BIBLIOGRAPHY

Bhavnani, Kum-Kum, and Donna Haraway. 1994. "Shifting the Subject: A Conversation between Kum-Kum Bhavnani and Donna Haraway." *Feminism and Psychology* 4, no. 4: 19–39.

Clynes, Manfred, and Nathan Kline. 1960. "Cyborgs and Space." *Astronautics* 13: 26–27, 74–75.

Haraway, Donna. 1976. *Crystals, Fabrics, and Fields: Metaphors of Organicism in Twentieth-Century Developmental Biology.* New Haven, Conn.: Yale University Press.

———. 1978a. "Animal Sociology and a Natural Economy of the Body Politic, part I: A Political Physiology of Dominance." *Signs* 4: 21–36.

———. 1978b. "Animal Sociology and a Natural Economy of the Body Politic, part II: The Past Is the Contested Zone: Human Nature and Theories of Production and Reproduction in Primate Behaviour Studies." *Signs* 4: 37–60.

———. 1979. "The Biological Enterprise: Sex, Mind, and Profit from Human Engineering to Sociobiology." *Radical History Review* 20: 37–70.

———. 1984. "Lieber Kyborg als Göttin! Für eine sozialistisch-feministische Unterwanderung der Gentechnologie." In *1984* (Argument-Sonderband 105), edited by Bernd-Peter Lange and Anna Maria Stuby, pp. 66–84. Berlin: Argument-Verlag.

———. 1985. "Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s." *Socialist Review,* no. 80: 65–108.

———. 1989. *Primate Visions: Gender, Race, and Nature in the World of Modern Science.* New York: Routledge.

———. 1991. *Simians, Cyborgs, and Women: The Reinvention of Nature.* New York: Routledge/Free Association Books.

———. 1994. "A Game of Cat's Cradle: Science Studies, Feminist Theory, Cultural Studies. *Configurations* 2, no. 1 (winter 1994): 59–71.

———. 1996. *Modest_Witness@Second_Millennium.FemaleMan©_Meets_OncoMouse™.* New York: Routledge.

Kuhn, Thomas. 1970. *The Structure of Scientific Revolutions.* 2d ed. Chicago: University of Chicago Press.

Minsky, Marvin. 1994. "Will Robots Inherit the Earth?" *Scientific American,* October, 86–91.

Spek, Inez van der. 1996. "A Momentary Taste of Being: Female Subjectivity, the Divine, and the Science Fiction of James Tiptree, Jr." Ph.D. diss., Rijksuniversiteit Utrecht, Enschede. Published as *Alien Plots: The Fiction of James Tiptree.* Liverpool: Liverpool University Press, 1999.

Winograd, Terry, and Fernando Flores. 1986. *Understanding Computers and Cognition: A New Foundation for Design.* Reading, Mass.: Addison-Wesley.

5. Don Ihde: The Technological Lifeworld

Peter-Paul Verbeek

What role does technology play in everyday human experience? How do technological artifacts affect people's existence and their relations with the world? And how do instruments produce and transform human knowledge? These are the central questions in Don Ihde's philosophy of technology.

Ihde, who was born in 1934, is a pioneer in two respects. First, he was one of the earliest philosophers in the United States to make technology the subject of philosophical reflection; and second, he was one of the first to apply to the study of technology the tools of the phenomenological tradition at a time when it was far out of the philosophical mainstream. Ihde studied theology with Paul Tillich, in the course of which he became interested in the philosophy of existence of Heidegger and Jaspers. He graduated from Boston University in 1964 with a thesis on the philosophy of Paul Ricoeur, which was the first systematic study in English of Ricoeur's work. Ihde continued to publish in the area of phenomenology, and in the early 1970s discovered and began writing essays on technology as an area of phenomenological exploration. He published his first book on the philosophy of technology, *Technics and Praxis,* in 1979, the first of over half a dozen books he has written in that field. He also began, and continues to edit himself, a book series devoted to the philosophy of technology, The Indiana Series in the Philosophy of Technology. Ihde's most important book, *Technology and the Lifeworld,* appeared in that series in 1990. This book draws together systematically the most important elements of his philosophy of technology.

Like the other philosophers discussed in this volume, Ihde develops a new

perspective on technology, a perspective that seeks closer contact with concrete technologies. Classical philosophy of technology tended to reify technology, treating it as a monolithic force, "Technology." Ihde, by contrast, shuns general pronouncements about Technology, fearing to lose contact with the role that concrete technologies play in our culture and in people's everyday lives. He sets himself the task of exploring this very role of technologies. Ihde does so from within the phenomenological tradition, which he has helped to connect to the philosophy of technology. His work departs from Heideggerian-style traditional phenomenological analyses of technology, and redirects that tradition in new ways with respect to the philosophy of technology.

I shall begin this chapter with a short description of phenomenology as a philosophical method, followed by a review of some key elements of Heidegger's analysis of technology, in order to create a background against which Ihde's philosophy of technology can be introduced. My account of Ihde's work will consist of three parts. The first will concern Ihde's analysis of the role of technology in human experience, the second his vision of the relation between technology and culture, and the third the implications of his philosophy of technology for the philosophy of science.

1. PHENOMENOLOGY AND THE PHILOSOPHY OF TECHNOLOGY

The phenomenological approach has always occupied an important place in the philosophy of technology thanks in large measure to the great influence of Heidegger, who devoted considerable attention to technology. Phenomenology is a philosophical approach that seeks to overcome the classical, Cartesian dichotomy between subject and object. Against this dualistic notion, phenomenology holds that subject and object—in later phenomenology this becomes "human beings" and "world"—cannot be thought independently of each other, but only as always already related. Humans cannot be conceived apart from their relations to the world, and the world cannot be conceived apart from people's relations to it.

In phenomenological terminology, this connectedness of humans and world is called *intentionality*. This intentionality must not be seen as a goal-conscious activity of human beings. This would imply that the relation of humans and world comes about through a voluntary act that they could just as well refrain from doing. Such a vision again would amount to a sharp division between humans and world, whereas humans are instead related to the world whether they want it or not—they cannot be otherwise. Human consciousness can never be adequately understood or described in isolation as consciousness-in-itself. It never exists by itself, but only as consciousness-of-something. The

same is true of perception: there is no perception-in-itself, since perception is always perception-of-something. Conversely, in the phenomenological perspective, there is no such thing as a thing-in-itself, either. If we experience things, we experience things-for-us, that is, things as they are revealed to us. Humans have no direct access to reality. Their reality is always what it is because it is revealed to them within a specific context of interpretation or praxis. Once again, the same goes for perception; just as perception is always a perception-of, it is also always a perception-as. To relate to the world is to interpret it. We never find ourselves in "the" world but always in "our" world. Things are what they are by virtue of our relations to them, just as we are what we are in terms of our relations to things. Humans and world are inseparably bound to each other and constitute each other in this bondage.

What, then, does all of this have to do with technology? German philosopher Martin Heidegger was one of the first to think about technology from this phenomenological perspective, and his views are an important part of the background against which Ihde's philosophy of technology is to be understood. Central to Heidegger's thought is the question of "being" as the ground of the continuing underlying relations of humans and their world. Humans can have a relation to beings—that is, to everything that "is"—only by virtue of the fact that those beings "are." This "being" of beings always involves a moment of transcendence, of not being reducible to us. That beings "are" and can be disclosed in our relations with them, is not our doing, but a situation in which we always already find ourselves. The "being" of beings transcends humans: it is not their product, but the omnipresent horizon of their relation to beings.

