Understanding the Place of Humans in Nature

James C. Williams

The relationship between people and nature is dynamic, interactive, complex, and messy. To be sure, humankind has not always understood its relationship to nature in the same ways, for we come from many cultures and experiences that continuously change over time. Nevertheless, we are all part of nature, and our physical beings comprise many of the same elements and rhythms that make up the world around us. Yet, while we are part of nature, we also see ourselves as distinct from it, standing outside, if not above, the rest of the natural world. This is particularly true of those of us in Western culture, for unlike any other living creatures, we inheritors of the Judeo-Christian tradition think of ourselves as being made in the image of God, the creator of nature itself. So our relationship with the rest of the natural world is hardly straightforward and simple.

One thing, however, is clear: our relationship with nature almost always involves technology. We cannot think about the environment without thinking about technology, nor can we think about technology without thinking about the environment. And over time both technology and the environment have evolved together, and both reflect the influence they have on each other in this evolutionary reciprocity. Therefore, to understand the relationship between humans and nature anywhere, one must look at how people, technology, and nature interact and, moreover, how technology serves as the junction between humankind and nature.

Relationships between Humans and Nature

Ancients saw few distinctions between human beings and the natural world. They saw themselves as fundamentally connected with nature and the cos-

mos. For millennia, people lived with nature's cycles, rising up and bedding down with the sun, hunting and gathering according to the seasons and to their location on the world's land masses, and eventually farming in concert with the weather and other dictates of the environment. The human body's responses to habitats and its creation of habitats—somatic responses—were rich in variety. People were actively aware that natural rhythms of their bodies —such as heartbeat, breathing, walking, sleep patterns, and menstrual cycles —linked them to rhythms outside their bodies.[1] They explained how things worked by drawing analogies between nature and their bodies plus those of animals: rivers, streams, and underground waters were veins and arteries; mountains were wrinkles on the earth's skin; volcanoes were warts.[2] "Mother Nature" did more than provide for and nourish humanity; people were inextricably bound up in the rhythms of the outside world. As the environmental historian Carolyn Merchant observes, the world of premodern humankind was a place of fate, not of control. People's consciousness was animistic, astrological, alchemic, and magical. The world in which people lived was an ecological one based on an ecocentric ethic of mutual obligations.[3] Societies offered merely a little stability in face of the vagaries of nature and the cosmos.

Still, one must be careful not to paint premodern peoples with an ecological halo. As the environmental historian Peter Coates rightly observes, the prevailing approach to nature in Greece and Rome was manipulative; it is inaccurate to think that earlier societies, whether in medieval Europe or pre-Columbian America, had a passive relationship with the physical environment. Precapitalistic economies were not stagnant, slothful, or without technological capacity. Archaeozoological and archaeobotanical studies of medieval England, for example, reveal "a vibrant picture of human intervention on land and inland waters," overturning "the conventional picture of stasis, nature's ascendancy, and human impotence." To be sure, medieval peasants may have "believed that the changing of the seasons, and the suffering involved in winter, were directly attributable to God's curse on the land, where eternal spring and summer had once reigned," and their apprehension may have "hardened into fear and loathing where nature in its wilder forms was concerned." But that did not prevent premodern Europeans from exerting some agency in terms of their relationship with nature; indeed, it may have inspired them. From the tenth to the twelfth century, they introduced the heavy-wheeled plow, the water mill, the clock, and sufficient other technological developments to dash any notion that they were passive and impotent. Similarly, the premodern peoples of Asia and America actively manipulated the worlds in which they lived.[4]

Nevertheless, the gulf between the ancient and modern worlds is enormous. Not until the dawn of the modern era did Europeans, led by Sir Isaac Newton (1642–1727) and other luminaries of the Enlightenment, reconceptualize nature as a machine and embrace the power of human reason to understand and control the natural world. This newfound rationalism and mechanical view of nature undermined belief in animism, astrology, alchemy, and magic. Ultimately, it tore asunder the intellectual bonds that linked people to nature and people to people, and it deadened humans' awareness of their somatic responses. Europeans and their descendants compulsively utilized increasingly powerful technologies to control and to improve the material world in which they lived, and a general tendency took hold to define human beings as being outside of nature. The environmental historian Donald Worster observes that "nature [became], at the hands of [their] instrumentalized reason, a mere miscellany of raw materials waiting to be worked up into something 'useful.' "[5]

At the same time, Enlightenment rationalism led to a vision of a technologically dominated environment. Scholars have explained it as a saga of modernization, the pursuit of modernity forever clothed in the idea of progress and the belief in "the gradual triumph of Western rationality over nature's constraints."[6] As people intellectually broke their ancient connections with nature, they conceived of it as a separate entity, an independent structure. As they mentally removed themselves from the ecology of nature, nature became the object of scientific investigation. Technology, increasingly science based, provided humankind with the tools to control and manipulate nature, to achieve modernity. In most of the Western world, communitarian values gave way to unbridled individualism and ultimately, by the twentieth century, to corporate capitalism. Nature became at best the quarry, at worst the enemy of all that was modern.

