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Four Philosophies of Technology

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Alan Drengson is an Emeritus Professor of Philosophy at the University of Victoria, BC, Canada, where he was a Director of Environmental Studies and a member of the Philosophy Department. In this essay Drengson develops some typologies of technology and of philosophy. He first presents four possible understandings of "philosophy" and argues that philosophy is best understood as "a sort of jazz played with concepts." He further identifies four stages of technological development: technological anarchy, technophilia, technophobia, and appropriate technology. The central criterion of demarcation is the dominant human attitude toward technology in each stage. Technological anarchy is a playful, anything goes stage, when the possibilities of a technology are explored and when there is no dominant standard. Technophilia is love of, and in some cases identification with technology. In this stage, as in early stages of a love affair, one often will not notice the downsides, limits, and problems of technology. The "personation" discussed by Doug Browning is a good example of technophilia. Technophobia is a fear or hatred of technology. It goes beyond a reasoned awareness of negative affects, and tends toward rejection. Drengson argues that appropriate technology, as a self-critical stage and attitude, is the most mature and philosophically rich. Appropriate technology urges us to balance all costs, maintain biodiversity, promote benign interactions between humans, non-human animals, and technology, and to promote human development. This view captures many of the insights and goals of current programs of sustainable development and sustainable, or green, engineering and design.

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Philosophy and Creative Inquiry

The aims of this essay are threefold: First, to describe four main philosophies of technology manifest in our culture; second, to engage in a process of creative inquiry that will make it progressively more obvious the extent to which an unwitting adherence to some of these philosophies can affect perceptions of technological possibilities; third, to outline the interconnection between conception, action, and social process with the aim of clarifying the role of conceptual design in intentional technological innovation.

In order to advance the aims of this essay, it is first necessary to explain what is meant by "philosophy" in this context. There are three levels to the term here: At the lowest level, a philosophy can be nonexplicit; at an intermediate level, it is an explicit elaboration of a particular position which spells out assumptions, axioms, etc., and argues for its conclusions; in the final and mature sense, philosophy is a creative activity of conceptual inquiry which frees us of attachment to specific models and doctrines in order to develop more appropriate cultural practices.

In the title of this essay, then, I speak of philosophy in the sense that one can express and live by a philosophy which is neither explicit nor clear, but which forms the structure and quality of one's experience. By "philosophy," then, is meant a way of life formed by attitudes and assumptions which, taken together, constitute a systematic way of conceptualizing actions and experiences by means of an implicit process of unquestioned judgments and conditioned emotional responses. In some dimensions these are cultural, in others they are familial or personal. Together these responses and judgments, constituted by both assumptions and evaluations, and an articulation of them in word and deed, make up one's philosophy of life. Most of the four philosophies of technology analyzed in this essay are culturally at the first level. The aim of this essay is to raise them to the second level, and then to move them to the third level by engaging in creative philosophizing about technological innovation and appropriate design. "Appropriate" here refers to right and artful fit between technique, tool, and human, moral, and environmental limits.

A caveat needs to be made at this point. The four philosophies of technology described here each occupies a given range on the continuum of responses to current technological development. The precise boundaries between each are difficult to mark. Moreover, each of these "philosophies" has certain specific adaptive and economic advantages. For example, a technophobic reaction to modern technology involves in part an attempt to revive and preserve simple, "primitive" technologies which, in the event of disaster, could serve survival and preservation of certain culture values. Technological change is highly dynamic in terms of its material manifestations, and the four philosophies described herein represent dominant views associated with technologically advanced societies. Nonetheless, the attitudes these philosophies represent tend to be primary human responses to change. A specific person may go through stages of development that pass through each of these philosophies. The creative philosopher recognizes the usefulness and limitations of each within this whole developmental process. He or she also recognizes the importance of a balance between each (as represented by different groups within a society) and within the dynamics of healthy social change.

Creative philosophy, as a form of inquiry, aims to free us of an attachment to doctrines and views, but enables us to use such doctrines and views to facilitate positive change and growth in understanding. In order to achieve this end, various metaphors and models are used as part of the activity of creative reflection on the four philosophies of technology. The use of such devices has certain risks. As has been observed by numerous sages, philosophers, insightful psychologists, novelists, Zen masters, and others, human thought tends to become fixated on various stereotypes, metaphors, models, paradigms and belief systems. Creative philosophizing recognizes their inherent limitations, but uses these various models, paradigms, etc., as a way of freeing understanding of their dominance. Initially one uses such models and the like as a way of conceptualizing the world in order to gain understanding and to serve practical aims. However, when these paradigms and their accompanying ideas, ideals, beliefs, and so on, become part of a belief system, it is easy to invest one's identity in them. When we invest our identities in beliefs we resist reflecting on them, and we resist their change, for this can seem a

threat to one's self-identity and sense of reality. Thus belief systems tend to become static. Since life is a dynamic process, flexibility and creative adaptation suffer, when cultural processes involving dynamic factors such as science (as inquiry) and technology (as creative technique) get out of harmony with these more static belief systems.