According to Heidegger, "being" must be conceived historically. Being, in Heidegger's terms, "sends itself"—*schickt sich*—in different ways in different historical epochs. In each epoch, "to be" means something different, which leads to a different disclosing of the world. This does not imply, however, that "being" must be conceived as determined by humans. Humans have only limited ways to determine how their world is disclosed, for that disclosure always happens against the background of a particular and historical meaning of "being." This background is not produced by humans, but is something in which they always already find themselves. Being has its own history, which cannot be completely understood through human interventions.

According to Heidegger, modern technology must be understood not as the sum total of technological devices, but as the ways in which our present-day epoch discloses the world. The most distinctive and essential feature of the technological way of world-disclosure is that it involves a forgetting of the moment of transcendence, which is indissolubly related to the being of beings. Technology is domination and control; it "sets upon" or "challenges" nature; it

is a process involving the appearance of nothing transcendent, nothing beyond beings. In the technological form of the disclosure of reality, the world, according to Heidegger, is a *Bestand*—a stock or warehouse—a collection of goods that have been stored up and made ready for manipulation and use. The technological disclosure of the world is not a "letting be" of the world but rather a "summoning" or "enframing" (*bestellen*) of it. What counts as reality is what can be made and manipulated. In modern technology, we encounter only beings, and no longer the "being" that is their ground. We have put ourselves in the place of that ground. In Heidegger's words, we have "forgotten" being.

Heidegger, therefore, thinks of technology as a way—but only *one* way—in which reality can be disclosed. Insofar as he thinks of concrete technological artifacts, it is as the products of this technological interpretation of reality. Heidegger does this deliberately, for his project is to understand "the essence" of modern technology. According to him, "the essence of technology is by no means anything technological," any more than the essence of a tree can be found among trees (Heidegger 1977, 4). Heidegger wants to understand technology as more than "a means to an end" or "a human activity." Technology, according to him, *is* indeed a means for ends and a human activity—these are what he calls the instrumental and anthropological definitions of technology—but its "essence" lies at a deeper level. Heidegger wants to understand "within what do such things as means and end belong?" (6). He thus questions "backwards," from concrete equipment and procedures to the underlying way in which reality is disclosed, which makes these equipment and procedures possible. In short, his questioning is not about "technologies" but about "Technology."

This approach was firmly rooted in the tradition of the philosophical thinking about technology in its early days. The pioneers of the philosophy of technology generally occupied themselves with trying to identify the essential characteristics of technology, and with trying to clarify its role in our culture. But the new generation of thinkers about technology discussed in this book no longer thinks in terms of Technology per se, and finds it problematic to try to understand phenomena in terms of essences. The philosophers of this new generation adopt various approaches in concerning themselves instead with concrete technologies and the roles they play in their specific contexts.

Don Ihde's approach, as mentioned, accomplishes this turn from Technology to technologies within phenomenology. In his thinking he breaks with the phenomenological tradition's conception of technology as stemming from a specific and limited way of disclosing reality. Ihde seeks to reflect about technology as it is concretely present in our daily existence: in the form of technological artifacts. Instead of questioning "backwards" he questions "forwards";

that is, instead of reducing technological artifacts to the technological form of world-disclosure that makes them possible, he asks what form of world-disclosure is *made possible by* technological artifacts.

The scope of Ihde's attention therefore is the relation of human beings to technological artifacts. From the perspective of human-technology relations he tries to understand the role of technology in the human lifeworld. Ihde inquires into the relation between human beings and technological artifacts on two levels: experience and culture. On the level of experience he inquires into the role that technological artifacts can play in the relation of human beings to reality; on the cultural level he inquires into the relation between technological artifacts and culture. These two sides of Ihde's research in the philosophy of technology will be discussed separately, followed by an overview of the way Ihde connects his philosophy of technology to the philosophy of science.

2. HUMAN-TECHNOLOGY RELATIONS

Ihde's conception of phenomenology is a manner of thinking that occupies itself principally with human experience, and specifically with the *structure* of experience (Ihde 1990, 21, 23; 1986, 21). Ihde calls his analysis of human experience *relativistic* (1990, 23–25; 1998, 46)—not in the sense of an epistemological relativism, but rather in the more literal sense of an *analysis of relations:* "A phenomenological account . . . always takes as its primitive the relationality of the human experiencer to the field of experience. In this sense, it is rigorously relativistic. The relationality of human-world relationships is claimed by phenomenologists to be an ontological feature of all knowledge, all experience" (1990, 25).

It is understandable that, according to Ihde, experience plays such a crucial role in phenomenology, since experience is the place where the mutual relation between human beings and their world can be localized. Ihde analyses human experience in terms of perception. He considers perception the key to understanding what was just called the "relation between human beings and their world." Perception is as it were the interweaving of both: in perception, human beings and world—or subject and object, for that matter—are not separated but always intertwined. Only afterward, when a perception is described and not enacted, does it make sense to separate out a perceiver and a perceived; or a subject and an object, as one says. In the perceiving itself that cannot be done, since to perceive is to perceive *the world.* In experiencing, people are as much "in" the world as the world is "in" them: they cannot be separated.

Ihde distinguishes two dimensions of perception. The first is sensory per-

ception, a bodily dimension that Ihde calls *microperception.* The second, an interpretive dimension that discloses meaning and is cultural in nature, he calls *macroperception:*

> What is usually taken as sensory perception (what is immediate and focused bodily in actual seeing, hearing, etc.), I shall call microperception. But there is also what might be called a cultural, or hermeneutic, perception, which I shall call macroperception. Both belong equally to the lifeworld. And both dimensions of perception are closely linked and intertwined. There is no microperception (sensory-bodily) without its location within a field of macroperception and no macroperception without its microperceptual foci. (1990, 29)

While it is true that microperception and macroperception can be distinguished from each other, they cannot be separated. A bodily perception can no more exist without being interpreted than an interpretation can exist without something to be interpreted. The two-fold meaning of the word *perception* to which Ihde points is illustratively present in the verb "to see," which we can use to describe a bodily-sensory perception ("I see a tree") and to characterize an interpretation of the world ("Since that talk I see things completely differently").

Ihde pursues his analysis of the role of technology in the interrelation of human beings and world by inquiring into the forms of these interrelations when technological artifacts are involved. To that end he distinguishes three different ways in which human beings can relate to technological artifacts. The first of these human-technology relations is the relation in which our perception is mediated by a technological artifact. In such a "relation of mediation" we are not *directly* related to the world but *via an artifact*—as for instance whenever we wear glasses or watch television. A second kind of relation, which Ihde calls an *alterity relation,* is a relation not via an artifact to the world but to an artifact itself. The third kind of human-technology relation Ihde calls a *background relation,* in which technological artifacts shape our relation to reality but by remaining in the background, as do thermostats that automatically switch the heat on and off without our intervention or even awareness. These human-technology relations will be discussed separately below.

Relations of Mediation

Technologies play an important role in our daily lives by mediating our experience. We read off the temperature via thermometers, we remember events via photographs, we speak with each other via telephones, and we keep abreast of current events via television. In all of these cases we are not directly in bodily-sensory experience present to the world but via technological artifacts. What happens to our perception when it is enacted via technologies?

Ihde begins to work out his answer to this question with the aid of Heidegger's analysis of tools and Merleau-Ponty's analysis of the role of "embodiment" in perception. Heidegger, in his analysis of equipment, asks himself how best to characterize the way that a tool or useful thing is present to human beings. He concludes that a tool is "something in order to"; it is serviceable, helpful, usable (Heidegger 1996, 64). A tool does not exist by itself, but in a context to which it refers. A hammer is for hammering: it is most present to us as a hammer when we hammer with it rather than use it as a paperweight, for instance. More generally, the way to encounter a tool as a tool, and not just as an object lying around, is not to examine it theoretically, but to take it up and actively use it. When this happens, the tool has the kind of being that Heidegger calls "handiness" or "readiness-to-hand" (*zuhandenheit*). It is characteristic of something handy that it withdraws itself in order to be handy. Someone who is hammering is not concerned with the hammer but rather with what is being done, or made, with the hammer. Only when human beings are not concerned with the tool but rather with the work that they are doing with their tools do these tools become present to them *as* tools. Tools call attention to themselves only if and when it is impossible to do anything with them; we notice our handy tool-objects only when, for whatever reason, they suddenly become unusable. The reliable dealings we are accustomed to having with them is disrupted, and the object suddenly forces itself on us, as does a hammer when its head flies off the handle. The tool is then "objectively present" or "present-at-hand" rather than "handy."