Human consciousness, people's collective awareness of the world, became mechanistic, utilitarian, and rational. In her book *Ecological Revolutions* Carolyn Merchant describes the emergence of the new, mechanistic human paradigm as an entirely new way of looking at the world, one based not on the premodern world's ethic of reciprocity between people and nature but on a homocentric ethic of natural human rights in which filling humankind's needs and appetites became paramount. Manuel Medina, a professor of science, technology, and society at the University of Barcelona, calls it a "technoscientific cosmovision," a philosophical and theoretical framework of "technomechanical action based on deliberate control and manipulation of natural processes, accomplished by means of whatever artifact . . . will achieve the projected end." Medina's countryman at the University of Valencia, the phi-

losopher of science José Sanmartín, observes that people came to believe that under the superideology of progress with science at its backbone "a better world is constructed through the technological reorganization of nature."[7]

People stood apart from nature in this new world. They redefined natural resources as commodities and unleashed their technology against nature to retrieve these commodities for the marketplace. America's first master corporate automaker, Henry Ford, declared that the machine was "the symbol of man's mastery of the environment."[8] One can almost imagine a war between technology and the environment. Sailing ships and steamboats sailed against and defeated oceans and rivers and reaped their resources. Steam and internal-combustion engines mastered the land, laid pathways over it, and stripped it of its minerals. Iron and steel conquered vertical and horizontal space and formed dense urban metropolises across the earth's surface. Electronics obliterated darkness, distance, and time. More recently, biogenetics manipulates life itself. The advance of machines is so relentless in the culture of modernity that technology itself is seen as deterministic, or as the Australian scholar Aidan Davison puts it, "an autonomous, transhuman force in social affairs."[9]

The principal relationship here, the one commonly referenced in public discourse about the subject, is of course the relationship between technology and the environment. We speak of the "interface of technology and the environment" or the "interplay between technology and the environment." We say that "the automobile created suburbia," one supposes by carving it, without any direction from human beings, out of a docile and compliant nature.[10] With these phrases we mentally distinguish ourselves from technology, just as we earlier defined ourselves apart from nature. Through our very use of language we endow technology with an independent agency so powerful that it now seems stronger even than its adversary, nature, and we seem at a loss to be able to control it. Like the sorcerer's apprentice, technology, in the popular view, seems to behave autonomously, possessing its own determinism, and its relationship with the environment becomes more and more problematic.

But does it? Is technology really so powerful? Is nature really so passive, so submissive? Are people really at the mercy of both technology and nature? Just what is the relationship between human beings and nature, and just what is the role of technology in that relationship?

Defining *Nature*

In order to address these questions, we need to think about what we mean by *nature, technology,* and other related terms. *Nature* has both concrete and abstract meanings. On the one hand, it is the entire external world, a physical entity; on the other, it is the creative and controlling force that directs the world. Moreover, it is often personified and gendered: Mother Nature, the goddess Nature, nature herself, Eve, and virgin land. The dominant definition of nature today, although not always in human history, is as a physical place, and we tend to perceive it as pure and untrammeled by people. From this perspective "nature becomes a byword for authenticity," writes Peter Coates, and we associate nature with "purity, simplicity and goodness."[11] Yet, most "natural environments" that we encounter are physical places that have been contrived by people—the rural countryside, suburbs and cities, and even state and national parks. Indeed, even what we call "wilderness" has been modified by centuries of human contact. The historian Simon Schama says simply that "this irreversibly modified world . . . is all the nature we have."[12]

Thus, we are confronted with a dilemma: just what do we mean when we speak of nature? Because prehuman nature no longer exists, and because the physical world is in constant flux, one might argue that we are not able to perceive nature directly at all. At best, we can see it only indirectly. Yet, according to the philosopher Ty Cashman, we do affect it straightforwardly: "The actions of our bodies *directly* move, disturb, change, refashion parts of the world."[13] As a result, argues Peter Coates, we may not "have made the natural world, but we have, in a sense, created nature." When we speak of nature, we really are talking about representations of nature, the nature we have made. As Marjorie Hope Nicolson puts it, "We see in Nature what we have been taught to look for, we feel what we have been prepared to feel."[14] This is not to say, however, that nature is something we have constructed solely in our minds. It *is* real, an intricate assemblage of organic and inorganic materials coming together in an incalculable number of ways, so many, indeed, that not all people at any given time nor over any time period can possibly experience nature in exactly the same way.