The four philosophies sketched here are offered as provisional models to facilitate insight into the patterns of philosophy of technological development inherent in our culture. The creative philosopher recognizes the limitations in these patterns of thought and approaches them with a serious, but playful attitude so that distinctions can be recast through a continuous process of conceptual adjustment, readjustment, and improvisation. In creative philosophy, concepts become tools, paradigms heuristic devices, clarity and insight products of philosophical activity. In creative philosophy the aim is not *a* philosophy, but the activity of philosophizing as a way of continuously clarifying human intelligence by freeing it from its conceptual constraints. The fully sound human understanding is one that sees the world as it is, while it also realizes that cultural adaptation (of which technology is a part) is a creative affair and has a range of possible options, given the nature of the world.

A final word of caution. Creative philosophizing in its mature form is a nonposition and an activity. It is a sort of jazz played with concepts. It is a creative art that one acquires through long practice. It is classically illustrated in many of Plato's Socratic dialogues. As was observed in *The Republic,* ultimate reality lies beyond all of our forms of thought. The contemporary creative philosopher realizes that as long as we do not identify with these forms, they can be adjusted to better fit reality as revealed through fully aware immediate experience. By approaching philosophy creatively, as a process of dialogue and interaction, of give and take, playfully adopting a variety of perspectives, we free our capacity for creative thought and insight. Insight involves (in part) a direct grasp of networks of relationships and a seeing of the world that reveals its significance and value intensity, which are part of a common ground in the unity of being.

In contemporary Western industrial culture there is wide disagreement about how we should develop resources, whether or how to exploit animal species, whether and which new technologies to develop, and how to manage our collective activities in relation to individual rights and to the biosphere. Thus, the four philosophies discussed here represent the kind of broad, pluralistic mix that one would expect in modern Western democracy. This is particularly evident if we think of this matrix as a dynamic process that displays dialectical features. Within democratic society as a whole, complete consensus is not possible, especially since different people are at different stages of development. The four philosophies to be discussed could be said to represent the stages of maturation of an industrial society, and its gradual transformation into a mature, postindustrial culture characterized by human-scaled, ecologically sound, appropriate technologies, consciously designed to achieve compatibility with fundamental moral values. These matters will be explored now in greater detail.

Four Philosophies

There are four fundamental attitudes toward technology that can be discerned in current cultural processes in the industrial West. These attitudes form a continuum from an extreme faith in, to a complete distrust of, technology. The degree to which the various possibilities in between are held varies from person to person and between various subcultural groups. They do not readily correspond to any particular economic philosophy. These four philosophies can be conceived of as nodal points or as dense nexus of social attitudes which are centered on constellations of paradigms and beliefs. Within the whole continuum of social response their features can be described. Since the culture as a whole is in process, and since individuals within the culture are also changing at varying rates, depending on their particular circumstances, these nodal points are not static. They do not define all or nothing positions for the culture as a whole. If Western culture were to become either too static, or too dynamic, these views could become polarized, and then precipitate unresolvable conflicts and statements. As it is, they now appear to represent developmental stages of a continuous growth in which each successively

becomes emphasized, as persons and the culture evolve.

For the purposes of this discussion I will designate the four philosophies under consideration as the following: (1) technological anarchy, (2) technophilia, (3) technophobia, and (4) technological appropriateness.[1] I shall now discuss the essential characteristics of each position and the interrelationships between them.

Technological anarchy was a dominant philosophy throughout much of the nineteenth-century industrial development of the West. In brief, technological anarchy is the philosophy that technology and technical knowledge are good as instruments and should be pursued in order to realize wealth, power, and the taming of nature. Whatever can be done to serve these ends should be done. The fewer government regulations over technology and the marketplace, the better. Ideally, there should be none, but this is impossible, since some basic order is necessary to further private ends. The market alone will determine which technologies will prevail. Technological anarchy is a philosophy of exuberant, youthful curiosity and self-centeredness. It is an expression of optimistic self-assertion and individual opportunism.

