can hide data by storing it on remote hosts, for example, a file server at their Internet Service Provider (ISP). Jim McMahon, former head of the High Technology Crimes Detail of the San Jose Police Department, reported that he had personally seen suspects hiding criminal data on non-local disks, often at ISP locations, but sometimes on the systems of innocent third parties with poor security, leaving them open to intrusions and subsequent abuse. Eugene Schultz, former manager of the Department of Energy's Computer Incident Advisory Capability, said that a group of hackers from the Netherlands had taken so much information from Defense Department computers that they could not store it all on their own disks. So they broke into systems at Bowling Green University and the University of Chicago and downloaded the information to these sites, figuring they could transfer it somewhere else later.[13] Software pirates have been known to stash their pilfered files in hidden directories on systems they have hacked.

Data can be hidden on removable disks and kept in a physical location away from the computers. Don Delaney, a detective with the New York State Police, told us in early 1997 that in one Russian organized crime case involving more than $100 million in state sales tax evasion, money laundering, gasoline bootlegging, and enterprise corruption, they had to obtain amendments to their search warrants in order to seize disks and records from handbags and locked briefcases in the offices at two locations. After an exhaustive six month review of all computer evidence, they determined that the largest amount of the most damaging evidence was on the diskettes. The crooks did their work in Excel and then saved it on floppies. The lesson they learned from this was to execute the search warrant with everyone present and look for disks in areas where personal property is kept. As storage technologies continue to get smaller, criminals will have even more options for hiding data.

Audit Disabling

Most systems keep a log of activity on the system. Perpetrators of computer crimes have, in many cases, disabled the auditing or deleted the audit records pertaining to their activity. The hacking tool RootKit, for example, contains Trojan horse system utilities which conceal the presence of the hacker and disable auditing. ZAP is another tool for erasing audit records. Both of these can be downloaded for free on the internet.

CONCEALING CRIMES THROUGH ANONYMITY

Crimes can be concealed by hiding behind a cloak of anonymity. A variety of technologies are available:

Anonymous Remailers

An anonymous remailer is a service that allows someone to send an electronic mail message without the receiver knowing the sender's identity. The remailer may keep enough information about the sender to enable the receiver to reply to the message by way of the remailer. To illustrate, suppose Alice wishes to send an anonymous e-mail message to Bob. Instead of e-mailing to Bob directly, Alice sends the message to a remailer (an e-mail server), which strips off the headers and forwards the contents to Bob. When Bob gets the message, he sees that it came via the remailer, but he cannot tell who the sender was. Some remailers give users pseudonyms so that recipients can reply to messages by way of the remailer. The remailer forwards the replies to the owners of the pseudonyms. These pseudo anonymous remailers do not provide total anonymity because the remailer knows who the parties are. Other remailers offer full anonymity, but they cannot support replies. All they do is act as a mail forwarder.

A remailer can accumulate batches of messages before forwarding them to their destinations. That way, if someone is intercepting encrypted Internet messages for the purpose of traffic analysis, the eavesdropper would not be able to deduce who is talking to whom.

There are numerous anonymous and pseudo anonymous remailers on the Internet. Some provide encryption services (typically using PGP) in addition to mail forwarding so that messages transmitted to and from the remailer can be encrypted. Users who don't trust the remailers can forward their messages through multiple remailers.

Anonymous remailers allow persons to engage in criminal activity while concealing their identities. President Clinton, for example, has received e-mail death threats that were routed through anonymous remailers. In one case involving remailers, an extortionist threatened to fly a model airplane into the jet engine of an airplane during takeoff at a German airport, the objective being to cause the plane to crash. The threats were sent as e-mail through an anonymous remailer in the United States. The messages were traced to introductory accounts on America Online, but the person had provided bogus names and credit card numbers. He was caught, however, before carrying out his threat.[14]

Anonymous Digital Cash

Digital cash enables users to buy and sell information goods and services. It is particularly useful with small transactions, serving the role of hard currency. Some methods allow users to make transactions with complete anonymity; others allow traceability under exigent circumstances, for example, a court order.

Total anonymity affords criminals the ability to launder money and engage in other illegal activity in ways that circumvent law enforcement. Combined with encryption or steganography and anonymous remailers, digital cash could be used to traffic in stolen intellectual property on the Web or to extort money from victims.

In May 1993, Timothy May wrote an essay about a hypothetical organization, BlackNet, which would buy and sell information using a combination of public-key cryptography, anonymous remailers, and anonymous digital cash.