One thing is clear: nature possesses enormous agency and stamina. The French historian Fernand Braudel reminds us that underneath the "frenetic and dramatic surface events" of history are "the slow and deep-seated, if unspectacular rhythms of 'submerged' natural history," in which human actors give way to mountains, rivers, and oceans. On a more popular level, the American writer James A. Michener begins his historical novels by focusing on the natural history embodied in what Braudel calls the history of *la longue durée* (the very long term). Ultimately, much of the day-to-day, month-to-month, year-to-year, and even generation-to-generation life experienced by humankind lacks the capacity to exert power and the staying power that is

possessed by nature over the very long term. But some people find geological history unexciting because its movement is so slow, so imperceptible. As one reader of *Centennial* put it, "Michener insists on devoting a much-too-long portion of his book to the land and wildlife; the first human doesn't make an appearance until after countless pages about plate tectonics, dinosaurs, and, in one of the more bizarre parts of the book, the love life of the bison, told from the bull's perspective."[15]

Perhaps our fixation on the hectic activities and events of humankind, what Braudel calls "conspicuous" history, makes geological detail and wooly mammoths through the mammoths' eyes a bit tedious. Nevertheless, the plodding rhythms of the natural world exert an enormous control, probably the definitive control, over the ultimate affairs of human life. We should be reminded of this when a natural event such as an earthquake, a hurricane, a wildfire, a tornado, a tsunami, or a volcanic eruption occurs. When such events impact people and their habitats, we call them "natural disasters," although we probably would not call them disasters if people had not created something that stood in the path of the natural event. The magnitude 8.1 New Madrid earthquake, in Missouri in 1811, is a known event but was not a disaster, natural or otherwise. Conversely, because people had constructed a dense habitat atop the San Andreas Fault in California, the magnitude 7.8 tremor in San Francisco in 1906 was plainly a disaster, as have been many other recent natural events.[16]

In the modern world, the border between what is natural and what is not seems increasingly indistinct, particularly when dealing with technology. A great number of technologies have depended on organisms or been designed around them, such as wagons and draft animals, dairy technology and cows, chainsaws and trees, and, more recently, biotechnology and genes. Human exploration in bionics also "suggests that nature [is] not just a passive source of raw materials" for humankind but also "an invaluable source of ideas" for human technological design. Biotechnology, genetic engineering, and bionics all challenge "the nature-technology dichotomy by elevating the importance of natural systems and by blurring the boundaries between the natural and technological."[17] In the end, then, our definition of nature remains imprecise in both its abstract and its concrete meaning. On Earth, nonhuman original nature is rare, if it exists at all. Nature is surely a social construction, so just what nature is varies worldwide.

Defining *Technology*

Like nature, technology is multifarious. The word *technology* comes from the Greek *techne*, which referred to art, crafts, or skills, things we generally think of separately today. The Greek term *logos* meant "systematic comprehension," and when it was used together with *techne*, it probably meant "systematic thought concerning an art."[18] Our word for *art* is derived from the Latin term *ars*, "to fit together," and it originally referred to anything made by humankind. Thus the Greco-Roman world did not distinguish between art and skilled crafts. Eventually, however, art and artists became distinct from artifacts and artisans, and in America's earliest years the term *useful arts* differentiated the work of artisans from what we term the *fine arts*. Besides *useful arts*, other early nineteenth-century American terms embraced things we now group together as *technology: useful knowledge, manufacturing, machines, inventiveness, applied science.*

The term *technology* per se was not actually used in America until 1829, when the Harvard professor Jacob Bigelow published his popular book *Elements of Technology*. Bigelow understood technology to be "the application of the sciences to the useful arts," or the practical application of knowledge, especially in industry or commerce.[19] In his book, he presented what in modern terms would be today's instrumental explanation of technology. He saw technology as object, such as tools, machines, structures, utensils, automata, clothes, and apparatus. He also saw technology as activity, such as processes of invention, design, production, maintenance, and craft. Technology as object and as activity became first-order explanations of technology, and one popular perception, perhaps emerging from them, has been a narrowing of the definition of *technology* to make it synonymous with *applied science*—the practice, description, and terminology of any or all of the applied sciences that have practical value and/or industrial use. But Bigelow was more broad-minded. He also included technical knowledge and skills in his explication of technology, thus opening the way to explaining technology also as something substantive, something fully essential to human experience. Thus, technology is also knowledge in the sense that it is "rules of thumb," technological theory, descriptive laws, and even unconscious sensorimotor awareness.[20]

Despite Bigelow's treatise, the term *technology* did not catch on in popular discourse. The historian David Nye explains: "As late as the 1840s, almost the only American use of the word was in reference to Bigelow's book. . . . Before 1855, even *Scientific American* scarcely used 'technology,' which only gradually

came into circulation." Where *technology* would be used today, nineteenth-century Americans continued to employ the terms *useful arts, invention,* and *science.* Nye observes that "a search of prominent American periodicals shows that between 1860 and 1870 'technology' appeared only 149 times, while invention occurred 24,957 times."[21] Not until the twentieth century did *technology* begin to become part of the American lexicon in the broad-minded way that Bigelow employed it. Nevertheless, even at its first use, the sense of technology's power as a crucial agent of change in human society was a powerful part of Western culture.

