Human Ecology as a Problem of Ecological Design

Man is everywhere a disturbing agent. Wherever he plants his foot, the harmonies of nature are turned to discords.

—George Perkins Marsh

The Problem of Human Ecology

Whatever their particular causes, environmental problems all share one fundamental trait: with rare exceptions they are unintended, unforeseen, and sometimes ironic side effects of actions arising from other intentions. We intend one thing and sooner or later get something very different. We intended merely to be prosperous and

1. Our ecological troubles have been variously attributed to Judeo-Christian religion (White 1967), our inability to manage common property resources
healthy but have inadvertently triggered a mass extinction of other species, spread pollution throughout the world, and triggered climatic change—all of which undermines our prosperity and health. Environmental problems, then, are mostly the result of a miscalibration between human intentions and ecological results, which is to say that they are a kind of design failure.

The possibility that ecological problems are design failures is perhaps bad news because it may signal inherent flaws in our perceptual and mental abilities. On the other hand, it may be good news. If our problems are, to a great extent, the result of design failures, the obvious solution is better design, by which I mean a closer fit between human intentions and the ecological systems where the results of our intentions are ultimately played out.

The perennial problem of human ecology is how different cultures provision themselves with food, shelter, energy, and the means of livelihood by extracting energy and materials from their surroundings (Smil 1994). Ecological design describes the ensemble of technologies and strategies by which societies use the natural world to construct culture and meet their needs. Because the natural world is continually modified by human actions, culture and ecology are shifting parts of an equation that can never be solved. Nor can there be one correct design strategy. Hunter-gatherers lived on current solar income. Feudal barons extracted wealth from sunlight by exploiting serfs who farmed the land. We provision ourselves by mining ancient sunlight stored as fossil fuels. The choice is not whether or not human societies have a design strategy, but whether that strategy works ecologically and can be sustained within the regenerative capacity of the particular ecosystem. The problem of ecological design has become more difficult as the human population has grown and technology has multiplied. It is now the overriding problem of our time, affecting virtually all other issues on the human agenda. How and how intelligently we weave the human presence into the natural world will re-

duce or intensify other problems having to do with ethnic conflicts, economics, hunger, political stability, health, and human happiness.

At the most basic level, humans need 2,200–3,000 calories per day, depending on body size and activity level. Early hunter-gatherers used little more energy than they required for food. The invention of agriculture increased the efficiency with which we captured sunlight permitting the growth of cities (Smil 1991, 1994). Despite their differences, neither hunter-gatherers nor farmers showed much ecological foresight. Hunter-gatherers drove many species to extinction, and early farmers left behind a legacy of deforestation, soil erosion, and land degradation. In other words, we have always modified our environments to one degree or another, but the level of ecological damage has increased with the level of civilization and with the scale and kind of technology.

The average citizen of the United States now uses some 186,000 calories of energy each day, most of it derived from oil and coal (McKibben 1998). Our food and materials come to us via a system that spans the world and whose consequences are mostly concealed from us. On average food is said to have traveled more than 1,300 miles from where it was grown or produced to where it is eaten (Meadows 1998). In such a system, there is no conceivable way that we can know the human or ecological consequences of eating. Nor can we know the full cost of virtually anything that we purchase or discard. We do know, however, that the level of environmental destruction has risen with the volume of stuff consumed and with the distance it is transported. By one count we waste more than 1 million pounds of materials per person per year. For every 100 pounds of product, we create 3,200 pounds of waste (Hawken 1997, 44). Measured as an "ecological footprint" (i.e., the land required to grow our food, process our organic wastes, sequester our carbon dioxide, and provide our material needs), the average North American requires some 5 hectares of arable land per person per year (Wackernagel and Rees 1996). But at the current population level, the world has only 1.2 hectares of usable land per person. Extending our lifestyle to everyone would require the equivalent of two additional earths!

Looking ahead, we face an imminent collision between a growing population with rising material expectations and ecological capacity. At some time in the next century, given present trends, the human population will reach or exceed 10 billion, perhaps as many as 15–20
percent of the species on earth will have disappeared forever, and the
effects of climatic change will be fully apparent. This much and more
is virtually certain. Feeding, housing, clothing, and educating another
4–6 billion people and providing employment for an additional 2–4
billion without wrecking the planet in the process will be a consider-
able challenge. Given our inability to meet basic needs of one-third of
the present population, there are good reasons to doubt that we will
be able to do better with the far larger population now in prospect.