Ihde finds in Heidegger's analysis of the ways in which tools are present for human beings three elements of special significance. First, Heidegger shows that each tool, each piece of equipment is related to a context. In itself it is nothing; as a piece of equipment it is a part of a meaningful whole. "This field within which a tool is what it can be is a complex one filled with 'involvements' or cross-relations" (Ihde 1990, 32). Second, it is clear from Heidegger's analysis that equipment has an "instrumental intentionality"; a tool is "something in order to," and in that "in order to" there is always a reference of that tool to a context, to whatever can be done with it. Later in this chapter we shall return to this concept of "technological intentionality." The third element Ihde considers important is that Heidegger shows that the tool, when used in practical activity (and not in descriptions of it), is a means of experiencing, rather than an object of experience.

This last element is central to Merleau-Ponty's analysis of the role that objects can play for human beings. Ihde finds in Merleau-Ponty a still deeper sensitivity to the relation between the human body and the world that lays the groundwork for a phenomenology of technology, and points to two examples

that Merleau-Ponty gives that are especially illuminating concerning how human beings are related "through objects" to the world: "the woman with the feather in her hat" and "the blind man with the cane." Merleau-Ponty uses these examples to show that human beings can use artifacts to stretch the spatiality of their bodies. A woman with a feather in her hat can extend her area of sensitivity to the world to the point where she can keep a safe distance between the feather and objects that might damage the feather, stooping instinctively when necessary; "she feels where the feather is just as we feel where our hand is" (Merleau-Ponty 1962, 143). The image of the blind man's cane carries this a step further, making it clear that human beings can not only extend the spatiality of their lived bodies with the aid of artifacts but perceive with them as well. With his hand, a blind man feels not so much the stick as the street and the objects in the way *through* the stick. Just as Heidegger's carpenter is not involved so much with the hammer while at work as with the nail to be nailed in place, so a blind person is not truly involved with the cane as with the world through the cane. These images of Heidegger and Merleau-Ponty are in effect complementary. While Heidegger analyzes the ways in which artifacts are present to human beings, "withdrawing" from their experience, Merleau-Ponty analyzes the relations to the world that can arise on the basis of this presence.

These analyses, taken together, point to a structure of perception that can be described in terms of mediation. The intentional relation between human beings and world is as it were extended or stretched out through artifacts. Ihde schematizes the difference between unmediated and mediated perception as follows:

unmediated perception: I—world
mediated perception: I—technology—world

It must be noted that by "unmediated" Ihde means unmediated *by artifacts.* As will shortly be seen in the discussion of Ihde's conception of hermeneutics, all perceptions are in a certain sense mediated, because human beings never have direct access to the world but only via interpretation. Ihde is not concerned here with mediation of this type—through language, for instance. When he speaks of "naked perception," he means not some pre-interpretive access to reality but a perception that takes place without the intervention of an artifact on the microperceptual level.

In analyzing a number of examples of mediated perception, Ihde comes to the conclusion that there are two basic sets of relations with artifacts in which they mediate people's relations with their world. The first involves what he calls *embodiment relations.* In these relations, human beings take technological artifacts into their experiencing, and thereby broaden the area of sensitivity of

their bodies to the world. An example of the embodiment relation involves the wearing of eyeglasses. When I wear eyeglasses, I do not look at them but through them at the world. I take as it were the pair of glasses into myself; it withdraws from my perceiving. But embodiment relations are not restricted to the visual. A dentist, for example, who uses a dental probe to feel out cavities in my teeth is using the probe to extend the sensitivity of touch, feeling cavities via the probe. Ihde schematizes embodied relations as follows:

embodiment relations: (I-technology) → world

The most important characteristic of embodied technologies is that they possess a certain transparency. They call attention not to themselves, but to (aspects of) the world given through them. In order for this transparency to occur, however, several conditions must be met: (1) The artifact must be technically serviceable; that is, its physical characteristics must allow it to be embodied. A pair of glasses made with opaque glass cannot serve embodied perception. (2) A certain skill or technique is required to perceive through the artifact; those not trained in dentistry cannot use dental probes to detect tooth decay. (3) The artifact should aim at making mediated perception take place in a way comparable to unmediated perception; a telescope ordinarily delivers a picture of a planet with roughly the same size as a microscope ordinarily delivers a picture of a red blood corpuscle—"the image size of galaxy or amoeba is the same" (Ihde 1990, 79).

The second set of mediated relations with artifacts consists of *hermeneutic relations.* In hermeneutic relations, too, we are involved with the world via an artifact, but the artifact is not transparent. The artifact does not withdraw from our relation to the world but provides a representation of the world, which requires interpretation in order to impart something to us about it. Because this relation involves interpretation (the artifact must be "read"), Ihde calls it hermeneutic, using the traditional term for the philosophical-theological discipline of reading signs—though his usage, as we shall see, is somewhat unconventional and provocative. In hermeneutic relations the world is not perceived through the artifact but by means of it. Ihde schematizes hermeneutic relations as follows:

hermeneutic relations: I → (technology-world)

An example of a hermeneutic relation with an artifact is the use of a thermometer. When we read a thermometer, we are not involved with the thermometer itself but with the world of which the thermometer reveals an aspect: its temperature. This revelation, however, does not have the character of a *sensing* of temperature but is rather a *representation* of it.

So what are the implications of these technological mediations for our experience? Mediation, for Ihde, is indissolubly linked with a transformation of perception. Naked perception and perception via artifacts are never completely identical. In this transformational character of technological mediation lies an important aspect of the non-neutrality of technology. This transformation of perception has, according to Ihde, an extensive structure involving amplification and reduction. Mediation always strengthens certain specific aspects of the reality perceived and weakens others. Whenever we look through a spyglass, for instance, we see objects that we wouldn't otherwise, and to this extent our visual access to reality is strengthened. But at the same time, we do not hear, smell, or feel what we see; our perception has been reduced to the visual. The dental probe is still a better example, since it shows the structure of amplification and reduction within the same sensorial field: it improves certain kinds of feeling while curtailing others.

The transformation of perception, with its structure of amplification and reduction, appears in different gradations. When we compare mediated perception with naked perception, we can distinguish between transformations of low contrast and transformations of high contrast with respect to perception "with the naked eye." The transformation that a pair of eyeglasses brings about, for instance, is a transformation of low contrast. The world that eyeglass wearers perceive strongly resembles the world that they saw before they needed glasses; the only difference is that the image is enframed. The transformation effected in a spectrogram, however, is of an entirely different order. A spectrogram is a visual deposition of the light given off by, say, a star, from which information can be derived about the star's chemical composition. The spectrogram's band of colored stripes is as removed as possible from the star that we see with the naked eye; nevertheless, it reveals important aspects of the star. This is a transformation of high contrast.