Technological anarchy helped to stimulate rapid technological development. It tends to encourage technological diversity. As industrial development matures, technological anarchy (within a given culture) tends to become less dominant. Technology becomes a more powerful directing force in the whole social process. Technology begins to take on certain autonomous features on a large scale. Technology, which was originally pursued as an instrument to satisfy desires and needs, tends in such a context to become an end in itself. As this process completes itself, technological anarchy loses its dominant position, even though it rarely completely disappears. It then gives way to technophilia, which in turn develops into a structure with technocratic features. (At the international level, technological anarchy still seems a dominant force.)

Technophilia, as the word implies, is the love of technology. It is like the love of adolescence. Humans become enamored with their own mechanical cleverness, with their techniques and tricks, their technical devices and processes. The products of our technology become not only productive instruments but also our toys. Technology becomes our life game. This is like the adolescent affair in which we identify with the objects of our love. As a result they tend to control us, for our unconscious identification with them invests these objects with our person. This identification becomes a form of control over us, since we are unable to disassociate ourselves from our technology. We cannot see it objectively. This can be illustrated by our love affair with the automobile. We can become so infatuated with automobiles that they become extensions of our selves. "Insults" to them become personal affronts, and can be felt as threats to self-esteem. This represents a loss of an objective understanding of the positive and the negative features of the technology of the auto – which includes the whole infrastructure of factories, gas stations, parking lots, roads, freeways, legal structures, supported, of course, by a whole complex of human routines and skills. Thus, although the automobile was first a means to an end, viz., transportation, it and its supporting infrastructure eventually became a dominant feature of the culture as a whole. Cities, land use, and even economic well-being have become entangled with the technology of the auto. What began as an instrumental value, as a means to the end which was transport, becomes an end in itself. Paradoxically this works to frustrate the original human values involved. Finally, the technology of the automobile can become a threat to life, health, economy, the environment, and even to our way of life.

Technophilia, as the love of technology, turns the pursuit of technology into the main end of life. It eventually aims to apply technology to everything: To education, government, trade, office work, health care, personal psychology, sex, etc. In this way it becomes technocracy, for technology is now a governing force. This represents the overwhelming of spontaneity by technique. In its most complete form, as technocratic, it represents the rule by and for technological processes. At this point humans are technologized by their own love of the technical and of techniques. Life becomes mere mechanism. However, this is only the implied logical terminus of technophilia. It is unlikely that it could achieve a complete technocracy because the social process is a stream with diverse

elements. The application of technology to nearly everything stirs counterforces, and the imagined logical end of this pursuit is unacceptable to many. The love affair with technology cools as the process of maturation leads many people to realize that technology is becoming an autonomous force endangering human and nonhuman values. Even the biosphere as a whole becomes threatened by the products and processes of human technological activity. The initial reaction to these imagined and perceived threats is first to attempt to control technology and its hazards by means of technique and the technological fix. But these are both only extensions of the technophilia which furthers the development of technocracy.

Technophobia emerges when it is realized that only human and humane values can curb the threats of a technology running out of human control. As an extreme reaction technophobia attempts to detechnologize human life, for to many persons the idea of applying engineering techniques and technocratic control to all aspects of human culture is repugnant. It is seen as a mechanization of the human, leading to the loss of the sensitive, spontaneous and vital organism. There is a natural desire to return to human autonomy, which was originally one of the motives in pursuing technology, but it is now seen as frustrated by the techno-structure. This autonomy is perceived to reside in the revitalization of crafts and arts, of simpler, "neoprimitive" technologies. A do-it-yourself attitude characterizes it. The aim is self-sufficiency; a distrust of complex technologies is one of its features. Even while this reaction is developing the forces of technocracy are consolidating their control of extensive industrial technologies, which in turn, by their own inner dynamics, are evolving toward post-industrial maturity through smaller scaled, flexible systems of production. Ultimately, technophobia aims to bring the large-scale technologies to an end, and to bring technology once more under local human control. It helps prepare the ground for evolution to appropriate technological design.

