PART 3

On Ecological Design

∴ AUTHOR'S NOTE 2010 ∴

The "ecological crisis" is the sum total of bad design with a tincture of bad intent, but the latter is not as easily solvable as the former. The emerging field of ecological design is the effort to recalibrate how we build, grow, make, power, move, live, and earn our keep so that they fit how the Earth works as a physical system. One day, that knowledge will help reshape and discipline human intentions as well. I intend the term design *broadly. The U.S. Constitution and the Federalist Papers, for example, are design blueprints for the conduct of the public business. The term applies more obviously to architecture, engineering, economics, finance, urban planning, manufacturing, and education. In all of its manifestations, ecological design is, in short, the harmonious integration of systems and functions within specific ecologies and places. At its most direct and tangible, good design requires local knowledge of soils, waters, topography, biota, animals, culture, history, and much more. The result of good design is, in a word, health—both human and ecological. Practically, good design means farms, buildings, neighborhoods, cities, and entire industries powered by renewable energy and discharging no waste and integrated into wholes in which the parts reinforce a larger emergent harmony. It is, in short, the art and science of applied resilience.*

Chapter 17

Designing Minds

(1992)

As the entry from *Homo sapiens* in any intergalactic design competition, industrial civilization would be tossed out at the qualifying round. It doesn't fit. It won't last. The scale is wrong. And even its apologists admit that it is not very pretty. The design failures of industrial technologically driven societies are manifest in the loss of diversity of all kinds, destabilization of the Earth's biogeochemical cycles, pollution, soil erosion, ugliness, poverty, injustice, social decay, violence, and economic instability.

Industrial civilization, of course, was not designed at all; mostly it just happened. Those who made it happen were mostly single-minded men and women innocent of any knowledge of what can be called the "ecological design arts," by which I mean the set of perceptual and analytical abilities, ecological wisdom, and practical wherewithal essential to making things that "fit" in a world of trees, microbes, rivers, animals, bugs, and small children. In other words, ecological design 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 purposes.

Ecological designers aim to maximize resource and energy efficiency, take advantage of the free services of nature, eliminate waste, make ecologically smarter things, and educate ecologically smarter people. This means incorporating intelligence about how nature works, what David Wann (1990) called "biologic," into the way we think, design, build, and live. Design applies to the making of nearly everything that directly or indirectly requires energy and materials, or governs their use, including

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farms, houses, communities, neighborhoods, cities, transportation systems, technologies, economies, and energy policies. When human artifacts and systems are well designed, they are in harmony with the larger patterns in which they are embedded. When poorly designed, they undermine those larger patterns, creating pollution, higher costs, and social stress in the name of spurious and short-run economizing. Bad design is not simply an engineering problem, although better engineering would often help. Its roots go deeper.

Good design begins, as Wendell Berry puts it, by asking, "What is here? What will nature permit us to do here? What will nature help us to do here?" (Berry 1987, 146). Good design everywhere has certain common characteristics, including right scale, simplicity, efficiency, a close fit between means and ends, durability, redundance, and resilience. Good designs also solve more than one problem at a time. They are often place specific or, in John Todd's words, "elegant solutions predicated on the uniqueness of place." Good design promotes

- human competence instead of addiction and dependence;
- efficient and frugal use of resources;
- sound regional economies;
- social resilience.

Where good design becomes part of the social fabric at all levels, unanticipated positive side effects (synergies) multiply. When people fail to design carefully and competently, unwanted side effects and disasters multiply.

As evidenced by the pollution, violence, social decay, and waste all around us, we have designed things badly. Why? There are, I think, three fundamental reasons. The first is that while energy and land were cheap and the world relatively "empty," we simply did not have to master the discipline of good design. We developed extensive rather than intensive economies. Accordingly, cities sprawled, wastes were dumped into rivers or landfills, farmers wore out one farm and moved on to another, houses and automobiles got bigger and less efficient, and whole forests were converted into junk mail and Kleenex. Meanwhile, the know-how necessary to a frugal, well-designed, intensive economy declined, and words like *realistic* or *convenience* became synonymous with habits of waste.

Second, design intelligence fails when greed, narrow self-interest, and individualism take over. Good design is a community process requiring people who know and value the positive things that bring them together and hold them together. Old-order Amish farmers, for example, refuse to buy combines, not because they would not make things easier or more

profitable, but because they would undermine community by depriving people of the opportunity to help their neighbors. This is pound-wise and penny-foolish, the way intelligent design should be. In contrast, American cities, with their extremes of poverty and opulence, are products of people who believe that they have little in common with other people. Suspicion, greed, and fear undermine good community and good design alike. Gun sales soar.