Today we understand that although *technology* may refer in its most popular usage simply to objects and ways of accomplishing tasks by using technical processes, methods, materials, or know-how, it clearly has deeper, more varied meanings. Among these are ideas about technology in relation to other things, such as social status, education and skill levels, politics, gender, God, and nature.[22] Our interest here is in nature and how technology is crucial to human dealings with nature. As the historians Melvin Kranzberg and Carroll Pursell put it in 1967, "Technology, in a sense, is nothing more than the area of interaction between ourselves, as individuals, and our environment, whether material or spiritual, natural or manmade."[23]

Finding Common Ground

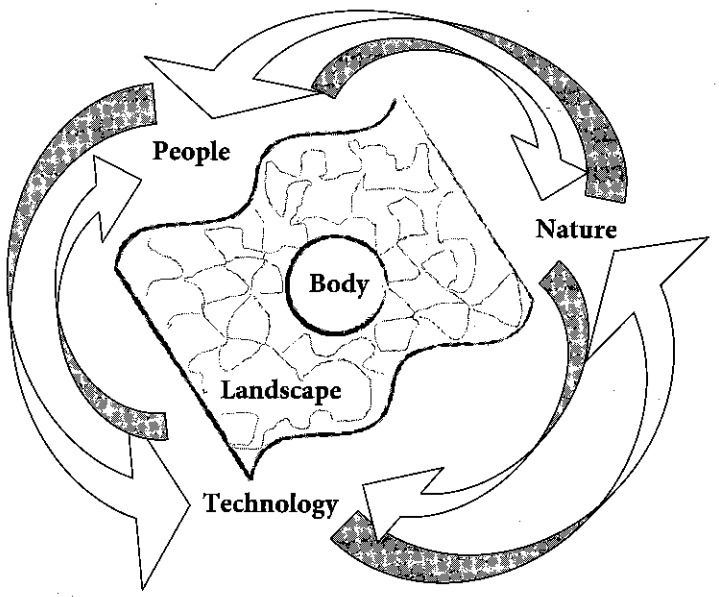
Seeing technology as "the area of interaction" between people and their environment, Kranzberg and Pursell contended that the study of technological history should embrace natural history as well as every other aspect of human history. It took three decades for students of natural history and human history to begin to think in terms of the relationships that Kranzberg and Pursell urged, and now the idea expressed by the German philosopher Walter Benjamin that "technology is not the mastery of nature but of the relations between nature and man"[24] has been embraced by many scholars. Increasingly, historians of technology and historians of the environment are examining this common ground.

For example, in discussing how the North American continent changed as a result of Americans' interaction with the environment, the environmental historian William Cronon employs the Hegelian concept that "second nature" is created by the cultural transformation of prehuman, or first, nature. Thus, the place we call America today is really a "second nature," a result of people's makeover of first nature. The Swedish historian of technology Arne Kaijser suggests that the idea of "second nature" may not go far enough, however, since human constructs of nature are multilayered and based on generations upon generations of people interacting with nature. When one considers that the Roman orator Marcus Tullius Cicero (106–43 BC) observed in *De Natura Deorum* that draining swamps and marshlands to create farmland in Italy created "a second world within the world of nature," Kaijser's notion of many layers of nature becomes all the more intriguing.[25]

Another example of common ground between environmental and technological history is seen in the environmental historian Arthur McEvoy's depiction of factories and other complex workplaces as possessing their own distinctive ecologies. McEvoy observes that "the workplace [is] an ecological system, of which the worker's body is the biological core." Thus, workplaces are a particularly appropriate subject for ecological study, and environment and technology merge in the factory because technology quite literally structures the workplace ecology, poses direct hazards to workers, and shapes the social organization in which workers toil.[26] On a related front, historians of the urban environment approach cities and metropolises as ecological systems in their own right. Urban ecosystems, they argue, comprise technological, social, economic, cultural, and political features that interconnect and overlap with climate, geology, biology, and topography. Our understanding of cities makes much greater sense when it is ecologically informed.[27] In this same vein, the historian Thomas P. Hughes posits that much of the world "consists of intersecting and overlapping natural and human-built systems, which together constitute *ecotechnological* systems," which humankind has created in concert with nature.[28] Furthermore, in the tradition of humans seeing nature as a machine, some scholars are exploring nature, even as humankind has modified it, as an *organic machine.* Whatever the approach, the message is plain: "We cannot understand human history without natural history, and we cannot understand natural history without human history."[29]

Reconsiderations

One of the benefits of the recent scholarship about the relationship between people, nature, and technology is that it provokes us to return to first things. It insists that we reconsider just what sort of agency each element in this relationship has. It demands that we see both technology and nature at least partly as cultural constructions, and in doing so it checks our impulse to treat either as being independent and deterministic. Perhaps most importantly, returning to first things prompts us to reassess the wisdom of our abandoning the paradigm of connectedness between humankind and nature.