The Default Setting

The regnant faith holds that science and technology will find a way to
meet human needs and desires without our having to make signifi-
cant changes in our philosophies, politics, economics, or in the way
we live. Rockefeller University professor Jessie Ausubel, for example,
asserts that

after a very long preparation, our science and technology are
ready also to reconcile our economy and the environment.
... In fact, long before environmental policy became con-
scious of itself, the system had set decarbonization in
motion. A highly efficient hydrogen economy, landless
agriculture, industrial ecosystems in which waste virtually disap-
ppears: over the coming century these can enable large, pros-
perous human populations to co-exist with the whales and
the lions and the eagles and all that underlie them. (Ausubel
1996, 15)

We have, Ausubel states, “liberated ourselves from the environ-
ment.” This view is similar to that of futurist Herman Kahn when he
asserted several decades ago that by the year 2200 “humans would
everywhere be rich, numerous, and in control of the forces of nature”
(Kahn and Brown 1976, 1). In its more recent version, those believing
that we have liberated ourselves from the environment cite advances
in energy use, materials science, genetic engineering, and artificial
intelligence that will enable us to do much more with far less and even-
tually transcend ecological limits altogether. Humanity will then take
control of its own fate, or more accurately, as C. S. Lewis once ob-
served, some few humans will do so, purportedly acting on behalf of

Ausubel’s optimism coincides with the widely held view that we
ought to simply take over the task of managing the planet (Scientific
American 1989). In fact, the technological and scientific capability is
widely believed to be emerging in the technologies of remote sensing,
geographic information systems, computers, the science of ecology
(in its managerial version), and systems engineering. The problems of
managing the earth, however, are legion. For one, the word “man-
agement” does not quite capture the essence of the thing being proposed.
We can manage, say, a 747 because we made it. Presumably, we know
what it can and cannot do even though they sometimes crash for rea-
sons that elude us. Our knowledge of the earth is in no way compara-
able. We did not make it, we have no blueprint of it, and we will never
know fully how it works. Second, the target of management is not
quite what it appears to be since a good bit of what passes for manag-
ing the earth is, in fact, managing human behavior. Third, under the
guise of objective neutrality and under the pretext of emergency,
management of the earth is ultimately an extension of the effort to
dominate people through the domination of nature. And can we trust
those presuming to manage to do so with fairness, wisdom, foresight,
and humility, and for how long?

Another, and more modest, possibility is to restrict our access to
nature rather like a fussy mother in bygone days keeping unruly chil-
dren out of the formal parlor. To this end Martin Lewis (1992) pro-
poses what he calls a “Promethean environmentalism” that aims to
protect nature by keeping us away from as much of it as possible. His
purpose is to substitute advanced technology for nature. This requires
the development of far more advanced technologies, more unfettered
capitalism, and probably some kind of high-tech virtual simulation to
meet whatever residual needs for nature that we might retain in this
Brave New World. Lewis dismisses the possibility that we could be-
come stewards, ecologically competent, or even just a bit more hum-
ble. Accordingly, he disparages those whom he labels “eco-radicals,”
including Aldo Leopold, Herman Daly, and E. F. Schumacher, who
question the role of capitalism in environmental destruction, raise is-
issues about appropriate scale, and disagree with the directions of tech-
nological evolution. Lewis’s proposal to protect nature by removing
humankind from it raises other questions. Will people cut off from
nature be sane? Will people who no longer believe that they need nature be willing, nonetheless, to protect it? If so, will people no longer in contact with nature know how to do so? And was it not our efforts to cut ourselves off from nature that got us into trouble in the first place? On such matters Lewis is silent.

Despite pervasive optimism, there is a venerable tradition of unease about the consequences of unconstrained technological development, from Mary Shelley's Frankenstein to Lewis Mumford's (1974) critique of the "megamachine." But the technological juggernaut that has brought us to our present situation, nonetheless, remains on track. We have now arrived, in Edward O. Wilson's (1998) view, at a choice between two very different paths of human evolution. One choice would aim to preserve "the physical and biotic environment that cradled the human species" along with those traits that make us distinctively human. The other path, based on the belief that we are now exempt from the "iron laws of ecology that bind other species," would take us in radically different directions, as "Homo unicus or 'shape-changer man'" (ibid., 278). But how much of the earth can we safely alter? How much of our own genetic inheritance should we manipulate before we are no longer recognizably human? This second path, in Wilson's view, would "render everything fragile" (ibid., 298). And, in time, fragile things break apart.