These mediations of microperception have consequences for macroperception, for the manner in which human beings interpret their world. Embodiment relations and hermeneutic relations can be viewed as the extremes of a continuum. As we move on this continuum of embodiment to hermeneutic relations more toward the hermeneutic pole, the transformation that reality undergoes in the mediation is one of progressively higher contrast: the perception effected by the mediation deviates ever more sharply from unmediated perception. The reason for this is that what mediated perception can make visible is determined with ever more specificity as the mediation grows more hermeneutic in nature. A hermeneutic technology, after all, provides a representation of reality, which implies that the design of such a technology predetermines which aspect of reality is to be made perceptible by it and in which

ways. The "space" available for reality to express itself becomes more restricted as the mediation of our perception becomes more hermeneutic in nature.

A pair of eyeglasses, for instance, that effects a transformation of extremely low contrast, provides access to reality in practically the same domain and with the same possibilities of interpretation as perception that is not mediated by technology. A spyglass and a telescope do that to a lesser extent, in that some of "the whole" of experience available in unmediated perception must be given up: experience is reduced to vision here. At the same time these technologies open worlds that previously had been hidden, since they allow us to see things we could not see without them. The transformation effected by a microscope is still greater because it makes perceptible a reality that deviates more strongly from our daily reality. Although biologists and medical specialists are able to embody the microscope in such a way that they know their way about in the new reality it discloses, this reality differs strongly from the world in which we live: looking in a microscope puts you in another world, which is more difficult to describe in terms of our everyday lifeworld. A spectrogram, finally, reveals reality only in terms of scientific phenomena, which further restricts the number of possible interpretations. It reveals only one aspect of reality, and a scientific one at that: the chemical constituents of the phenomena perceived.

The insight that technologies can play a mediating role in our experience, in which certain aspects of the world are strengthened and others weakened, therefore points to the need to nuance the classical, Heideggerian thought that technology consists of a specific, and reduced, interpretation of the world. According to Heidegger, technology is characterized by an interpretation of the world as "standing reserve," or *Bestand;* as a storehouse of goods that lie ready for human manipulation. This interpretation allows the world to appear only in a very limited respect: under the guise of control and domination. But whenever we consider technology in terms of concrete, mediating artifacts, as does Ihde, it becomes clear that our dealings with these artifacts do not require us to have such a "controlling" interpretation of the world. A tree is not forced to show itself as firewood or as potential furniture material when viewed through a pair of eyeglasses; rather, the pair of eyeglasses opens up to its wearer the same domain of possibilities of interpretation as are available to the non-eyeglass wearer. But there is more: technology can even allow the world to manifest itself in new ways. Ihde points to infrared photography as an example. In this form of photography we lose, to be sure, the non-visual aspects of the photographic object and the depth of the unmediated image, but at the same time it makes perceivable things that remain invisible to the naked eye (Ihde 1991, 73–74). It is easier to tell whether the trees are diseased on the basis of infrared photographs of trees than through inspection with the naked eye.

Technology, conceived as concrete technological artifacts, therefore does not necessarily reduce our relation to the world to "setting upon" or "summoning." It can indeed constrict our access to the world, but at the same time it offers us different ways of access to the world, even ones that would be impossible without technology. The nature of these ways of access varies from technology to technology, because technologies transform perception differently. Technologies are more ambivalent than alienating, with respect to the interpretations of the world with which they are linked. When they mediate our experience, they have as much a reductive as a strengthening impact on our experience. The more it is possible to embody a technology, the less it predetermines in which ways the world can manifest itself through it, and the less it reduces our interpretation of the world. Moreover, both embodied and hermeneutic technologies can make possible new modes of access to the world, which would be impossible without mediation.

One question that might arise from this analysis of technological mediation is whether Ihde remains faithful here to the phenomenological ambition of overcoming the subject-object schema. For he appears to affirm that schema in his analyses of the roles of technologies in the relations between humans on the one side and the world on the other. By locating mediation "between" human beings and world ("I-technology-world"), Ihde seems to put subject and object over against one another, instead of starting from the idea that they mutually constitute each other. This problem deserves some attention, since it gnaws at the roots of this approach to the phenomenology of technology.

There is a solution to this problem. The central thought of phenomenology, that subject and object must be thought of as mutually interwoven, does not necessarily clash with Ihde's analysis of technological mediation. It might be tempting to conceive mediation as a process in which a transformation occurs of the manner in which a subject (human) experiences an object (world)—in other words, as a process between a fixed subject and a fixed object in which only the manner in which the object is experienced by the subject is affected. Yet from a phenomenological point of view this is not what is happening in technological mediation. For a phenomenologist, the interrelation between subject and object always precedes the subject and the object themselves; the subject and the object are constituted in their interrelation. This notion of mutual constitution must be borne in mind when considering Ihde's discussion of the various relations between humans and artifacts. The difficulty with this, however, is that the "interrelation" of subject and object—or human and world—concerns a level that in fact precedes subject and object (human and world), and that there is no way to speak about this interrelation without making use of the words "subject" and "object," or "humans" and "world."

Mediation by artifacts must, therefore, not be seen as a mediation "between" subject and object, but as a mediation of a sort in which both subject and object are constituted. Mediating artifacts shape not only the way a predefined subject relates to a predefined object or the way a predefined object can appear to a predefined subject. They shape the interrelation itself between subject and object, from which both are constituted. Mediation does not simply take place *between* a subject and an object, but rather *co-shapes* subjectivity and objectivity. Formulations in terms of the "access to reality" offered by an artifact should be read as relating to the way in which an artifact makes possible the constitution of a world and a human in the very process of perception. Humans and the world they experience are the *products* of technological mediation, and not just the poles between which the mediation plays itself out.

Alterity Relations

The second human-technology relation described by Ihde is the alterity relation. In alterity relations humans are not related, as in mediating relations, via a technology to the world; rather, they are related to or with a technology. The role played by technologies in this set of relations can be characterized as that of a "quasi-other." This set of relations can be formalized as follows:

alterity relations: I → technology (-world)

Technology appears in alterity relations as quasi-other, because while we may encounter technologies in ways in which they seem to behave as an "other," they can, of course, never be present as a true person. Humans often approach the technologies that they encounter in anthropomorphic ways: they project human properties on artifacts ("intelligent computers"), or entertain certain feelings for them ("caring for" a piano). As Ihde points out, an automobile can indeed be seen as an other that I can care for, but it is far less of an other even than a horse, in whose place I can also put myself, but which does not always obey—and can even start or rear if a rabbit happens to cross its path. The otherness of technologies is of a completely different sort. The reason that technologies in alterity relations are experienced as quasi-other is that technologies on the one hand possess a kind of independence and on the other hand can give rise to an "interaction" between humans and technologies. Many toys, such as tops and music boxes, are fascinating precisely because of the apparent autonomy that they possess. Robots possess such an autonomy, to the extent that one could truly speak of "interacting" with these technological "beings." And today, automatic train ticket machines can not only take money and dispense tickets, but also give advice, provide route information, answer questions, and protest when something is done incorrectly.

As mentioned above, hermeneutic relations and embodiment relations form the extremes of a continuum. That continuum, however, is but a part of a still greater continuum, in which alterity relations also play a role. On the one end of this continuum are embodiment relations, in which technologies have the role of a quasi-I. In embodied relations technology always coincides as it were with myself. At the other extreme are alterity relations, in which technologies are present as a quasi-other, as indicated above. Between these two are hermeneutic relations, in which the technology on the one hand mediates and is therefore not present "as itself," but at the same time draws attention to itself because it is not embodied but "read."