The relationship between people, technology, and nature. The human body occupies the central position in the landscape created by the interaction of these three.

In my musings about the relationship between nature, people, and technology, I have been reminded of patchwork quilting, a traditional folk art form. The essence of quilting is in intricately stitching together varieties of cloth into an artful cover that conveys a message, theme, or idea. "Quilts reflected every theme of everyday life—religion, family history, community setting, plant and animal life, children's toys and fairy tales, friendships and love, death and mourning, weddings and other celebrations, and all manner of work from the construction of log cabins to production in the cotton gins."[30] Now, imagine that the patches in the quilt represent outcomes of the interplay between humankind and nature, all with comparable autonomy. The patches are melded together by needle and thread, which create seams as well as intricate patterns on the surface of the quilt. Imagine that the needle and thread represent the available and achievable technologies devised by human beings and used to the extent permitted by nature. Then imagine that the finished quilt is a diverse mixture, a bricolage of the human and the natural world, interconnected and overlapping in what we commonly call "landscapes," the places in which we live out our lives.

The word *landscape* stems from the German *landschaft* and signifies an area of human occupation. It came to England by way of the Dutch *landschap* and became *landskip* in English, accompanied by illustrations of people walking, riding, fishing, driving animals, and so forth. From the Italian equivalent, *parerga*, came "the pastoral idyll of brooks and wheat-gold hills."[31] In answer to the question, "When you hear the word 'landscape,' what sort of terrain immediately appears before your inner eye?" the Danish art historian Jacob Wamburg suggests that the images are quite universal in the Western world. Most of us probably think of green, grassy hills, mildly curving, with meadows, hedges, and fields here and there and occasional roads and houses, "a landscape in which there are technological modifications of nature but the modifications have been 'naturalized,' so as to create a harmony between nature and culture."[32] Put simply, since nature in its original state no longer exists, and since there is no longer such a thing as an entirely unspoiled natural landscape, landscapes are either "man-made or man-modified spaces" in which we live out our lives.[33] It is not possible to conceive of a landscape without also conceiving of the technologies that were used to create it.

In our patchwork quilt, the materials, stitching, and finished designs, like landscapes in the human-nature relationship, are real as well as representational. Landscapes may be primitive or wildernesslike, pastoral or rural, industrial, commercial, urban, suburban. They may be places for play or work, for viewing or consuming. Like an Islamic garden, a landscape may be a place of escape from scorching desert aridity, or it may be an ideal, a "middle state, between the *savage* and the *refined*."[34] In effect, landscapes are both culturally and environmentally defined, and in the words of Arthur McEvoy: "Technology is the tangible instrument of the process: it is the point of interaction between the human and the natural."[35] The Finnish historian Timo Myllyntaus, whose work focuses on both technology and the environment, echoes McEvoy: "Technology constitutes the predominant contacting surface between humanity and the environment." In an analogy befitting the snowy land of Finland, he continues, "To put it simply, one might say that technology is a mitten between culture and nature."[36]

Technology melds together the proverbial quilt of relationships between humans and nature, and out of the process emerges landscapes. Technology is the junction between humankind and nature, and landscapes are the arenas in which the relationship is played out. David Nye writes: "A technology is not merely a system of machines with certain functions; rather it is an expression of a social world." In effect, it creates an environment. For example, technologies of lighting create distinctive night landscapes, and electronic-communication technologies create invisible landscapes of sound. Nye continues that landscape offers "a physical measure of technological change. . . . Landscapes

express the technologies and land use of earlier generations." Thus, like technologies, landscapes are social constructions. They represent the continual social (re)construction not just of the environment, of nature, but of the world in which we live.[37]

In the Western world, humankind has given technology enormous agency. In part this is because it is one of the most important things that distinguish human beings from virtually all other animals.[38] It also is because technology has typically been controlled by people "with an accumulation of knowledge, capital, and power." The environmental historian Ann Vileisis observed, "Our understanding of technology is historically constructed—it comes from the cultural experience of people who disliked railroads cutting through their property or setting awful terms for shipping that they had no control of; and of those who dislike the stench of spewing smokestacks, and . . . indiscriminate spraying of pesticides. . . . Technology seems to have agency to those who do not have any way to exert control or power in its face."[39] Of course, our understanding of technology also has been historically constructed by its advocates, those who have helped shape it or control it, as well as those who have been mesmerized by it.[40]