The sociologist and theologian Jacques Ellul, is even more pessimistic. "Our machines," he writes, "have truly replaced us." We have no philosophy of technology, in his view, because "philosophy implies limits and definitions and defined areas that technique will not allow" (1990, 216). Consequently, we seldom ask where all of this is going, or why, or who really benefits. The "unicity of the [technological] system," Ellul believes, "may be the cause of its fragility" (1980, 164). We are "shut up, blocked, and chained by the inevitability of the technical system," at least until the self-contradictions of the "technological bluff," like massive geologic fault lines, give way and the system dissolves in "enormous global disorder" (1990, 411–412). At that point he thinks that we will finally understand that "everything depends on the qualities of individuals" (ibid., 412).

The dynamic is by now familiar. Technology begets more technology, technological systems, technology-driven politics, technologypedependent economies, and finally, people who can neither function nor think a hair's breadth beyond the limits of one machine or another. This, in Neil Postman's (1992) view, is the underlying pattern of Western history as we moved from simple tools, to technocracy, to "technopoly." In the first stage, tools were useful to solve specific problems but did not undermine "the dignity and integrity of the culture into which they were introduced" (ibid., 23). In a technocracy like England in the eighteenth and nineteenth centuries, factories undermined "tradition, social mores, myth, politics, ritual and religion." The third stage, technopoly, however, "eliminates alternatives to itself in precisely the way Aldous Huxley outlined in Brave New World." It does so "by redefining what we mean by religion, by art, by family, by politics, by history, by truth, by privacy, by intelligence, so that our definitions fit its new requirements" (ibid., 48). Technopoly represents, in Postman's view, the cultural equivalent of AIDS, which is to say a culture with no defense whatsoever against technology or the claims of expertise (ibid., 63). It flourishes when the "tie between information and human purpose has been severed" (ibid., 70).

The course that Ausubel and others propose fits into this larger pattern of technopoly that step by step is shifting human evolution in radically different directions. Ausubel (1996) does not discuss the risks and unforeseen consequences that accompany unfettered technological change. These, he apparently believes, are justifiable as unavoidable costs of what he deems to be progress. This is precisely the kind of thinking that has undermined our capacity to refuse technologies that add nothing to our quality of life. A system that produces automobiles and atom bombs will also go on to make supercomputers, smart weapons, genetically altered crops, nanotechnologies, and eventually machines smart enough to displace their creators. There is no obvious stopping point, which is to say that, having accepted the initial premises of technopoly, the powers of control and good judgment are eroded away in the flood of possibilities.

Advertised as the essence of rationality and control, the technological system has become the epitome of irrationality in which means overrule careful consideration of ends. A rising tide of unanticipated consequences and "normal accidents" mock the idea that experts are in control or that technologies do only what they are intended to do. The purported rationality of each particular component in what Wilson (1998, 289) calls a "thickening web of prosthetic devices" added together as a system lacks both rationality and coherence. Nor is there anything inherently human or even rational about
words such as “efficiency,” “productivity,” or “management,” that are used to justify technological change. Rationality of this narrow sort has been “as successful—if not more successful—at creating new degrees of barbarism and violence as it has been at imposing reasonable actions” (Saul 1993, 32). Originating with Descartes and Galileo, the foundations of the modern worldview were flawed from the beginning. In time, those seemingly small and trivial errors of perception, logic, and heart cascaded into a rising tide of cultural incoherence, barbarism, and ecological degradation. Ausubel’s optimism notwithstanding, this tide will continue to rise until it has finally drowned every delicate possibility that might have been unless we choose a more discerning course.