Technophobia can be compared to the disenchantments of early adulthood. One learns that attachments which are centered in romantic and erotic identification can frustrate growth and can generate suffering, pain, grief, and fear of loss. Such loss is felt initially as a severe threat to one's self-image. Unable to accept full responsibility for oneself (in every dimension), because one does not understand the exact nature of the situation, one inevitably suffers disappointment and may attempt to avoid such relationships in the future. This is usually not possible, although it is probably necessary to take this "pledge" as a step toward more mature relationships with others. In a similar way, perceiving the dangerous character of the technological panoply can at first be very disorienting, especially since it was originally thought that building such a technostructure would make life easier and safer. However, direct planning and innovation has often been done by persons who were not able to be fully responsible because they lacked sufficient understanding of the nature and implications of powerful technologies, or because they were caught in structures that made responsibility difficult. When human imagination is harnessed to technophilia in order to create and to proliferate technologies (as in the chemicals industry, e.g.), and when competition becomes an important force (whether national or international), it then becomes very difficult to control these technological forces. Fearing that this technological power will ultimately lead to total control of humans, or even to ecocide, finally brings disenchantment with the whole process. The romantic entanglement with technology (technophilia) is now perceived as threatening human integrity and survival.

Technophobia rejects technological autonomy and asserts human autonomy over it. This accomplishes two important things. First, it brings renewed commitment to humane values. Second, as already noted, it leads to the revitalization and preservation of arts, crafts, techniques, and skills that *emphasize* personal and interpersonal development as more important than technological supremacy over humans and nature. This not only preserves simpler technologies, but it insures that the process of maturation will continue, since it is necessary to psychologically distance ourselves from these activities, if we are to understand them. This understanding is necessary, if we are to perceive the possibilities for new forms of technology that are under our control and that are more appropriate to human and to natural values.

It is realized at this stage that it is the relationship between technology and ourselves that we must understand. This means understanding the relationship between nature and technology as well, for humans are born as nature and through techné and other cultural activities they modify themselves. The tendency is to see this cultural process as fixed, rather than the stochastic process that it is. In this case, jazz is a good paradigm for the art of self-creation as a stochastic process, for here there is the possibility of both control *and* spontaneity. The culture provides different roles for us to play. Thus there are patterns through which our activities can cohere and gain meaningful harmony. We could compare this process to the capacity of learning how to learn. Becoming aware of the possibility of knowing how to learn sets the stage for a continuous, consciously ordered transformation. If one becomes adept at learning, then one is adept at adjustment to ongoing changes in the world. One then becomes sensitively attuned to these changes, and can stay with them. When one learns how to bring one's full attention to a subject, and becomes capable of learning all there is to learn about it, then one becomes a master learner. From this vantage point technophobia can be seen as one of the stages of growth that involves becoming aware of the use of technology in a consciously reflective, critical way. We have the chance to see it from a meta-level.

Appropriate technology represents the fourth stage of technological development we have been describing in terms of the evolution of philosophy of technology and technological design. The fourth stage involves a maturing of the reciprocal relationships between technology, person, and world. Appropriate technology requires that we reflect on our ends and values, before we commit ourselves to the development of new technologies, or even to the continuation and use of certain older ones. As in mature love, one becomes capable of compassion and helping others to attain their ends (this is the very essence of the compassionate person), so in this stage we become capable of mastering our technology as instrumental to ends about which we become progressively more clear.

In the philosophy of appropriate technology, technologies should be designed so that they meet the following requirements. First, they should preserve diversity; second, they should promote benign interactions between humans, their machines, and the biosphere; third, they should be thermodynamically sound in the generation and use of energy; fourth, they should dynamically balance all costs; fifth, they should promote human development through their use. Let us reflect upon these points. Diversity is one of the features of both stable ecosystems and stable economies. Diverse technologies provide a large range of options to individuals and to further social development. Benign, symbiotic interactions between technology and the biosphere are necessary features of future technologies, if we are to develop sustainable economies. Compatibility with ecosystem principles is a minimal requirement. This is emphasized in sound thermodynamic design, for ecological compatibility and thermodynamic soundness work together to balance social, economic, and environmental costs. Finally, when technologies evolve to the level of appropriateness, they can be designed in such a way as to facilitate human development. Such technologies are designed to allow humans to master whole processes as arts, which stimulate the development of the complete human person. Thus the maturation of appropriate technology involves the transformation of the technological process into an art. The technological processes then become a life-enhancing part of a significant set of values. Labor thus becomes meaningful work. Comparing the stage of maturity of appropriateness to the capacity to love, we can say that it corresponds to the capacity for compassion. The compassionate person loves in order to enhance the other. Here technology is designed to enhance individual persons, ecological integrity, and cultural health.