Nevertheless, technology is but an instrument in relationships between humans and nature. Human beings have definitive agency over technology, and through their inventive activity they have developed a large repertoire of techniques to interface with the natural environment. Similarly, nature has agency over human beings and their success with technology, for it poses a variety of conditions that shape people and their societies. Geography, climate, and resource endowments are only the most obvious natural conditions with which humankind must contend. We may seek to alter the physical environment and create landscapes to suit our needs, but nature will always exert profound influence over our efforts. In fundamental ways, as McEvoy points out, people and nature act ecologically "through the medium of biology and adaptation." People develop technology "in continual, reciprocal adaptation with the natural and social environments" in which it is used.[41]

Conclusion

Seeing technology as the junction between humankind and nature is useful in a number of ways. It helps us to view technology clearly as human artifacts, processes, and systems, none of which act by themselves, but rely on human agency. Technology extends humanity in physical terms by enlarging our capacities to overcome the restrictions of our world, and it extends our intellectual faculties through technical improvements, but first and foremost technology is driven by human intent. According to the historian Sara B. Pritchard, "Technologies are instruments of envisioned relationships between people and the natural environment." They are "tools of prescription and realization." A distinguishing characteristic of the human species is the ability to refine technology to the degree it does. "To quarrel with technology," writes Jacob Bronowski, "is to quarrel with the nature of man—just as if we were to quarrel with his upright gait, his symbolic imagination, his faculty for speech, or his unusual sexual posture and appetite."[42]

But we must also remember that the roots of technology also are embedded in the natural world, in raw materials and in suggestions supplied to human inventors by the nonhuman environment. As Donald Worster reminds us, "Technology is a product of human culture *as conditioned* by the nonhuman environment." Technology exists in reciprocity with both natural and social environments, all the while in symbiosis with its human creators. It has no logic of its own, and the politics that are inherent in every technology come from its human creators. When I think about where final control over technology rests, the memorable statement of the prominent medieval historian Lynn White comes to mind: "A new device merely opens a door; it does not compel one to enter."[43]

The concept of the technology junction helps us to keep in mind that the role of technologies in the relationship between humans and nature is dynamic and interactive. Humankind's technological development always depends on the influence of numerous factors—proximate resource endowments, climate, demography, economic conditions, societal beliefs, and so forth. All of these combine with an ever-constant give and take between people, their technologies, and nature to make up what I have elsewhere called a crude calculus of ever-changing advantages by which people make technological choices.[44] And whatever choices people ultimately make, one can depend on the fact that technological innovation will, in turn, change both natural and social ecologies. Donald Worster calls it "a story of reciprocity and interaction rather than of culture replacing nature." We try to shape nature, and nature shapes us. To borrow from William Butler Yeats: "How can we know the dancer from the dance?"[45]

Because technology is found wherever the spheres of human and natural history meet, the concept of the technology junction offers a new perspective on the dialectic of social and environmental relationships. Technology not only brings people close to nature but also distances them from it. It can mask nature from human perception, as well as sharpen people's understanding of

the world around them. It reflects nature as well as culture and often transforms both, frequently doing the latter while performing the most mundane tasks of its human creators. Bears in Yosemite National Park have learned to unscrew peanut butter jars, break into dumpsters, and open up automobiles. A baby orangutan at the San Diego Zoo learned to unfasten his cage and ran about the nursery unscrewing light bulbs, and dogs have learned how to use doorknobs. From these and other examples, Edward Tenner concludes that while technology modifies the environment, it also changes the behavior of people and other living creatures, which in turn inspires new technology.[46]

The historian of science Hunter Dupree suggested thirty years ago that "technology . . . connects the species of biological organism Homo sapiens with its environment."[47] Whereas other organisms appear to reach a balance with nature by biological adaptation, technology, an instrument of culture, is interjected into the relationship between humans and nature. With it, people and nature mutually sculpt the landscapes in which we live out our lives. It is always present, whether in the form of a digging stick, a fence, an axe or a chain saw, a structural design, a computer, a swimming pool, a lawnmower, or a centrifuge. Whatever the tasks in which we engage, we are bound to nature, and nature is bound to us by our technology.

Notes

An earlier version of this essay appeared as "The Technology Junction: Exploring Technology and the Environment," *ICON: Journal of the International Committee for the History of Technology* 6 (2000): 7–20.