> BlackNet can make anonymous deposits to the bank account of your choice, where local banking laws permit, can mail cash directly . . . , or can credit you in 'CryptoCredits,' the internal currency of BlackNet. . . . If you are interested, do *not* attempt to contact us directly (you'll be wasting your time), and do *not* post anything that contains your name, your e-mail

> address, etc. Rather, compose your message, encrypt it with the public key of BlackNet (included below), and use an anonymous remailer chain of one or more links to post this encrypted, anonymized message on one of the locations listed. . . .
>
> (May 1996a).

Although May said he wrote the essay to point out the difficulty of 'bottling up' new technologies (May 1996b), rumors spread shortly after May's essay appeared on the Internet of actual BlackNets being used for the purpose of selling stolen trade secrets.

In an essay called 'Assassination Politics,' James Dalton Bell suggested using cyber betting pools to kill off Internal Revenue Service (IRS) agents and other 'hated government employees and officeholders' (Bell 1996).[15] The idea was simple: using the internet, encryption, and untraceable digital cash, anyone could contribute anonymously to a pool of digital cash. The person, presumably the assassin, correctly guessing the victim's time of death wins. After spending nearly two years peddling his ideas on internet discussion groups and mailing lists, Bell was arrested and pled guilty to two felony charges: obstructing and impeding the IRS and falsely using a social security number with the intent to deceive. In his plea agreement, he admitted to conducting a 'stink bomb' attack on an IRS office in Vancouver (McCullah 1997).[16] He also disclosed the passphrase required to decrypt e-mail messages that had been sent to Bell by his associates encrypted under PGP.

Although Bell did not implement any betting pools, an anonymous message was posted to the Cypherpunks internet mailing list announcing an Assassination Politics Bot (program) called Dead Lucky that did. The message also listed four potential targets. A related message pointed to an interactive Web page titled Dead Lucky, which contained the statement 'If you can correctly predict the date and time of death of others then you can win large prizes payable in untaxable, untraceable eca$h'. The page also stated 'Contest will officially begin after Posting of Rules and Announcement of Official Starting Date (Until then it is for Entertainment Purposes Only)'. Another anonymous message posted to Cypherpunks had the subject 'Encrypted InterNet DEATH THREAT!!! / ATTN: Ninth District Judges / PASSWORD: sog'. The PGP encrypted message, when decrypted with 'sog,' contained death threats and a claim to authorship of the Assassination Bot. Investigators linked the messages and Bot to an individual by the name of Carl Edward Johnson. In August 1998, a warrant was issued charging Johnson with threatening 'to kill certain law enforcement officers and judges of the United States, with intent to impede, intimidate, or interfere with said officers and judges on account of their official duties'.[17]

Computer Penetrations and Looping

By breaking into someone's computer account and issuing commands from that account, a criminal can hide behind the account holder's identity. In one such case, two hackers allegedly penetrated the computers of Strong Capital Management and sent out 250,000 ads with fraudulent headers that bore the company's name. The ads were for on-line striptease services ('cyber stripping'), computer equipment, and sports betting. SCM filed a $125 million lawsuit against the hackers, demanding penalties of $5,000 per message (Kabay 1997).

Hackers can make it difficult for investigators to discover their true identity by using a technique called 'looping'. Instead of penetrating a particular system directly, they can enter one system and use that as a springboard to penetrate another, use the second system to penetrate a third, and so forth, eventually reaching their target system. The effect is to conceal the intruder's location and complicate an investigation. In order to trace the connection, investigators need the help of systems administrators along the path. If the path crosses several national borders, getting that co-operation may be impossible.

Cellular Phones and Cloning

Drug lords, gangsters, and other criminals regularly use 'cloned' cell phones to evade the police. Typically, they buy the phones in bulk and discard them after use. A top Cali cartel manager might use as many as thirty-five different cell phones a day (Ramo 1996). In one case involving the Colombia cartel, DEA officials discovered an unusual number of calls to Colombia on their phone bills. It turned out that cartel operatives had cloned the DEA's own number! Some cloned phones, called 'lifetime phones', hold up to ninety-nine stolen numbers. New numbers can be programmed into the phone from a keypad, allowing the user to switch to a different cloned number for each and every call. With cloning, whether cellular communications are encrypted may have little impact on law enforcement, as they do not even know which numbers to tap.

Digital cellular phones use stronger methods of authentication that protect against cloning. As this technology replaces analog cell phones, cloning may be less of a problem for law enforcement.