From what has been said so far, we can see that technology cannot be separated from the selves that create and perpetuate it. If its creators and its perpetuators are immature selves, then the technical process will reflect their characteristics in various ways. Some of the bad consequences of technology are the result of design unduly influenced by immaturity, ignorance, confusion of ends, impatience, and too narrow values.

Appropriate technology is the most complete philosophy of the four outlined, since it addresses more of the relevant values, and since

it also brings subject and object together in a responsible, reciprocal interaction. Furthermore, it recognizes the useful roles that the other philosophies can play. At this stage there is the possibility for continuing technological development in ways that resolve the negative consequences of the technological imperative of modern human history.

At present we seem to be moving toward the emergence of the philosophy of appropriate technology as a major force in our society. The period of the maximum influence of technophobia might be waning, but this is by no means certain, for there remain powerful forces of technocratic intent which are supported by vast resources with great institutional momentum. This tends to increase political and environmental opposition to technocratic policies. Technophobia could wax, particularly if there are large-scale failures of major technological projects which fully reveal all of their hazardous dimensions, such as pollution, debt, tyranny, and their displacement of human workers.

Appropriate Technology, Innovation and Mastery

Each of the philosophies outlined has played a role throughout the process of industrialization in the West. The technological anarchy that was dominant earlier was important in exploring and developing options that led to the industrial revolution. The forces of technophilia and the technocratic mind-set helped to create large-scale processes and infrastructures of continental and global extent that have importance and value. Without the function of these four philosophies expressed in individual lives and in collective social activities, we would lack many positive things we have today.

It would seem that the revolution in modern electronics, the miniaturization of technologies, the emerging solar technologies, improved organic agriculture, and various forms of personal and spiritual growth taken together point toward the possible emergence of the philosophy of appropriate technology as a major cultural force. It is a philosophy conducive to, and compatible with, these postindustrial technologies. From the perspective of appropriate technology, we have the opportunity to create new benign technologies with a clear intent of purpose.

An important feature of appropriate technology is that it forces us to ask central questions for the philosophy of technology: What shall be our relationship to technology? How should we define it? These and other fundamental questions receive our conscious attention. We are able to articulate assumptions of current policy and evaluate them in terms of the human context. Ultimately, appropriate technology aims to transform our relationship with technology in such a way that it becomes a means to the realization of abiding values we fully understand and freely choose. This means that the limits of technology are clearly perceived, and the values of simplicity realized in reduced dependence on heavy technologies.

Appropriate technology will also help to promote the re-creation of community vitality. Many of our current systems are too centralized. It is now necessary to shift to community revitalization through the development of decentralized, human-scaled technologies that preserve the values of the places in which communities have their being. Some of the large processes that are built into the system have now generated spin-off technologies that make such down-scaling and decentralization possible. The transition to such appropriate technologies can be aided by government policies, such as tax incentives and facilitating citizen participation in planning, but ultimately it can only be fully realized as the result of community and personal commitments which grow out of a mature understanding of the values at stake. As Plato saw so clearly, beyond all ideas, at the very center of existence is the Good. Putting this in twentieth-century terms, we can say that appropriate technology leads us to reflect deeply on life as a whole, and mature reflection leads us to realize that life has value at its center. The division between fact and value is only a logical division of concepts with limited usefulness. The practice of science and technology is a value-laden activity. Understanding life requires cognizance and appreciation for its many dimensions of value.

The philosophy of appropriate technology can be further illuminated by considering the four levels of innovation it recognizes. With respect to technological innovation, appropriate

technology recognizes four fundamental forms: (1) technological modification, (2) technological hybridization, (3) technological mutation, and (4) technological mastery and creation. Technological modification involves improvement of a technology by means of gradual modification. This process relies heavily on trial and error. In the case of hybridization, we have the merging of two or more technologies to form a new technology or a new technological solution to an existing problem. An example of this would be the design of hybrid vehicles such as a propane-electric automobile. Technological mutation is the transformation of a technology to some other form, or for some radically different purpose. For example, the Chinese used gunpowder for fireworks entertainment, but not to do work or to fight battles. The Mongols and then the Europeans transformed this technology and applied it not only to armaments and warfare, but also for use in the construction of roads, tunnels, dams, and other things. In a reverse direction, atomic bomb technology has been transformed to nonwarfare applications in medicine, the generation of electricity, and the propulsion of ships. These forms of innovation are recognized by the other philosophies of technology discussed here. But appropriate technology emphasizes technological mastery and creation, which involves the capacity to transcend technology and much of human dependence on it. At the same time it opens endless possibilities for the creation of new appropriate technologies. One masters an art by transcending one's fascination with techniques; for the master there is fluency and freedom in the art.[2] Rules and a breakdown of techniques are useful for instructing learners. Mastery transcends these since it leads to spontaneous, creative activity. We often depend on rules and techniques because we have not achieved complete mastery or fluency in the art. Technological mastery in the context of appropriate technology leads to the possibility of transcending technology as a force in human life that lies beyond our control.[3]