1. Arnold Pacey, *Meaning in Technology* (Cambridge, MA: MIT Press, 1999), 22.
2. Daniel B. Botkin, *Our Natural History: The Lessons of Lewis and Clark* (New York: G. P. Putnam's Sons, 1995), 13.
3. See Carolyn Merchant, *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill: University of North Carolina Press, 1989), and her earlier work, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper & Row, 1980). See also Richard Worthington, "The Nature of Global Processes," in *New Worlds, New Technologies, New Issues*, ed. Stephen Cutcliffe et al. (Bethlehem, PA: Lehigh University Press, 1992), 132.
4. Peter Coates, *Nature: Western Attitudes since Ancient Times* (Berkeley and Los Angeles: University of California Press, 1998), 39–40, 42, 57, 62–63. See also Jean Gimpel, *The Medieval Machine: The Industrial Revolution of the Middle Ages* (New York: Penguin Books, 1976); and Lynn White Jr., *Medieval Technology and Social Change* (London: Oxford University Press, 1962).
5. Donald Worster, *Under Western Skies: Nature and History in the American West* (New York: Oxford University Press, 1992), 71.
6. John M. Staudenmaier, "Rationality versus Contingency in the History of Technology," in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith and Leo Marx (Cambridge: MIT Press, 1994), 270.
7. Merchant, *Death of Nature*, 192–235; idem, *Ecological Revolutions*, ch. 1; Manuel Medina, "The Culture of Risk: New Technologies and Old Worlds," in Cutcliffe et al., *New Worlds*, 62, 64; José Sanmartín, "The New World of New Technology," in ibid., 73. See also Nancy Langston, *Forest Dreams, Forest Nightmares: The Paradox of Old Growth in the Inland West* (Seattle: University of Washington Press, 1995), 5.
8. Quoted in David E. Nye, *Technology Matters: Questions to Live With* (Cambridge, MA: MIT Press, 2006), 87.
9. Aidan Davison, *Technology and the Contested Meanings of Sustainability* (Albany: State University of New York Press, 2001), ix.
10. Jeffrey Stine and Joel Tarr, "At the Intersection of Histories: Technology and the Environment," *Technology and Culture* 39 (October 1998): 612; James C. Williams, *Energy and the Making of Modern California* (Akron, OH: University of Akron Press, 1997), 2; Smith and Marx, *Does Technology Drive History?* xi. See also Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (Cambridge, MA: MIT Press, 1978).
11. Coates, *Nature*, 9.
12. Simon Schama, *Landscape and Memory* (New York: Vintage, 1995), 7.
13. Quoted in Coates, *Nature*, 9.
14. Quoted in ibid., 10.
15. "Not worth the money," reader review of *Centennial*, 20 November 1999, http://www.amazon.com. Braudel is quoted in Coates, *Nature*, 19. See also Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II* (1949; reprint, Berkeley and Los Angeles: University of California Press, 1996); and idem, *Capitalism and Material Life, 1400–1800* (1967; reprint, New York: Harper Colophon Books, 1975), both of which explore long-term rhythms and cycles in history.
16. James C. Williams, "Earthquake Engineering: Designing Unseen Technology against Invisible Forces," *ICON: Journal of the International Committee for the History of Technology* 1 (1995): 172–94.
17. Tim LeCain, " 'Rethinking the Nature-Technology Dichotomy': A Session Report from Las Vegas," *Envirotech Newsletter* 6 (Fall 2006): 2 (http://www.stanford.edu/jhowe/Envirotech/2006%20Fall%20newsl%E2%80%A61%20version%202.pdf), discusses three papers delivered at the annual meeting of the Society for the History of Technology in Las Vegas, NV, October 2006.
18. Carl Mitcham, *Thinking Through Technology: The Path between Engineering and Philosophy* (Chicago: University of Chicago Press, 1994), 128–29.
19. Ruth Schwartz Cowan, *A Social History of American Technology* (New York: Oxford University Press, 1997), 204.
20. The changing and varied meanings of *technology* are discussed in Mitcham, *Thinking Through Technology*, and Davison, *Technology and the Contested Meanings of Sustainability*, ix. It is worth noting that continental European languages maintain a distinction between *technique* and *technology* that English has abandoned. See Eric Schatzberg, "From Knowledge to Object: The Contested Meanings of Technology" (paper presented at the conference "Wrestling with Nature: From Omens to Science," Madison, WI, 28 April 2001).
21. Nye, *Technology Matters*, 11–12.
22. Ruth Oldenziel, *Making Technology Masculine: Men, Women and Modern Machines in America, 1870–1945* (Amsterdam: Amsterdam University Press, 1999), which offers a marvelous

discussion of technology and gender in American history; David F. Noble, *The Religion of Technology: The Divinity of Man and the Spirit of Invention* (New York: Knopf, 1997).