**Ecological Design**

The unfolding problems of human ecology are not solvable by repeating old mistakes in new and more sophisticated and powerful ways. We need a deeper change of the kind Albert Einstein had in mind when he said that the same manner of thought that created problems could not solve them (quoted in McDonough and Braungart 1998, 92). We need what architect Sim van der Ryn and mathematician Stewart Cowan define as an ecological design revolution. Ecological design in their words is “any form of design that minimize(s) environmentally destructive impacts by integrating itself with living processes . . . the effective adaptation to and integration with nature’s processes” (1996, x, 18). For landscape architect Carol Franklin, ecological design is a “fundamental revision of thinking and operation” (1997, 264). Good design does not begin with what we can do, but rather with questions about what we really want to do (Wann 1996, 22). Ecological design, in other words, is the careful meshing of human purposes with the larger patterns and flows of the natural world and the study of those patterns and flows to inform human actions (Orr 1994, 104).

In their book *Natural Capitalism* (1999), Paul Hawken, Hunter Lovins, and Amory Lovins propose a transformation in energy and resource efficiency that would dramatically increase wealth while using a fraction of the resources we currently use. Transformation would not occur, however, simply as an extrapolation of existing technologi-cal trends. They propose, instead, a deeper revolution in our thinking about the uses of technology so that we don’t end up with “extremely efficient factories making napalm and throwaway beer cans” (Benyus 1997, 262). In contrast to Ausubel, the authors of *Natural Capitalism* propose a closer calibration between means and ends. Such a world would improve energy and resource efficiency by perhaps tenfold. It would be powered by highly efficient, small-scale, renewable energy technologies distributed close to the point of end-use. It would protect natural capital in the form of soils, forests, grasslands, oceanic fisheries, and biota while preserving biological diversity. Pollution, in any form, would be curtailed and eventually eliminated by industries designed to discharge no waste. The economy of that world would be calibrated to fit ecological realities. Taxes would be levied on things we do not want such as pollution and removed from things such as income and employment that we do want. These changes signal a revolution in design that draws on fields as diverse as ecology, systems dynamics, energetics, sustainable agriculture, industrial ecology, architecture, landscape architecture, and economics.

The challenge of ecological design is more than simply an engineering problem of improving efficiency; it is the problem of reducing the rates at which we poison ourselves and damage the world. The revolution that van der Ryn and Cowan (1996) propose must first reduce the rate at which things get worse (coefficients of change) but eventually change the structure of the larger system. As Bill McDonough and Michael Braungart (1998) argue, we will need a second industrial revolution that eliminates the very concept of waste. This implies, as McDonough is fond of saying, “putting filters on our minds, not at the end of pipes.” In practice, the change McDonough proposes

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2. The roots of ecological design can be traced back to the work of Scottish biologist D’Arcy Thompson and his magisterial *On Growth and Form*, first published in 1917. In contrast to Darwin’s evolutionary biology, Thompson traced the evolution of life forms back to the problems that elementary physical forces such as gravity pose for individual species. His legacy is an evolving science of forms evident in evolutionary biology, biomechanics, and architecture. Ecological design is evident in the work of Bill Browning, Herman Daly, Paul Hawken, Wes Jackson, Aldo Leopold, Amory and Hunter Lovins, John Lyle, Bill McDonough, Donelle Meadows, Eugene Odum, Sim van der Ryn, and David Wann.
implies, among other things, changing manufacturing systems to eliminate the use of toxic and cancer-causing materials and developing closed-loop systems that deliver “products of service,” not products that are eventually discarded to air, water, and landfills.

The pioneers in ecological design begin with the observation that nature has been developing successful strategies for living on earth for 3.8 billion years and is, accordingly, a model for

- Farms that work like forests and prairies
- Buildings that accrue natural capital like trees
- Waste water systems that work like natural wetlands
- Materials that mimic the ingenuity of plants and animals
- Industries that work more like ecosystems
- Products that become part of cycles resembling natural materials flows.

Wes Jackson (1985), for example, is attempting to redesign agriculture in the Great Plains to mimic the prairie that once existed there. Paul Hawken (1993) proposes to remake commerce in the image of natural systems. The new field of industrial ecology is similarly attempting to redesign manufacturing to reflect the way ecosystems work. The new field of “biomimicry” is beginning to transform industrial chemistry, medicine, and communications. Common spiders, for example, make silk that is ounce for ounce five times stronger than steel, with no waste by-products. The inner shell of an abalone is far tougher than our best ceramics (Benyus 1997, 97). By such standards, human industry is remarkably clumsy, inefficient, and destructive. Running through each of these ideas is the belief that the successful design strategies, tested over the course of evolution, provide the standard to inform the design of commerce and the large systems that supply us with food, energy, water, and materials, and remove our wastes (Benyus 1997).