Background Relations

The final set of human-technology relations that Ihde identifies is background relations. In contrast with the two kinds of relations already discussed, technological artifacts in background relations do not play a central role in our experience. In background relations, we are related not explicitly to a technology or via a technology to the world; instead, technologies shape the context of our experience in a way that is not consciously experienced. Schematically:

Background relations: I (-technology/world)

Refrigerators and central heating systems are examples of technologies with which we can have a background relation. These technologies switch themselves on and off in the background of our experience; we notice scarcely if at all that the room temperature is almost always the same and that the refrigerator is on. Technologies give rise to a background "field" in which we can have experiences without explicitly experiencing these technologies. They are present and absent at the same time: without us noticing them, they give form to our experience by shaping a context for it. And they can have many of the same transformational characteristics as the other technologies mentioned, with which our involvements are much more explicit. Their (absent) presence is usually experienced only when they stop functioning—when a storm knocks out the electricity, for instance. In such cases the context shaped by the background technologies, which we otherwise take for granted, is suddenly not self-evident any more.

3. TECHNOLOGY AND CULTURE

Ihde seeks to understand human-technology relations not only on the level of human experience, but also on the level of culture. Clarifying the relation between technology and culture has been the ambition of many philosophers

of technology. In all the various approaches to this relation, two extreme positions can be characterized, which can, after Borgmann, be called *instrumentalism* and *substantivism* (cf. Borgmann 1984, 7–12). Instrumentalists see technology as a mere tool, as the means to accomplish certain tasks. Within this approach technology appears as something neutral; if technology is viewed as a means to an end, this implies that it is not to be judged in itself but only in its use. Substantivists, on the other hand, think that instrumentalists overlook the fact that technology is not at all neutral. According to the substantivists, technology must be understood as an independent power that can alter culture drastically. The substantivists attribute two properties to technology. First, they conceive of technological development as something autonomous. Technology always gives rise to new possibilities, and these new possibilities are always realized eventually. Nothing can stop technological development; technology follows its own dynamic. Second, the substantivists ascribe to technology the ability to change culture. Technological development, so to speak, takes culture along with it.

Ihde considers both positions to be unsatisfactory. Underlying both instrumentalism and substantivism is an assumption that he finds to be untenable: that one can speak about technology independently of the humans who are involved with it and the culture in which it functions. Technologies, according to Ihde, do not exist "in themselves," but only as related to humans and to culture, for humans are always and only involved with technology in a cultural context. One could say that Ihde is making here the same phenomenological move that others in that tradition made with respect to "consciousness" and "perception." Just as perception-in-itself and consciousness-in-itself do not exist, neither does technology-in-itself. Just as perception can be understood intentionally only as perception-of, and consciousness only as consciousness-of, so technology can only be understood as technology-in-order-to. The "in order to" indicates that technologies always and only function in concrete, praxical contexts and cannot be technologies apart from such contexts. In Ihde's words: "Were technologies merely objects totally divorced from human praxis, they would be so much 'junk' lying about. Once taken into praxis one can speak not of technologies 'in themselves,' but as the active relational pair, human-technology" (Ihde 1993, 34).

But just as technology cannot be grasped in isolation, neither can culture. A culture is only what it is in the praxes in which it manifests itself—praxes that are mediated by technologies. Not only does technology become what it is in and through the interweaving of technology and culture, so does culture and the human beings using the technology: "The human with a steel axe is different than the human without one—the transformational effect becomes

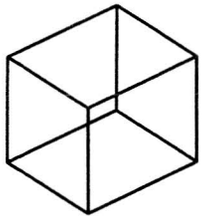

Figure 1 The Necker cube.

clear when we regard as the *primitive* of our analyses, this *human-technology pairing*" (Ihde 1993b, 34).

Multistability

The insight that technologies are indissolubly linked with humans-in-culture implies that technologies have no "essence"; they are only what they are in their use. Ihde names this ambiguity of technology *multistability,* and to clarify what he means he makes use of a perceptual example, the so-called Necker cube (figure 1).

When we look at this figure, we can see more than one thing. Sometimes we see a three-dimensional cube with the top surface and two side surfaces facing us, while at other times we see a cube with the bottom surface and two side surfaces turned toward us. If we try, we can make what we see switch between the two cubes. We can also interpret the figure two-dimensionally and see it as an insect with six legs sitting in a six-sided cell of its web. Ihde uses this example to illustrate that different ways of seeing produce different figures. The figure allows multiple interpretations. What it "really" is remains undetermined. It is many things at once; it is "stable" in multiple ways.

Something similar, according to Ihde, is at work in the relation between culture and technology. As with the Necker cube, so with technologies: one cannot say in isolation what they "really" are. Technologies are always technologies-in-use, and this use context is part of a larger cultural context. This contextuality makes technologies multistable, in a way that is analogous to the different possible ways of "seeing" the Necker cube: the same artifact can have different meanings or identities in different cultural contexts. Ihde illustrates this multistability with the aid of examples involving technology transfer between cultures. One of these examples concerns the "cultural embeddedness" of sardine cans in New Guinea, which in the 1930s were left behind by Australian gold prospectors and snatched up by the inhabitants for use as the centerpieces of their headgear (Ihde 1990, 125). But Ihde also uses examples closer to home; the early development of the typewriter and the telephone, he says, were driven by the desire to design equipment for the blind and hard of hearing to help them hear and write. The context in which they actually functioned, however, quickly defined these devices in a way that was much more than what they were designed for. They were seen not only as aids for the blind and hard of hearing, but as devices that were meaningful and useful for everyone (Ihde 1993a, 116). Feenberg's analysis of the introduction of Minitel in France, discussed in chapter 3, is another good illustration of the multistability of technologies. What these technologies "really" are cannot be determined with finality.

The multistability of cultural relations to the world implies not only that artifacts can have different meanings in different cultural contexts, but also that the same goals can be technologically realized in different ways. Ihde's favorite example of this is the difference between Western navigational techniques and the traditional navigational techniques of the South Sea islanders. While Western navigation is strongly instrumentally mediated and mathematical in nature—one navigates with charts and compasses—the South Sea islanders navigate by carefully observing stationary clouds (which hang over islands), birds, and wave patterns (Ihde 1990, 146–49). The South Sea islanders had an extremely complex navigational system and could navigate at least as well as the first Westerners who encountered them at the time of the first voyages of discovery. Though their navigational system was not technological in nature, instruments could in principle play a role in them, in the form of instruments that could peer through mist, make wave patterns more perceptible, and so forth. The cultural "way of seeing" of the South Sea islanders could then give rise to an entirely different technology than the Western one involving charts and compasses. The South Sea system always "looks" laterally from the position of the navigator, which calls for a completely different type of navigation than the Western system, which looks from overhead, down on the water and land. Human ends, therefore, can be realized in many different ways, depending on the cultural context in which they play a role. Different cultural contexts, different "ways of seeing," thus can lead to the development of different technologies.

The insight that technology can be described only as interwoven with culture, and that this interwovenness makes technologies multistable, makes the substantivist position untenable. Technology cannot be understood as an independent power that holds culture in its grip, for its form is ambiguous; it becomes what it is only in the context of culture.

Technological Intentionality

Following this discussion revealing the cultural index of technology, we seem to be back at the instrumentalist position where we began. If the cultural context determines what a technology is, it seems to follow that the technology itself has a certain indifference with respect to what it is, and therefore cannot play any significant role in culture and everyday life. But this is not the case. It is true that Ihde's remarks about multistability are intended to undermine substantivist conceptions that reify technology into a unified and stubborn force. Nevertheless, his deconstruction of this determinism does not at all turn technology into something soft and pliable that assumes whatever meanings culture would give it. Technology, according to Ihde, possesses a certain "robustness" and therefore is as little neutral as it is determining. Ihde calls this robustness of technology *technological intentionality* (Ihde 1990, 141). By this he means that because technologies provide a framework for human actions, they have a certain influence on those actions.