23. Melvin Kranzberg and Carroll W. Pursell Jr., eds., *Technology in Western Civilization*, vol. 1 (New York: Oxford University Press, 1967), 11. As one of my students suggested, technology is "the conscious manipulation of natural processes or resources to produce a desired outcome at a specific place and/or time." Keith L. Bennett, "Man: A Part of Nature or Apart from Nature" (essay, De Anza College, October 2002).
24. Walter Benjamin, *Reflections: Essays, Aphorisms, Autobiographical Writings*, ed. Peter Demetz (New York: Shocken, 1986), 93.
25. William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: Norton, 1991), xix, 56; Arne Kaijser, comments in an unrecorded discussion at the "Technology and Environment" session, 26th Symposium of the International Committee for the History of Technology, Belfort, France, August 1999; Cicero, quoted in Coates, *Nature*, 21, and cited in Thomas Hughes, *Human-Built World: How to Think about Technology and Culture* (Chicago: University of Chicago Press, 2004), 17, and, Nye, *Technology Matters*, 8. The confluence of environmental and technological history is illustrated particularly in Stine and Tarr, "At the Intersection of Histories," 601–40, and by essays in "Technology, Pollution, and the Environment," ed. Jeffrey Stine and Joel Tarr, special issue, *Environmental History Review*, 18 (Spring 1994).
26. Arthur F. McEvoy, "Working Environments: An Ecological Approach to Industrial Health and Safety," *Technology and Culture* 36 (April 1995): S149, S156.
27. Jared Orsi, *Hazardous Metropolis: Flooding and Urban Ecology in Los Angeles* (Berkeley and Los Angeles: University of California Press, 2004); Joel A. Tarr, ed., *Devastation and Renewal: An Environmental History of Pittsburgh and Its Region* (Pittsburgh: University of Pittsburgh Press, 2005).
28. Hughes, *Human-Built World*, 156, emphasis added.
29. Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill & Wang, 1995), ix.
30. Bettina Aptheker, *Tapestries of Life: Women's Work, Women's Consciousness, and the Meaning of Daily Experience* (Amherst: University of Massachusetts Press, 1989), 68.
31. Schama, *Landscape and Memory*, 10.
32. Jacob Wamburg, "Abandoned Paradise: The Western Pictorial Paradigm Shift around 1420," in *Technologies of Landscape: From Reaping to Recycling*, ed. David E. Nye (Amherst: University of Massachusetts, 1999), 69.
33. John Brinkerhoff Jackson, quoted in Nye, *Technologies of Landscape*, 3.
34. Quoted in Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1964), 105.
35. McEvoy, "Working Environments," S152.
36. Timo Myllyntaus, "Technology and the Environment: Searching for Their Nexus in History," *Tekniikan Waiheita* (Finnish quarterly for the history of technology) 21, no. 2 (2003): 11.
37. Nye, *Technology Matters*, 47, 88–89. See also Anne Whiston Spirn, *The Granite Garden: Urban Nature and Human Design* (New York: Basic Books, 1984).
38. There is some limited evidence to the contrary. For example, chimpanzees in Senegal have been observed breaking a branch off a tree, trimming its leaves, sharpening one end, and then using this primitive tool to spear nocturnal bush babies asleep in deep tree hollows. See "Chimps Make Wood Spears, Kill Smaller Animals for Food," *San Francisco Chronicle*, 23 February 2007, A4.
39. Ann Vileisis, e-mail message to author, 8 October 2006.
40. Donald MacKenzie and Judy Wajcman, eds., *The Social Shaping of Technology*, 2d ed. (Buckingham, UK: Open University Press, 1999), is essential to this topic. See also David E. Nye, *American Technological Sublime* (Cambridge, MA: MIT Press, 1994).
41. McEvoy, "Working Environments," S150, S153.
42. Sara B. Pritchard, " 'The New Rhone is Born': Nature and Technology in France after World War II" (paper presented at the 26th Symposium of the International Committee for the History of Technology, Belfort, France, August 1999), 4; Jacob Bronowski, "Technology and Culture in Evolution," in *Technology and Change*, ed. John G. Burke and Marshall C. Eakins (San Francisco: Boyd & Fraser, 1979), 58.
43. David Rothenberg, *Hand's End: Technology and the Limits of Nature* (Berkeley and Los Angeles: University of California Press, 1993), xiii, 29–30; Donald Worster, "Transformations of the Earth: Toward an Agroecological Perspective in History," *Journal of American History* 76 (March 1990): 1089, emphasis added; Pacey, *Meaning in Technology*, 22–23; Lynn White, *Medieval Technology*, 28. I also draw here from McEvoy, "Working Environments," S152; and Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: University of Chicago Press, 1986), 19–39.
44. Williams, *Energy*, 9.
45. Worster, *Under Western Skies*, 251; *The Collected Poems of W. B. Yeats*, ed. Richard J. Finneran, 2d rev. ed. (New York: Scribner, 1996), 217. See also McEvoy, "Working Environments," S153.
46. Edward Tenner, *Our Own Devices: The Past and Future of Body Technology* (New York: Knopf, 2003), 4.
47. A. Hunter Dupree, "Comment: The Role of Technology in Society and the Need for Historical Perspective," *Technology and Culture* (October 1969): 529–30. See also Richard White, " 'Are You an Environmentalist or Do You Work for a Living?': Work and Nature," in *Uncommon Ground: Rethinking the Human Place in Nature*, ed. William Cronon (New York: Norton, 1996), 182.