The philosophy of appropriate technology encompasses the possibility of mastery and creativity. In its mature form this can be seen as the possibility for a self-mastery that transcends self-manipulation and the desire to control others. In short, the end of domination by technology is seen to lie beyond technology in the realization of human possibilities for mastery of technology in a way that emphasizes the value of persons, develops creative community, and promotes communion with nature. This is the ultimate raison d'être of a fully mature, appropriate technology.

Technophilia and Appropriate Technology Compared: Four Examples

In this section we shall explore more fully the contrast between the approach of appropriate technology (which involves the self-mastery necessary for the wise use of technology) and the approach of technophilia (which uses technology as a means to provide the power to control nature and other humans). The philosophy of appropriate technology applies technology to the natural world in a way respectful of its intrinsic values, whereas technophilia seeks to impose technology upon a nature seen only as resources having instrumental values. The appropriate technologist is respectful of the values *in* the world, whereas the technocratic mind of technophilia attempts to impose patterns of its own devising *on* the world. The aim of appropriate technology is to understand the world and appreciate it, so that humans can interact with it to realize a maximum of reciprocal benefits and also of such values as wonder, delight, and compassion. Technophilia (in contrast) does not seek to know the other, to experience the other, but only to manipulate and control the other, to possess the other. It sees the other as object, not as subject. For the appropriate technologist, however, the living world is filled with subjects. Its dynamic, untamed, organic processes are interdependent. It cannot be approached in a fragmentary way, as a collection of objects to be subdued. It must be approached as a subject-other.

Appropriate technology is a philosophy that includes the human self as part of nature's selves. Questions of ends are primary, and ends depend upon knowing the kinds of beings that we are and can be. This finally leads beyond all techniques and tools, beyond their limits to our own limits. These limits are known through self-knowledge and self-mastery. Self-mastery leads to a mastery of technology that is appropriate

to ends worthy of human pursuit. In order to illustrate this important aspect of the philosophy of appropriate technology let us now consider four examples. These examples will help to illustrate the difference between appropriate technology and technophilia in the use and design of technology. The four examples we will discuss are interpersonal conflict, alpine hiking, exercise, and energy generation and use.

Consider, then, some of the levels of technology available for resolving interpersonal conflicts. We shall use examples of warfare and a specific martial art to illustrate the practical difference in philosophy between technophilia and appropriate technology. Suppose that two tribes, two countries, or two treaty groups have a disagreement that seems unresolvable and tending toward violence. Naturally, in these situations tempers can become inflamed. Tension builds while the conflict simmers on. Under these conditions fears arise. These fears magnify the perception of what are interpreted as threats. At a certain stage one or both of the antagonists will think of resorting to force in order to remove the tension. If they apply the full range of modern technology to this conflict, the forces involved could destroy one or even both sides. If they think in terms of winning and losing, then an all-out technological response would seem irrational, given nuclear arms. Hence, they are forced to consider other options. Negotiation and willingness to compromise could be buttressed by this powerful technology, but only if the parties know that there is no armed technological solution to their conflict. It becomes clear at this point that the total use of this vast technological power negates its practicality. It is no longer useful for its originally designed purpose, for technological power has undermined the rationale of war. The pursuit of a technological solution to the conflict could then lead beyond a focus on technology, as a result of the very logic of technophilia's total technological response. At this point it can be seen that the appropriate response to human conflict is not technological warfare. The application of technology leads us to realize that ignorance, immaturity, and lack of self-mastery underlie much interpersonal and international conflict. This can be brought out more clearly at the level of an interpersonal conflict restricted to two persons.