The greatest impediment to an ecological design revolution is not, however, technological or scientific, but rather human. If intention is the first signal of design, as McDonough puts it, we must reckon with the fact that human intentions have been warped in recent history by violence and the systematic cultivation of greed, self-preoccupation, and mass consumerism. A real design revolution will have to transform human intentions and the larger political, economic, and institutional structure that permitted ecological degradation in the first place. A second impediment to an ecological design revolution is simply the scale of change required in the next few decades. All nations, but starting with the wealthiest, will have to:

- Improve energy efficiency by a factor of 5–10
- Rapidly develop renewable sources of energy
- Reduce the amount of materials per unit of output by a factor of 5–10
- Preserve biological diversity now being lost everywhere
- Restore degraded ecosystems
- Redesign transportation systems and urban areas
- Institute sustainable practices of agriculture and forestry
- Reduce population growth and eventually total population levels
- Redistribute resources fairly within and between generations
- Develop more accurate indicators of prosperity, wellbeing, health, and security.

To avoid catastrophe, all of these steps must be well under way within the next few decades. Given the scale and extent of the changes required, this is a transition for which there is no historical precedent. The century ahead will test, not just our ingenuity, but our foresight, wisdom, and sense of humanity as well.

The success of an ecological design will depend on our ability to cultivate a deeper sense of connection and obligation without which few people will be willing to make even obvious and rational changes in time to make much difference. We will have to reckon with the power of denial, both individual and collective, to block change. We must reckon with the fact that we will never be intelligent enough to understand the full consequences of our actions, some of which will be paradoxical and some evil. We must learn how to avoid creating problems for which there is no good solution, technological or otherwise (Dobb 1996; Hunter 1997) such as the creation of long-lived wastes, the loss of species, or toxic waste flowing from tens of thousands of mines. In short, a real design revolution must aim to foster a deeper transformation in human intentions and the political and economic institutions that turn intentions into ecological results. There is
no clever shortcut, no end-run around natural constraints, no magic bullet, and no such thing as cheap grace.

The Intention to Design

Designing a civilization that can be sustained ecologically and one that sustains the best in the human spirit will require us to confront the wellsprings of intention, which is to say, human nature. Our intentions are the product of many factors, at least four of which have implications for our ecological prospects. First, with the certain awareness of our mortality, we are inescapably religious creatures. The religious impulse in us works like water flowing up from an artesian spring that will come to the surface in one place or another. Our choice is not whether we are religious or not as atheists would have it, but whether the object of our worship is authentic or not. The gravity mass of our nature tugs us to create or discover systems of meaning that places us in some larger framework that explains, consoles, offers grounds for hope, and, sometimes, rationalizes. In our age, nationalism, capitalism, communism, fascism, consumerism, cyberism, and even ecologism have become substitutes for genuine religion. But whatever the -ism or the belief, in one way or another we will create or discover systems of thought and behavior that give us a sense of meaning and belonging to something larger. Moreover, there is good evidence to support the claim that successful resource management requires, in E. N. Anderson's words, "a direct, emotional religiously 'socialized' tie to the resources in question" (1996, 169). Paradoxically, however, societies with much less scientific information than we have often make better environmental choices. Myth and religious beliefs, which we regard as erroneous, have sometimes worked better to preserve environments than have decisions based on scientific information administered by presumably rational bureaucrats (Lansing 1991). Accordingly, solutions to environmental problems must be designed to resonate at deep emotional levels and be ecologically sound.

Second, despite all of our puffed up self-advertising as *Homo sapiens*, the fact is that we are limited, if clever, creatures. Accordingly, we need a more sober view of our possibilities. Real wisdom is rare and rarer still if measured ecologically. Seldom do we foresee the ecological consequences of our actions. We have great difficulty understanding what Jay Forrester (1971) once called the "counterintuitive behavior of social systems." We are prone to overdo what worked in the past, with the result that many of our current problems stem from past success carried to an extreme. Enjoined to "be fruitful and multiply," we did as commanded. But at 6 billion and counting, it seems that we lack the gene for enough. We are prone to overestimate our abilities to get out of self-generated messes. We are, as someone put it, continually overrunning our headlights. Human history is in large measure a sorry catalog of war and malefanesance of one kind or another. Stupidity is probably as great a factor in human affairs as intelligence. All of which is to say that a more sober reading of human potentials suggests the need for a fail-safe approach to ecological design that does not overtax our collective intelligence, foresight, and goodness.