Third, poor design results from poorly equipped minds. Good design can be done only by people who understand harmony, patterns, and systems. Good design requires a breadth of view that leads people to ask how human artifacts and purposes "fit" within the immediate locality and within the region. Industrial cleverness, however, is mostly evident in the minutiae of things, not in their totality or in their overall harmony. Moreover, good design uses nature as a standard and so requires ecological intelligence, by which I mean a broad and intimate familiarity with how nature works. For all of the recent interest in environment and ecology, this kind of knowledge, which is a product of both local experience and stable culture, is fast disappearing.

George Sturt, one of the last wheelwrights in England, in *The Wheelwright's Shop* describes "the age-long effort of Englishmen to fit themselves close and ever closer into England" (Sturt 1984, 66). Sturt built wagons crafted to fit the buyers' particular habits, fields, and topography. To do so, he needed to know a great deal about how his customers used a wagon, whether they drove fast or slow, whether their land was rocky or wet, and what they hauled. As a result, "we got curiously intimate with the peculiar needs of the neighborhood. In farm-wagon or dung-cart, barley-roller, plough, water barrel, or what not, the dimensions we chose, the curves we followed, were imposed upon us by the nature of the soil in this or that farm, the gradient of this or that hill, the temper of this or that customer or his choice perhaps in horseflesh" (Sturt 1984, 18).

Furthermore, a good wheelwright needed to know what kinds of trees gave particular parts extra strength, or flexibility, or weight, where these trees grew, and when they were ready to harvest. And finally he needed to know the traditions and skills unique to his craft that were passed down as folk knowledge:

> What we had to do was to live up to the local wisdom of our kind to follow the customs, and work to the measurements, which had been tested and corrected long before our time in every village shop all across the country. (Sturt 1984, 19)

The kind of mind that could design and build a good wagon depended a great deal on time-tested knowledge and intimate familiarity with place. The results were wagons that fit particular people and a particular landscape.

A contemporary example of ecological design can be found in John Todd's "living machines," which are carefully orchestrated ensembles of plants, aquatic animals, technology, solar energy, and high-tech materials to purify wastewater but without the expense, energy use, and chemical hazards of conventional sewage treatment technology. According to Todd,

> people accustomed to seeing mechanical moving parts, to experiencing the noise or exhaust of internal combustion engines or the silent geometry of electronic devices, often have difficulty imagining living machines. Complex life forms, housed within strange light-receptive structures, are at once familiar and bizarre. They are both garden and machine. They are alive yet framed and contained in vessels built of novel materials. . . . Living machines bring people and nature together in a fundamentally radical and transformative way. (Todd 1991, 335–43)

Todd has created several working examples of living machines, each resembling a greenhouse filled with exotic plants and aquatic animals. Wastewater enters at one end; purified water leaves at the other. In between, the work of sequestering heavy metals in plant tissues detoxifying toxics, and removing nutrients is done by plants and animals in an ecosystem driven by sunlight. A decade earlier he designed and built structures that similarly used aquatic systems to process waste, grow food, and store heat. Living machines and the logic of ecology imply changes in the way we process wastewater, grow food, and build houses and in the ways we integrate these and other functions into systems patterned after natural processes to do what industrial technology can only do expensively and destructively.

Ecological design also applies to the design of governments and public policies. Governmental planning and regulation require large and often ineffective or counterproductive bureaucracies. Design, in contrast, means

> the attempt to produce the outcome by establishing the criteria to govern the operations of the process so that the desired result will occur more or less automatically without further human intervention. (Ophuls 1977, 228–29)

In other words, well-designed policies and laws get the macro things right, like prices, taxes, and incentives, while preserving a high degree of micro freedom in how people and institutions respond. Design focuses on the structure of problems as opposed to their coefficients. For example, the Clean Air Act of 1970 required car manufacturers to install catalytic converters to remove air pollutants. Decades later, emissions per vehicle are down substantially, but with more cars on the road, air quality is about the same. A design approach to transportation would lead us to think more about creating access between housing, schools, jobs, and recreation that eliminate the need to move lots of people and materials over long distances. A design approach would have led us to reduce dependence on automobiles by building better public transit systems, restoring railroads, and creating bike trails and walkways. A design approach would also lead us to rethink the use of urban land and to reintegrate agriculture and wilderness into urban areas.