Let us consider the range of options open to two persons, assuming a high level of conflict between them. At the technical level they could resort to bombs, guns, swords, knives, clubs, stones, fists, and feet. If they are martial artists they might use karate, judo, or boxing. Now the technocratic approach is to try to control the other person through the use of technology and techniques. The philosophy of appropriate technology can be illustrated by the martial art of aikido. The aikido martial artist practices the martial way but uses the energy that would be spent on fighting to transcend fighting. The master aikidoist is the ultimate martial artist, since there can be no aggression and competition. Aikido is such a complete art that it resolves conflicts before they can progress to fighting. It is highly subtle, since it masters the impulse to fight by transcending the small self that would fight. It leads one to understand others and the reasons for our impulses toward aggression. This is an art that has its origin in the techniques of fighting, but ultimately it transcends fighting and techniques by means of a practice which leads toward self-mastery. Instead of attempting to manipulate and control others through techniques and fighting technology, aikido resolves conflicts through self-mastery, self-correction, and understanding.

Consider as our second example alpine hiking. Let us compare two hikers: One is loaded with every conceivable camping device modern technology has produced. He is also involved in learning all available techniques. His weekend pack weighs at least 100 pounds. When he camps he employs these various techniques and technology to make a well-organized, "comfortable" camp. He engages in lots of wood craft, lots of "wild-river Jim," nailing, chopping, and building. He loads up his gear in the morning, after spending two hours flipping pancakes on a fancy griddle.

In contrast, the appropriate technology hiker travels light. She is not a "live off the wilderness" wildperson, digging up roots, rooting out berries, and eating the flowers. She is there to celebrate the joy of being alive, and the joy of being able to know nature in an intimate way. She is there to listen to the softer voices of the world and to the deeper voices within herself. Her equipment is carefully designed to be simple, light, durable,

minimally polluting, and harmless to the world in its production and use. She is comfortable, but not isolated from the elements of nature she would know. The rain is not an enemy, nor is the sunshine the only pleasure. She eats simple food, such as a breakfast of homemade granola, that requires no or minimal cooking, but nonetheless is optimally nutritious and aesthetically satisfying.

These two hikers illustrate the differences in philosophy between the technophiliac and the appropriate technologist. For the former, the equipment becomes a burden that isolates him from the natural world. For the latter, the equipment is a minimal intrusion which is efficient and enhances her enjoyment of the natural world. It is not a burden, but a joy to use.

As our third example let us consider the range of possibilities open to us with respect to technology and exercise. Ideally, the aims of exercise are self-discipline, fun, and a strong, healthy, flexible, and aesthetically balanced body. Technology can be used to assist in this process. However, the ultimate end of applying technology to exercise undermines many of these aims, as is seen in the exercise machines that do all the moving for you. There is no interaction. You become the manipulated. The other contrasting attitude approaches exercise as a form of self-discipline to be enjoyed also for its own sake.

In jogging, one needs only running shoes, nothing else. Aikido can be done with soft clothes, a padded floor, and one other person. Isometrics and calisthenics require no equipment or helpers. For the philosophy of appropriate technology, the approach to exercise is an integrated and elegant one that uses technology minimally, and would emphasize self-mastery instead of some "easy" technological solution to overweight and lack of sound conditioning. In the technocratic approach, machines become a substitute for this self-discipline and tend to alienate one from one's own body.

Finally, for our fourth example consider the generation and use of energy to illustrate the contrast between the technocratic thrust of technophilia and the approach of appropriate technology. The epitome of the technocratic approach is represented by nuclear power. The use of nuclear fission to boil water to generate steam to power electric generators involves the use of highly capitalized and centralized technology. In the form of electricity this power is distributed through complex grids to distant end users. Electricity is applied to a variety of uses, such as cooling, cooking, and space heating. Nuclear power is highly complex and requires vast subsidies in the form of publicly financed insurance and storage of dangerous wastes. It presents difficult problems of security and increases the probability of the spread of nuclear weapons. In terms of energy use it employs high-temperature processes to accomplish many practical ends which are of low thermodynamic quality. It adds thermopollution to rivers. For these and many other reasons, nuclear power is environmentally, economically, and thermodynamically unsound. It raises serious moral questions. Nonetheless, to the technocrat it is a "logical" way to go.

In contrast, for the appropriate technologist the aim is to diversify and decentralize the use and production of energy. Instead of relying on vast power systems (although some may be developed), the aim is to develop a large variety of smaller scale technologies such as photovoltaic, hydroelectric, and solar. Such approaches as cogeneration and conservation within communities create local systems that use generated power and heat over several times. It gives to local communities greater control over their future, lower costs and debt, and broader public participation, in contrast to many of the large-scale projects which promote complex bureaucratic management structures, increased environmental hazards, and large debt. Appropriate technology emphasizes thermodynamic soundness, doing more with less, conservation, and keeping open a large variety of options. It is rich in understanding of natural processes and takes advantage of the rhythms of natural sources of energy that are readily available on site. It relies on a mastery of design that blends technology and ecological processes, rather than imposing powerful technologies upon nature. In contrast, technocratic forces strive to master nature by controlling and overwhelming rather than working with it.