Third, quite possibly we have certain dispositions toward the environment that have been hardwired in us over the course of our evolution. E. O. Wilson, for example, suggests that we possess what he calls "biophilia," meaning an innate "urge to affiliate with other forms of life" (1984, 85). Biophilia may be evident in our preference for certain landscapes such as savannas and in the fact that we heal more quickly in the presence of sunlight, trees, and flowers than in biologically sterile, artificially lit, utilitarian settings. Emotionally damaged children, unable to establish close and loving relationships with people, sometimes can be reached by carefully supervised contact with animals. And after several million years of evolution, it would be surprising indeed were it otherwise. The affinity for life described by Wilson and others, does not, however, imply nature romanticism, but rather something like a core element in our nature that connects us to the nature in which we evolved and which nurtures and sustains us. Biophilia certainly does not mean that we are all disposed to like nature or that it cannot be corrupted into biophobia. But without intending to do so, we are creating a world in which we do not fit. The growing evidence supporting the biophilia hypothesis suggests that we fit better in environments that have more, not less, nature. We do better with sunlight, contact with animals, and in settings that include trees, flowers, flowing water, birds, and natural processes than in their absence. We are sensuous creatures who develop emotional attachment to particular landscapes. The implication is that we need to
create communities and places that resonate with our evolutionary past and for which we have deep affection.

Fourth, for all of our considerable scientific advances, our knowledge of the earth is still minute relative to what we will need to know. Where are we? The short answer is that despite all of our science, no one knows for certain. We inhabit the third planet out from a fifth-rate star located in a backwater galaxy. We are the center of nothing obvious to our science. We do not know whether the earth is just dead matter or whether it is, in some respects, alive. Nor do we know how forgiving the ecosphere may be to human insults. Our knowledge of the flora and fauna of the earth and the ecological processes that link them is small relative to all that might be known. In some areas, in fact, knowledge is in retreat because it is no longer fashionable or profitable. Our practical knowledge of particular places is often considerably less than that of the native peoples we displaced. As a result, the average college graduate would flunk even a cursory test on local ecology, and stripped of technology most would quickly founder.

To complicate things further, the advance of human knowledge is inescapably ironic. Since the Enlightenment, the goal of our science has been a more rational ordering of human affairs in which cause and effect could be empirically determined and presumably controlled. But after a century of promiscuous chemistry, for example, who can say how the 100,000 chemicals in common use mix in the ecosphere or how they might be implicated in declining sperm counts, rising cancer rates, disappearing amphibians, or behavioral disorders? And having disrupted global biogeochemical cycles, no one can say with assurance what the larger climatic and ecological effects will be. Undaunted by our ignorance, we rush ahead to reengineer the fabric of life on earth. Maybe scientists will figure it all out. It is more probable, however, that we are encountering the outer limits of social-ecological complexity in which cause and effect are widely separated in space and time, and in a growing number of cases no one can say with certainty what causes what. Like the sorcerer’s apprentice, every answer generated by science gives rise to a dozen more questions, and every technological solution gives rise to even more problems. Rapid technological change intended to rationalize human life tends to expand the domain of irrationality. At the end of the bloodiest century in history, the Enlightenment faith in human rationality seems overstated at best. But the design implication is not less rationality, but a more complete, humble, and ecologically solvent rationality that works over the long term.

Who are we? Conceived in the image of God? Perhaps. But for the time being the most that can be said with assurance is that, in an evolutionary perspective, humans are a precocious and unruly newcomer with a highly uncertain future. Where are we? Wherever it is, it is a world full of irony and paradox, veiled in mystery. And for those purporting to establish the human presence in the world in a manner that is ecologically sustainable and spiritually sustaining, the ancient idea that God (or the gods) mocks human intelligence should never be far from our thoughts.