This influence does not have the character of a determinism but rather that of an inclination or "trajectory." Technologies "want" people to do things in particular ways, as it were: they have a certain "intention" and promote this intention among their users.[1] As an example, Ihde mentions the difference in writing style that arises when one writes with a fountain pen, typewriter, or word processor. One writes slowly with a fountain pen, with the result that it allows one to think over the sentence several times while composing it. The compositional speed is much faster with a typewriter, which tends to promote a style much closer to that of spoken language. And a word processor, in contrast to pen and typewriter, vastly expands the ability to compose a text; for instance, sentences can be moved around and footnotes inserted at will. These writing technologies do not have a determining influence, for one can indeed write a slowly composed and carefully thought out text on a word processor and can capture the cadence of spoken language using a pen. But the technologies in question incline toward a distinct use. The thoughts that Ihde develops here concerning "technological intentionality" recall Winner's discussion of the "politics of artifacts" and what constructivists call the "script" of technological artifacts. Technologies, so to speak, can play a role of their own when people use them. Far from being neutral, they can "ask" in compelling ways for specific ways of being used; they can contain their own implicit "application manual."[2]

The technological intentionalities discussed so far have chiefly concerned individual human-technology relations. But technologies can play a role of their own on the cultural level as well. In the last part of *Technology and the Lifeworld,* "Lifeworld Shapes," Ihde sketches out a number of character traits

of the technological lifeworld to illustrate this point. The first and most important "cultural intentionality" that Ihde mentions is that technology has transformed our culture into what he calls a pluriculture. Here he cites explicitly communication, information, and imaging technologies, technologies that mediate our experience (Ihde 1990, 164–67; see also 1993b, 62). These technologies have made possible an exchange between cultures to such a large extent that they have come to play a role in the everyday life of almost everyone. Thanks to the media, we are confronted with many other cultures than our own. This confrontation does more than allow us to see what goes on in another culture from a distance; it effects an exchange of cultures on a daily basis.

Ihde speaks pointedly not of multiculturalism but of pluriculturalism. By *multiculturalism* he understands the co-existence of several cultures that in principle could exist apart from each other. The term *pluriculturalism* denotes, by contrast, that several cultures simultaneously play mutually interwoven roles in our lifeworld. Pluriculturalism goes further than the fact that we eat Chinese, Italian, and French foods, and that we decorate our living rooms with African carvings and Indonesian batiks. The pluriculturalism of the contemporary lifeworld entails that it is not enough to have a single cultural interpretive framework, a single "macroperception." We have to be able to "see" in several ways at the same time; we have to have a "compound eye," in Ihde's words, the way the director of a television program has several television screens playing simultaneously in the studio directing room. The world has become a mosaic and cannot be engaged from a single cultural interpretive framework (cf. 1993a, 114–15).

Ihde points to still another important change in our culture wrought by technological development: technologies create a "decisional burden" because of the many new choices they make possible. Having children, for instance, is no longer something that simply befalls us but has become a conscious decision. For those who are eager to have children but are unable to conceive, there are a steadily increasing number of options available. Prenatal diagnosis opens the possibility of terminating pregnancies of unwanted types of fetuses, and so forth. All of these technological developments create ever more moments, as well as kinds, of choice. And we no longer have the freedom to shirk them: "The one choice I do not have is the choice not to make a choice," Ihde says, with a nod to Sartre (1990, 181).

More generally, it can be said that technological developments produce ever more contingency (Ihde 1990, 183–84). That is, it is ever less obvious that things are "for good" what they are now, because ever more things that were once taken for granted have become controllable or at least influenceable through technological developments. The increasing pluriculturalism adds to

this increasing contingency. In a lifeworld that cannot be engaged from a single way of seeing, interpretations are no longer self-evident; there are always several ways of seeing, without any one being a priori more adequate than the others.

Neutrality or Substantivism?

What is the significance of all this for understanding the relation between technology and culture? Ihde's arguments concerning the coming about of a pluricultural lifeworld, and the increasing contingency and decisional burden, weaken the instrumentalist conception of technology. Technology, after all, cannot be neutral if it is able to change a culture drastically. But doesn't Ihde thereby return us to a substantivist conception of technology as a relatively independent force? Ihde raises this question himself—"At the end of this second program, then, it appears that a different form of technological-cultural determination has reappeared" (1990, 161)—but he does not explore further the implications of this. How is his claim that there is a "different form of technological-cultural determination" related to his claim that technology is precisely not deterministic because it always has a cultural index? Does the cultural context have the last word, because a technology is what it is only inside that cultural context—or do technologies have the last word, because they have specific intentionalities by virtue of which they can change culture? To put it another way: Is the cultural relation to technologies multistable, or do technologies have a culture-changing power?

In seeking to resolve the tension between these two claims, it is helpful to reflect further on the cultural role of imaging technologies. If we try to understand the multistable cultural embeddedness of television, for instance, it is possible to say, analogously to the case of the sardine cans interpreted as ornaments for headgear, that the artifact that we call a "television" can indeed have several roles; as an occasional table, for instance, or as a display case for family pictures. But these other "stabilities" of the television-artifact do not possess the specific ability of the television: to reproduce images that were made elsewhere. Although a television can be used as a table, as soon as it is used as a television one of its "intentionalities" is to bring us in contact with other cultures, and so to contribute to the realization of a pluricultural framework of interpretation. The television thus owes its identity not only to itself, but to its context as well; but whenever it receives an identity in its multistable use context—whenever human beings relate to the artifact as a television and not as a display case—it contains its own script within that relation.

It does not therefore follow from the idea that cultural relations to the world are multistable that technology is unable to effect cultural change. Technologies are eminently able to do so, even though their role always depends on the specific context in which they function. Ihde's idea that technology can be understood only as interwoven with culture does not imply that technology cannot influence the context in which it plays a role. Technologies can do so precisely because they are always interwoven with culture. The tension between multistability and substantivism is thus only apparent. Once a relation to a technology is taken on, the relation to the technology is stable rather than multistable and the technology is able to influence the relation taken toward it, without its influence on the relation being deterministic. In principle, several cultural relations are always possible toward an artifact. But once a relation with an artifact is taken on, a "technological intentionality" arises within that relation.

4. SCIENCE AS TECHNOLOGICAL HERMENEUTICS

In *Instrumental Realism, Expanding Hermeneutics,* and elsewhere, Ihde has examined the implications of his philosophy of technology for the philosophy of science. Here, too, perception—both microperception and macroperception—plays a central role: Ihde investigates the consequences for the philosophy of science of his analyses of the role of technology in human perception.

One obvious connection between Ihde's approach to technology and the philosophy of science arises from his understanding of macroperception. Ever since Kuhn, the philosophy of science has developed in such a way as to take ever more seriously the context dependence of scientific knowledge. In place of seeking possible ways to ground scientific knowledge in reality, to find characteristics of a language adequate to speak about reality, or to discover the conditions of possibility for scientific knowledge, contemporary philosophy of science has sought to understand how the significance of scientific statements arises from the context in which they were formulated. Following Kuhn, philosophers of science have seen its development as moving, not ever closer toward a final solution to a puzzle, but rather from one framework of interpretation to another. Science always takes place inside what Kuhn called a *paradigm;* it is the work of a community of scientists who share an interpretation of reality as well as a definition of the problems deemed to be important.

Kuhn therefore did not inquire into the ground of the certainty and possibility of scientific knowledge; he relativized this ground by historicizing it. Foucault did something similar, according to Ihde, through his concept of *episteme.* Foucault's concept is less sociologically laden than Kuhn's "paradigm," and describes the "way of knowing" of a specific period specified by the language spoken by the scientists—the "discourse" with which they engage each

other (Ihde 1991, 33). In the concepts of paradigm and episteme Ihde sees parallels with his own concept of macroperception. Science has to do with the ways of seeing of scientists.