We can see from these examples, and from earlier comments in this essay, that attempting to resolve the problems caused by technology without first appreciating the human elements involved leads nowhere. The problems of technology that

have social and personal implications are not just problems of technology. If we do not appreciate the influence of the particular philosophy of technology that underlies our own individual approach, and see its contrast with other views within our culture, then we will lack a perspective that enables us to move beyond the search for technical solutions to nontechnical problems. In philosophizing about these philosophies of technology I have attempted to sketch how their conceptions of technology affect self, society, and nature. If through this activity we are better able to attend to these attitudes directly, then the chances for a flexible, creative adjustment of our interactions with one another and the world will be increased.

Conclusion

The problems of technology do not all have technical solutions, for the root of some problems of technology lies in the problems of human life itself. Our attitudes toward technology define us, and they bind us to the creation of processes that magnify our initial failure to understand life as the interrelated, holistic process that it is. Powerful modern technologies express in their material forms problems for human life precisely because these technologies reflect the nonresolution of underlying uncertainties about existence and value. Martin Heidegger was one twentieth-century thinker who realized this. He saw that much modern technology grows out of a confused metaphysics that manifests itself in our material and other cultural processes. This confused metaphysics, he observed, is essentially the result of a failure to understand Being and what it means to dwell in the world. Our failure is not that we have linked our industrial technology to profit; it is rather that our pursuits and their technology fail to understand what it is to be in the world in the full openness (the mystery) of Being. Modern industrial technology, as often applied, is an example of a lack of comprehension of Being, a lack of care for the world, and a failure to perceive the fundamental essence of things. It lacks an understanding of the sense of life and of values. With this failure goes the inability to let others be. It begins with confused, calculative thinking, but once this thinking is expressed in the material of technology, that technology then carries it across political and economic boundaries. This is why in the contemporary world industrial technologies and their negative features are transpolitical. The philosophy of appropriate technology recognizes these failings and is open to new possibilities. Because of this it can help us to free our minds of narrower technological concerns, and the sense of being overwhelmed by the "inevitability" of the domination of humans by their own technology. Technology need not be an alien power that overrides responsible human choice. We are better able to solve problems because we better understand their source. The dialogue of creative philosophy frees our minds, the philosophy of appropriate technology frees our practical work of technical and technological tyranny. Together they blend science and art in creative adaptation to a natural world that embodies values to which humans contribute.

Notes

1 "Appropriate technology" is a term sometimes used for intermediate technologies (Dunn, 1978). Intermediate technologies are designed for application in developing economies. As we use the term, "appropriate technology" refers to the philosophy we have here described. It is capable of guiding technological designs for many levels of development. Dunn's definition of appropriate technology in his first chapter is not incompatible with the one used here. For a more detailed discussion of the philosophy of appropriate technology, see my article, "Toward a Philosophy of Appropriate Technology," *Humboldt Journal of Social Relations*, Spring/Summer, 1982, vol. 9, no. 2, pp. 161–76. This issue of the journal is devoted entirely to appropriate technology.

2 On the mastery of arts as a form of self-development and self-transcendence, see my paper, "Masters and Mastery," *Philosophy Today*, Fall, 1983, vol. 27, no. 3/4, pp. 230–46. On the relationship between art, imagination, and technology, see my paper, "Art and Imagination in Technological Society," *Research in Philosophy and Technology*, Fall, 1983, vol. 6, pp. 77–91.

3 One example of the creation of a completely new technology would be learning how to directly influence the informational forms that underlie matter, and which direct energy to create specific material forms. Gene splicing would be another

example (perhaps just a different application of the former). Such new technologies depend on a deep understanding of natural processes, which could work with them, rather than attempting to subdue or overwhelm them. Many earlier (and present) industrial technologies are less subtle, poorer in understanding, and are often crudely overpowerful. However, biotechnologies carry some profound risks. There are also inherent limits to the pursuit of a technological fix. For an exploration of some of these issues, see my paper, "The Sacred and the Limits of the Technological Fix," *Zygon*, September, 1984, vol. 19, no. 3, pp. 259–75. This issue of *Zygon* contains other articles relevant to new biotechnologies.

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