Ecological Design Principles

As creatures more ignorant than knowledgeable, what principles can safely guide our actions over the long term? There is no operating manual for planet Earth, so we will have to write our own as a set of design principles. Ecological design, however, is not so much about how to make things as about how to make things that fit gracefully over long periods of time in a particular ecological, social, and cultural context. Industrial societies, in contrast, work under the conviction that “if brute force doesn’t work, you’re not using enough of it.” But when humans have designed with ecology in mind, there is greater harmony between intentions and the particular places in which those intentions are played out that preserves diversity both cultural and biological; utilizes current solar income; creates little or no waste; accounts for all costs; and respects larger cultural and social patterns. Ecological design is not just a smarter way to do the same old things or a way to rationalize and sustain a rapacious, demoralizing, and unjust consumer culture. The problem is not how to produce ecologically benign products for the consumer economy, but how to make decent communities in which people grow to be responsible citizens and whole people who do not confuse what they have with who they are. The larger design challenge is to transform a wasteful society into one that meets human needs with elegant simplicity. Designing ecologically requires a revolution in our thinking that changes the kinds of questions we ask from how can we do the same old things more efficiently to deeper questions such as:
results in communities in which feedback between action and subsequent correction is rapid, people are held accountable for their actions, functional redundancy is high, and control is decentralized. In a well-designed community, people would know quickly what's happening, and if they don’t like it, they know who can be held accountable and can change it. Such things are possible only where livelihood, food, fuel, and recreation are, to a great extent, derived locally; where people have control over their own economies; and where the pathologies of large-scale administration are minimal. Moreover, being situated in a place for generations provides long memory of the place and hence of its ecological possibilities and limits. There is a kind of long-term learning process that grows from the intimate experience of a place over time. Ecological design, then, is a large idea but is most applicable at a relatively modest scale. The reason is not that smallness or locality has any necessary virtue, but that human frailties limit what we are able to comprehend and foresee, as well as the scope and consistency of our affections. No amount of smartness or technology can dissolve any of these limits. The modern dilemma is that we find ourselves trapped between the growing cleverness of our science and technology and our seeming incapacity to act wisely.

The standard for ecological design is neither efficiency nor productivity but health, beginning with that of the soil and extending upward through plants, animals, and people. It is impossible to impair health at any level without affecting it at other levels. The etymology of the word “health” reveals its connection to other words such as healing, wholeness, and holy. Ecological design is an art by which we aim to restore and maintain the wholeness of the entire fabric of life increasingly fragmented by specialization, scientific reductionism, and bureaucratic division. We now have armies of specialists studying bits and pieces of the whole as if these were separable. In reality it is impossible to disconnect the threads that bind us into larger wholes up to that one great community of the biosphere. The environment outside us is also inside us. We are connected to more things in more ways than we can ever count or comprehend. The act of designing ecologically begins with the awareness that we can never entirely fathom those connections. This means that humans must act cautiously and with a sense of our fallibility.

Ecological design is not reducible to a set of technical skills. It is anchored in the faith that the world is not random but purposeful and
stitched together from top to bottom by a common set of rules. It is grounded in the belief that we are part of the larger order of things and that we have an ancient obligation to act harmoniously within those larger patterns. It grows from the awareness that we do not live by bread alone and that the effort to build a sustainable world must begin by designing one that first nourishes the human spirit.

Finally, the goal of ecological design is not a journey to some utopian destiny, but is rather more like a homecoming. Philosopher Suzanne Langer once described the problem in these words: “Most people have no home that is a symbol of their childhood, not even a definite memory of one place to serve that purpose. Many no longer know the language that was once their mother-tongue. All old symbols are gone. . . . The field of our unconscious symbolic orientation is suddenly plowed up by the tremendous changes in the external world and in the social order” (1942, 1976, 292). In other words, we are lost and must now find our way home again. For all of our technological accomplishments, the twentieth century was the most brutal and destructive era in our short history. In the century ahead we must chart a different course that leads to restoration, healing, and wholeness. Ecological design is a kind of navigation aid to help us find our bearings again. And getting home means recasting the human presence in the world in a way that honors ecology, evolution, human dignity, spirit, and the human need for roots and connection.