Ecological design requires the ability to comprehend patterns that connect, which means getting beyond the boxes we call disciplines to see things in their ecological context. It requires, in other words, a liberal education, but nearly everywhere the liberal arts have tended to become more specialized and narrow. Design competence requires the integration of firsthand experience and practical competence with theoretical knowledge, but the liberal arts have become more abstract, fragmented, and remote from lived reality. Design competence requires us to be students of the natural world, but the study of nature is being displaced by the effort to engineer nature to fit the economy instead of the other way around. Finally, design competence requires the ability to inquire deeply into the purposes and consequences of things, to know what is worth doing and what should not be done at all. But the ethical foundations of education have been diluted by the belief that values are relative. All of this is to say that from an ecological perspective, the "liberal arts" have not been liberal enough. I think this is evident in three respects.

First, the liberal arts have not been liberal enough in their response to the rapid decline in the habitability of the Earth. Changes in global and national policy are necessary but insufficient to reverse downward trends in the Earth's vital signs. It is also essential that we educate a citizen constituency that supports change and is competent to do the local work of rebuilding households, farms, institutions, communities, corporations, and economies that (1) do not emit carbon dioxide or other heat-trapping gases; (2) do not reduce biological diversity; (3) use energy, materials,

and water with high efficiency; and (4) recycle wastes. In other words, a constituency that is capable of building economies that can be sustained without further reducing the Earth's potential to sustain life. At a minimum this will require a modification of the skills, aptitudes, abilities, and curriculum by which we learned how to industrialize the Earth.

Second, the liberal arts have come to mean an education largely divorced from practical competence. Inclusion of the ecological design arts in the liberal arts means bringing practical experience back into the curriculum in carefully conceived ways. The reasons, in Alfred North Whitehead's words, are straightforward: "First-hand knowledge is the ultimate basis of intellectual life . . . the second-handedness of the learned world is the secret of its mediocrity" (Whitehead 1967, 51). In contrast to the distinction that John Henry Newman once drew between desirable and useful knowledge (Newman 1982, 84–88), Whitehead argued that there is a "reciprocal influence between brain activity and material creative activity" essential for good thinking. In other words, good thinking and practical experience are mutually necessary. Accordingly, he thought, "the disuse of hand-craft is a contributory cause to the brain-lethargy of aristocracies" (Whitehead 1967). J. Glenn Gray has argued similarly that the exclusion of manual skills from the liberal arts is dangerous "because it first divorces us from our own dispositions at the level where intellect and emotions fuse." Purely analytical and abstract thinking "separates us from our natural and human environment" (Gray 1984, 85). Genuinely liberal education, in contrast, cultivates the full person, including manual competence and feeling as well as intellect.

Third, the liberal arts have come to include any number of fields, subfields, issues, and problems, excepting those that are closest at hand in the local community. Inclusion of the ecological design arts suggests a symbiotic relation between learning and locality. Here, too, the reasons are part of an older tradition going back to John Dewey. In 1899 John Dewey wrote that "the school has been so set apart, so isolated from the ordinary conditions and motives of life" that children cannot "get experience—the mother of all discipline" (Dewey 1990, 17). His solution required integrating opportunities for students "to make, to do, to create, to produce" and ending the separation of theory and practice. Dewey proposed that the immediate vicinity of the school be a focus of education, including the study of food, clothing, shelter, and nature. Through the study of these things, students might learn "the measure of the beauty and order about him, and respect for real achievement" (Dewey 1990). Gray has likewise

argued that liberal education is "least dependent on formal instruction. It can be pursued in the kitchen, the workshop, on the ranch or farm" (Gray 1984, 81). It can also be pursued through the study of energy, water, materials, food, and waste flows on the campus.

How can competence in the ecological design arts be taught within the conventional curriculum? There are at least two broad possibilities. The best, but most difficult, approach is to make over entire institutions so that their operations and resource flows (food, energy, water, materials, waste, and investments) become a laboratory for the study of ecological design. There is a strong case for doing this for economic as well as educational reasons. A second possibility follows the suggestion of Herman Daly and John Cobb to establish separate centers or institutes within colleges and universities with the mission of fostering ecological design intelligence (Daly and Cobb 1989, 357–60). Ecological design arts centers would aim to (1) develop a series of ecological design projects that involve students, faculty, and staff; (2) study institutional resource flows; (3) develop curriculum; and (4) carry out studies on environmental trends throughout the region. Ecological design projects could include, for example,

- design and construction of zero discharge buildings using no fossil fuels, constructed with local materials;
- development of a bioregional directory of building materials;
- inventory and model campus resource flows;
- restoration of degraded ecosystems;
- design and development of a sustainable farm system;
- survey of resource and dollar flows in the local economy.