This association with "seeing," however, at the same time brings to light a lacuna in the "new" (contextualist) way of thinking about science, or at any rate one aspect of science that deserves further attention in it. Science, to be sure, is to be understood as a "way of seeing," but everything said so far has localized this to the macroperceptual level only. Besides this, however, science also has everything to do with "seeing" on a microperceptual level—with concrete sensory perceptions. According to Ihde, science must not only be related to the contexts of interpretation in which it takes place, but at the same time to the sensory perceptions of scientists. And one principal characteristic of contemporary science is that these perceptions are mediated by technologies. Right here, according to Ihde, lies the most interesting connection between his approach to the philosophy of technology and the philosophy of science. Philosophers of science have readily acknowledged that scientists "see" reality in a certain way, but have paid insufficient attention to the fact that these ways of seeing are also based on concrete, but technologically mediated, perceptual seeing.

Ihde's broad thought is therefore that the philosophy of science must complement the study of the macroperceptual aspects of science with an analysis of its microperceptual aspects—and the role technologies play in these. In this way, one might say, Ihde gives a new twist to Heidegger's conviction that technology has primacy over science. Technology has primacy not because the technological mode of thinking is presupposed in scientific thinking, but because contemporary science is helpless without technologically mediated instrumental perceptions (1991, 62–63). The mediation of scientific perceptions by technological instruments is no mere accident, but has become an essential part of scientific knowledge. To understand the context in which scientific knowledge arises, philosophers of science need to extend their attention beyond paradigms and epistemes to include also scientists' perceptions and the technologies that make scientific perceptions possible.

Scientific instruments, for Ihde, are not neutral passageways to "the world itself," as should be clear from the above discussion of his analysis of the technological mediation of perception. Instruments mediate the perceptions of scientists and transform them in the process. Many phenomena studied by scientists would be unobservable without technologies. Radio telescopes, for instance, make things "perceivable" that are not accessible to the naked eye. Computer tomographs and ultrasound scanners produce images of the human body and its structures that would otherwise be unobservable. These mediated

perceptions therefore reveal entities that we would never have known about but for mediating technologies.

Technological instruments, Ihde claims, play an essential role in the generation of scientific knowledge, and studying this role is crucial to understanding contemporary science. Note that Ihde tries to understand science in terms of what scientists *do,* not just in terms of the structure, conditions of possibility, and foundations of the knowledge they produce. Attending to scientific practice does not lead him, however, into a sociological or anthropological perspective, as it does many scholars in the field of science studies. For Ihde, a turn to scientific practice does not mean a turn to the analysis of the social interaction of scientists but rather to the embodiment of science in observations and in the instruments with which these observations take place. Ihde calls his position *instrumental realism.* A philosopher of science who wants to do justice to scientific practice cannot cling to a naive realism, which believes in a one-to-one relation between what scientific knowledge makes visible and what is "really" there. The reality studied by scientists is co-constituted by the technological instruments they use.

Ihde has recently elaborated the connection between instrumental mediation and the content of scientific knowledge in the last part of *Expanding Hermeneutics.* His program there is "to show how science can do a 'hermeneutics of things' by turning them into scientific objects" (1998, 139). In other words, he asks how we are to understand the scientific way of interpreting reality "in action": how reality is "prepared" by technologically mediated interpretations so that science can be done with it. For this, the classical meaning of hermeneutics needs to be expanded. Traditionally, hermeneutics was understood to involve the interpretation of texts, as well as reflection on the process of interpretation and its conditions. Ihde, however, develops a more material conception of hermeneutics. For him, it is possible to interpret things other than texts hermeneutically, and he also discerns non-linguistic forms of interpretation, such as those offered by scientific instruments. Scientific instruments constitute what scientists observe; they "interpret" reality before humans can observe it.

Borrowing a distinction of constructivism, Ihde points to two different ways in which such a material hermeneutics can be carried out: a "strong" program and a "weak" program. In a weak program, instruments are conceived as forming an interface between science and the reality it studies, co-determining how that reality is to be interpreted. A strong program goes a step further, viewing instruments as actually constituting the objects studied by the sciences and therefore co-determining the content of scientific knowledge.

The approach that Ihde characterizes as a weak program occupies itself

with bringing to light the various ways that scientific observation is mediated by technologies. With this, Ihde wants to add a material-hermeneutic perspective to the post-Kuhnian thought that science is to be understood as a "manner of seeing." For Ihde, scientific observation is "*through, with, and by means of instruments*" (1998, 159), and this observation is hermeneutical in nature not only because it forms the basis of interpretations of reality, but also because the mediated seeing provided by instruments always involves, as it were, an "interpretation" performed by the instrument. Instruments prepare reality for observation: they make scientific objects out of it by making it present in very specific ways. "[T]he instrument is already *a hermeneutic device*," Ihde concludes (1998, 149). Following a similar path as Latour, who says that scientific objects are prepared in the laboratory in and through the production of "inscriptions" that make things scientifically analyzable, Ihde argues that laboratory instruments make things "readable." Instruments prepare phenomena in reality to function as scientific objects.

This process of making things readable by turning them into scientific objects can take place in two ways. The first is by transforming something that is invisible to the naked eye into something visible. This can happen via simple magnification, as in the case of microscopes and telescopes, but also by way of more radical means of mediation. For instance, in order to make microorganisms microscopically visible, it is necessary to stain them with aniline dye. In this way they lose their isomorphism with "naked perception"—if naked perception of such small organisms is possible at all. Technologies such as X rays, ultrasound, and MRI scans go a step further: they provide a picture of the human body (or parts thereof) based on the passage of invisible rays, the bouncing of sound waves, or nuclear resonance, phenomena that are not perceivable without technologies and that thus need to be "translated" into the visible. Science is ever more occupied with things whose scale is beyond the reach of human perception, both in the microscopic and macroscopic directions: electron microscopes and radio telescopes make formerly invisible worlds visible. Ever more things that would be invisible without technology have become the objects of scientific research.

A second way in which instruments make things readable is through "text-like visualization." Text-like visualization provides a representation of reality to be "read": graphs, tables, maps, and so forth. This sort of visualization can retain an analogy with direct perception, like the mercury level in a thermometer that is high at high temperatures and low at low temperatures. But such an analogy need not take place. For instance, the way a spectrogram provides an image of a star has no analogy to the star itself.

Ihde's strong program has a more radical goal than the weak program. It

not only aims to show that science always has a hermeneutical dimension insofar as it uses instruments, but at the same time that this hermeneutical dimension is constitutive of the content of scientific knowledge. Ihde indeed develops his instrumental realism as a material-hermeneutic counterpart of (social) constructivism. His principal metaphor in this connection is the "giving of a voice" to things (1998, 172). Scientific instruments "give a voice" to entities, so that they can be heard. The technology used co-constitutes the object that is investigated. Ihde calls this *technoconstitution.*

Ihde provides many examples to make clear the validity and necessity of a strong program. One is the manner in which the investigative domain of astronomy was enormously expanded by the arrival of radio telescopes and techniques to make visible invisible forms of light, such as infrared and ultraviolet. What was not directly observable became constituted as an observable object by translation technologies, allowing new phenomena to be revealed to scientific research. Another variant of technoconstitution is the use of multiple instruments to observe the same object, as the application of X ray, ultrasound, and MRI devices to study the human brain. Ihde speaks of these practices as a material variant of the Husserlian method of "phenomenological variation." Husserl's method for being able to view the "essence" of a phenomenon was to mentally imagine all sorts of variations of the phenomenon so as to be able to intuit what they have in common. Without claiming that essences can be laid bare in science—the idea of "essential intuition" stands squarely opposed to the radical hermeneutical perspective that Ihde wants to carry forward—Ihde says that science often carries out "instrumental phenomenological variations." A phenomenon is perceived throughout manifold ways with the help of different technologies, with the whole of these variations providing a picture of the phenomenon in question. These pictures do not need to converge: different instruments can offer different perceptions of the phenomenon observed.