Cellular Phone Cards

A similar problem occurs with cellular phone cards. These pre-paid cards, which are inserted into a mobile phone, specify a telephone number and amount of air time. In Sweden, phone cards can be purchased anonymously, which has made wiretapping impossible. The narcotics police have asked that purchasers be required to register in a database that would be accessible to the police (Minow 1997). A similar card is used in France, however buyers must show an identification card at the time of purchase. In Italy, a pre-paid card must be linked to an identity, which must be linked to an owner.

CONCLUSIONS

Criminals and terrorists are using encryption and other advanced technologies to hide their activities. Indications are that use of these technologies will continue and expand, with a growing impact on law enforcement. Although the majority of investigations we heard about were not stopped by encryption, we heard about a few cases that were effectively derailed or put on hold by encryption. Even when the encryption was broken, however, it delayed investigations, sometimes by months or years, and added to their cost, in a few cases costing agencies hundreds of thousands of dollars to crack open encrypted files.

Efforts to decrypt data for law enforcement agencies or corporations in need of recovering from lost keys have been largely successful because of weaknesses in the systems as a whole. That success rate is likely to drop, however, as vendors integrate stronger encryption into their products and get smarter about security. It is not possible to break well-designed cryptosystems that use key lengths of 128 bits or more. It is not just a matter of paying enough money or getting enough people on the Internet to help out. The resources simply do not exist – anywhere.

Most of the investigators we talked to said that they had not yet detected substantial use of encryption by large organized crime groups. This can be attributed to several factors, including the difficulty and overhead of using encryption (particularly the personnel time involved) and a general sense that their environments are already reasonably isolated and protected from law enforcement.

Maria Christina Ascents, who runs the Italian state police's crime and technology centre, said that the Italian Mafia is increasingly looking to use encryption to help protect it from the government. She cited encryption as their greatest limit on investigations, and noted that instead of hiring cryptographers to create their codes, mobsters download copies of Pretty Good Privacy (PGP) off the internet (Ramo 1996).

As the population becomes better educated about technology and encryption, more and more criminals will have the knowledge and skills needed to evade law enforcement, particularly given the ease with which unbreakable, user-friendly software encryption can be distributed and obtained on the Internet. We recommend ongoing collection of data on the use of encryption and other advanced technologies in crime. We need to know how encryption is impacting cases – whether it is broken or circumvented, whether cases are successfully investigated and prosecuted despite encryption, and costs to investigators.

Encryption is a critical international issue with severe impact and benefits to business and order. National policy must recognize not only the threat to law enforcement and intelligence operations, but also the need to protect the intellectual property and economic competitiveness of industry. Encryption policy must also respect consumer needs for encryption and basic human rights, including privacy and freedom of expression. Addressing all of these interests is enormously challenging.

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NOTES

1 The paper is an update of a study we conducted in 1997 at the invitation of the US Working Group on Organized Crime, National Strategy Information Center, Washington, DC.

2 Additional information was provided by Detective R. J. Montemayor in the Dallas Police Department.

3 The key used by Ames was disclosed to us by Robert Reynard on 18 February, 1998.

4 Data provided by CART on 9 December 1998.

5 United States District Court, Northern District of Illinois, Eastern Division, Search Warrant, Case Number 97–157M, 8 May 1997; *United States of America vs. Adam Quinn Pletcher*, United States District Court, Western District of Washington at Seattle, Magistrate's Docket No. Case No. 97–179M, 9 May 1997.

6 Byron W. Thompson, presentation at HTCIA/FBI Training Seminar, Perspectives on Computer Crime, November 12–13, 1998.

7 Information on this case was provided by Fred B. Cotton of SEARCH Group, Inc. Cotton was the investigator who activated the PGP program on the defendant's computer.

8 http://www.hiwaay.net/boklr/bsw_crak.html as of February 1997.

9 This case was reported to us by Howard Schmidt.

10 This case was reported by Brian Kennedy of the Sacramento County Sheriff's Department.

11 This case was first reported to us on 22 February 1997 by Jim McMahon, former head of the High Technology Crimes Detail of the San Jose Police Department. We received additional information from Robert Reynard on 10 June 1998.

12 Data provided by CART on 9 December 1998.

13 Communication from Eugene Schultz, 15 May 1998.

14 Presentation by Christoph Fischer at Georgetown University, 22 July 1998.

15 A version of Bell's essay on Assassination Politics is in Schwartau, W., (1996) *Information Warfare*, 2nd ed., NY, USA: *Thunder's Mouth Press*, pp. 420–425.

16 http://jya.com/jimbell3.htm.

17 *United States of America vs. Carl Edward Johnson*, Warrant for Arrest, Case No. 98–430M, United States District Court, Western District of Washington, 19 August, 1998.

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