Conclusion

Ecological design is far more than the application of instrumental reason and advanced technology to the problems of shoehorning billions more of us into an earth already bulging at the seams with people. Humankind, as Abraham Heschel once wrote, “will not perish for want of information; but only for want of appreciation...what we lack is not a will to believe but a will to wonder” (1951, 1990, 37). The ultimate object of ecological design is not the things we make but rather the human mind and specifically its capacity for wonder and appreciation.

The capacity of the mind for wonder, however, has been diminished by the tacit design of the systems that provide us with food, energy, materials, shelter, health care, entertainment, and by those that remove our voluminous wastes from sight and mind. There is little in these industrial systems that fosters mindfulness or ecological competence, let alone a sense of wonder. On the contrary, these systems are designed to generate cash, which has itself become an object of wonder and reverence. It is widely supposed that formal education serves as some kind of antidote to this uniquely modern form of barbarism. But conventional education, at its best, merely dilutes the tidal wave of false and distracting information embedded in the infrastructure and processes of technopoly. However well intentioned, formal education cannot compete with the larger educational effects of highways, shopping malls, supermarkets, urban sprawl, factory farms, agribusiness, huge utilities, multinational corporations, and nonstop advertising that teaches dominance, power, speed, accumulation, and self-indulgent individualism. We may talk about how everything is ecologically connected, but the terrible simplifiers are working overtime to take it all apart.

If it is not to become simply a more efficient way to do the same old things, ecological design must become a kind of public pedagogy built into the structure of daily life. There is little sense in only selling greener products to a consumer whose mind is still pre-ecological. Sooner or later that person will find environmentalism inconvenient, or incomprehensible, or too costly and will opt out. The goal is to calibrate human behavior with ecology, which requires a public that understands ecological possibilities and limits. To that end we must begin to see our houses, buildings, farms, businesses, energy technologies, transportation, landscapes, and communities in much the same way that we regard classrooms. In fact, they instruct in more fundamental ways because they structure what we see, how we move, what we eat, our sense of time and space, how we relate to each other, our sense of security, and how we experience the particular places in which we live. More important, by their scale and power they structure how we think, often limiting our ability to imagine better alternatives.

When we design ecologically, we are instructed continually by the fabric of everyday life: pedagogy informs infrastructure, which in turn informs us. Growing food on local farms and gardens, for example, becomes a source of nourishment for the body and instruction in soils, plants, animals, and cycles of growth and decay (Donahue 1999). Renewable energy technologies become a source of energy as
well as insight about the flows of energy in ecosystems. Ecologically designed communities become a way to teach about land use, landscapes, and human connections. Restoration of wildlife corridors and habitats instructs us in the ways of animals. In other words, ecological design becomes a way to expand our awareness of nature and our ecological competence.

Most important, when we design ecologically we break the addictive quality that permeates modern life. “We have,” in the words of Bruce Wilshire, “encase(d) ourselves in controlled environments called building and cities. Strapped into machines, we speed from place to place whenever desired, typically knowing any particular place and its regenerative rhythms and prospects only slightly” (1998, 18). We have alienated ourselves from “nature that formed our needs over millions of years [which] means alienation within ourselves” (ibid.). Given our inability to satisfy our primal needs, we suffer what Wilshire calls a “deprivation of ecstasy” that stemmed from the 99 percent of our life as a species spent fully engaged with nature. Having cut ourselves off from the cycles of nature, we find ourselves strangers in an alien world of our own making. Our response has been to create distractions and addictive behaviors as junk food substitutes for the totality of body-spirit-mind nourishment we’ve lost and then to vigorously deny what we’ve done. Ecstasy deprivation, in other words, results in surrogate behaviors, mechanically repeated over and over again, otherwise known as addiction. This is a plausible, even brilliant, argument with the ring of truth to it.

Ecological design is the art that reconnects us as sensuous creatures evolved over millions of years to a beautiful world. That world does not need to be remade but rather revealed. To do that, we do not need research as much as the rediscovery of old and forgotten things. We do not need more economic growth as much as we need to relearn the ancient lesson of generosity, as trustees for a moment between those who preceded us and those who will follow. Our greatest needs have nothing to do with the possession of things but rather with heart, wisdom, thankfulness, and generosity of spirit. And these virtues are part of larger ecologies that embrace spirit, body, and mind—the beginning of design.