Science originates in perceptions—but what is perceived is first prepared and made readable by instruments. Scientific observations are technologically constituted, and are not simply depictions of nature. Neglecting this technological constitution would lead to a new variant of the naive realism that constructivists warn about: the assumption of a correspondence between a scientific theory or observation on the one hand, and "reality-in-itself" on the other (Ihde 1998, 178). This assumption fails to recognize the active constituting role played by scientists through their interpretations, practices, and instruments. Until now, this role has been underplayed in science studies due to the tendency to relate the content of scientific knowledge solely to the context of interpretation in which it arose. In so doing, science studies encounters the danger of running into the opposite pitfall of naive realism: naive idealism, or

the view that the ultimate font of knowledge is not the world but our ideas about it. Scientific knowledge is a product not only of interpretations, but also of the material conditions on which these are formulated—the instruments with which scientific observations are carried out.

CONCLUSION

Ihde's work offers an entirely different perspective on technology than that of traditional phenomenology. For however much Ihde and Heidegger pose the same question concerning this issue—"What does technology mean for our relation with the world?"—they arrive at completely different conclusions. Whereas Heidegger sees technology mainly as a controlling way of world disclosure, Ihde articulates a much more ambivalent picture.

The difference between Heidegger and Ihde stems from a difference in the ways in which each conceptualizes technology. As elaborated at the beginning of this chapter, the traditional project of the philosophy of technology consisted of research into the interpretative relation to reality that lies behind technology. Technology was understood as the product of a way of disclosing meaning, and this way of disclosing was extrapolated to culture in general: technology was said to imply a one-sided manipulative relation to the world. Ihde's approach to technology, however, does not begin with this world-interpretation, but with our dealings with the concrete technological artifacts, and the praxes and interpretations that are made possible by them. When the question of meaning is posed from this perspective, an entirely different picture of technology emerges.

On an experiential level, as something that mediates our experience, technology no longer appears to entail necessarily a reduction of the ways in which the world is revealed to us. There are many possible forms of technological mediation that transform our access to the world in different ways; some of these open up to us new ways of access, while others narrow this access. On the cultural level, technology is no longer seen as fostering a coordinated, uniform framework of interpretation in which the world is coerced to appear as *Bestand*, standing reserve. "[T]he predictions of analytic uniformity (Marcuse), of the victory of technique (Ellul), and even of the sheer world of calculative thought (Heidegger) are wrong. There will be diversity, even enhanced diversity, within the ensemble of technologies and their multiple ambiguities, in the near future" (Ihde 1990, 159). Technological culture does not develop in the direction of one-dimensionality, calculativity, and uniformity, but rather in the direction of plurality. Technology does not create one single way of disclosing reality—the "technological way of revealing"—rather, it fosters the proliferation of different ways of seeing within our culture. That is not to deny that important

aspects of reality remain invisible within an exclusively technological way of thinking, only to say that it is a gross misunderstanding to claim that technological culture holds our entire culture in its clutches.

Moreover, technology plays a constitutive role in the production of scientific knowledge thanks to its role in scientific perception. The role of scientific instruments in the production of scientific knowledge runs far deeper than that of "depicting reality": instruments co-constitute the reality investigated. They make visible aspects of reality that otherwise would be invisible, aspects that have to be actively represented and thus "interpreted" by the instrument. In the course of elucidating this process of technoconstitution, Ihde goes much further than Heidegger did in pointing out that science must be seen as applied technology rather than the other way around.

Ihde does more justice to technology than the tradition from which he comes. Phenomenology after Husserl has always seen its main task as understanding the world in its everydayness. With respect to technology, it did not succeed in this. The role of technology in human everyday life involves far more than calculative thinking, and Ihde has begun to forge the tools necessary to understand the richness of our technological lifeworld.

NOTES

1. Ihde uses the phrase *technological* (or sometimes *instrumental*) *intentionality* in another sense as well in his discussion of mediated technologies to refer to the directionality or scope of mediated technologies. A cassette recorder, for instance, has an "intentionality" with respect to sound—a completely different one than human listeners, because it records equally foreground and background noises. Another phrase Ihde uses for this is *technological telos* (1979 77–78; 1983, 56; 1990, 102–103).

2. Phenomenologically speaking, it would be more adequate to localize "technological intentionality" not in technologies themselves but in the relation between humans and world that is mediated by technologies. By mediating this relation, technologies co-shape "intentionality"; they facilitate specific relations between humans and world, and in so doing play a role in the constitution of both. A car, for instance, is not a neutral means of going from point A to point B. It asks for specific ways of dealing with itself and with the world, and thereby helps to constitute in a specific way both the human beings driving it and the environment through which they drive. Mediating technologies are foci around which the interweaving of humans and world gets its shape, thus turning "intentionality" into "technological intentionality."

BIBLIOGRAPHY

Borgmann, Albert. 1984. *Technology and the Character of Contemporary Life: A Philosophical Inquiry.* Chicago: University of Chicago Press.

Heidegger, Martin. 1977. *The Question Concerning Technology and Other Essays.* Translated by William Lovitt. New York: Garland.
———. 1996. *Being and Time.* Translated by Joan Stambaugh. Albany: State University of New York Press.
Ihde, Don. 1979. *Technics and Praxis.* Dordrecht: Reidel.
———. 1983. *Existential Technics.* Albany: State University of New York Press.
———. 1986. *Consequences of Phenomenology.* Albany: State University of New York Press.
———. 1990. *Technology and the Lifeworld: From Garden to Earth.* Bloomington: Indiana University Press.
———. 1991. *Instrumental Realism: The Interface Between Philosophy of Science and Philosophy of Technology.* Bloomington: Indiana University Press.
———. 1993a. *Philosophy of Technology: An Introduction.* New York: Paragon House.
———. 1993b. *Postphenomenology: Essays in the Postmodern Context.* Evanston, Ill.: Northwestern University Press.
———. 1998. *Expanding Hermeneutics: Visualism in Science.* Evanston, Ill.: Northwestern University Press.
Merleau-Ponty, Maurice. 1962. *Phenomenology of Perception.* Translated by Colin J. Smith. London: Routledge.

6. Langdon Winner: Technology as a Shadow Constitution

Martijntje Smits

In 1978 Langdon Winner took a short vacation to San Luis Obispo, in central California, where he grew up during the 1950s. On a sunny December day he joined a tourist bus excursion to a nuclear power reactor under construction in Diablo Canyon. The bus followed a windy road that surmounted several hills, and when the bus reached the top of the last hill, Winner caught his first sight of the gigantic power plant with its two gleaming white cooling towers. In the background lay the capricious coastline of the Pacific Ocean. Right at that moment a huge California gray whale surfaced in the distant waves, blew out a stream of water vapor from its blowhole, and then disappeared again beneath the waves.

In the essay "The Whale and the Reactor," which is included in a collection of essays by the same name, Winner describes how overwhelmed he was by the contrast between these two powerful symbols in such close proximity—one of the power of nature, the other of the power of human artifice (Winner 1986, 168). The experience, which he describes as an "epiphany," made him realize that his fascination with the moral and political dilemmas of modern technology lay closer to his own personal and intellectual roots than he had thought. Until then he believed his political engagement to have begun during his student years at the University of California in the 1960s. This engagement continued during his summer as a "systems analyst" at the Pentagon, where he was struck by the sharp contrast between the impressive rational planning of the national defense system and the bloody, senseless, and escalating war in Vietnam that that very system was enacting. These events, he had once