The list could be easily extended, but the point is clear. The functions of ecological design institutes would be to equip young people with a basic understanding of systems; develop habits of mind that seek out "patterns that connect" human and natural systems; teach young people the analytical skills necessary for thinking accurately about cause and effect; give students the practical competence necessary to solve local problems; and teach young people the habit of rolling up their sleeves and getting down to work.

Chapter 18

Loving Children: A Design Problem

(2002)

The SkyMall catalogue, conveniently available as an anesthetic for irritated airplane passengers, recently offered an item that spoke volumes about our approach to raising children. For a price of several hundred dollars, parents could order a device that could be attached to a television set that would control access to the television. Each child would be given a kind of credit card, programmed to limit the hours he or she could watch TV. The child so disciplined would presumably benefit by imbibing fewer hours of mind-numbing junk. He or she might also benefit from the perverse challenge to discover the many exciting and ingenious ways to subvert the technology and the intention behind it, including a flank attack on parental rules and public decency via the Internet.

My parents had a rather different approach to the problem. It was the judicious and authoritative use of the word *no*. It cost nothing. My brother, sister, and I knew what it meant and the consequences for ignoring it. Still, I sometimes acted otherwise. It was a way to test the boundaries of freedom and parental love and the relation between the two.

The SkyMall device and the authoritative use of the word *no* both represent concern for the welfare of the child, but they are fundamentally different design approaches to the problem of raising children, and they have very different effects on the child. The device approach to discipline

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is driven by three factors that are new to parenting. It is a product of a commercial culture in which we've come to believe that high-tech gadgetry can fix human problems, including that of teaching discipline and self-control to children. Moreover, the device is intended mostly for parents who are absent from the home for much of the day because they must (or think they must) work to make an expanding number of ends meet. And, all of our verbal assurances of love notwithstanding, it is a product of a society that does not love its children competently enough to teach them self-discipline. The device approach to parenting is merely emblematic of a larger problem that has to do with the situation of childhood within an increasingly dysfunctional society absorbed with things, economic growth, and self.

We claim to love our children, and I believe that most of us do. But like sheep, we have acquiesced in the design of a society that corrupts genuine love. One result is a growing mistrust of our children that easily turns to fear and dislike. In a recent survey, for example, only one-third of adults believed that today's young people "will eventually make this country a better place" (Applebome 1997). Instead, we find them "rude" and "irresponsible." And often they are. We find them overly materialistic and unconcerned about politics, values, and improving society. And many are too materialistic and detached from important issues (Bronner 1998). Not infrequently they are verbally and physically violent, mimicking a society saturated with drugs and violence. A few kill and rape other children. Why are the very children that we profess to cherish becoming less than likable and sometimes less than human?

Some will argue that nothing of the sort is happening and that every generation believes that its children are going to hell. Eventually, however, things work out. Such views are, I think, questionable because they ignore the sharp divide imposed between the hyperconsumerism and the needs of children for extended nurturing, mentoring, and imagining. The evidence indicates that it's the economy that we love most, not our children. The symptoms are all around us. We spend 40 percent less time with our children than we did in 1965. We spend, on average, 6 hours per week shopping, but only 40 minutes playing with our children (Suzuki 1997, 23). It can no longer be taken for granted that this civilization can pass on its highest values to enough of its children to survive. Without intending to do so, we have created a society that cannot love its children, indeed one in which the expression of real love is increasingly difficult.

No society that loved children would consign nearly one in five to

poverty and leave them without adequate health care. No society that loved its children would put them in front of television for 4 hours or more every day. No society that loved its children would lace their food, air, water, and soil with hundreds of chemicals known or suspected of being carcinogenic, endocrine disrupters, or mutagenic. No society that loved its children would build so many prisons and so few parks and schools. No society that loved its children would teach them to recognize hundreds of corporate logos but hardly any plants and animals in their own regions. No society that loved its children would divorce them so completely from contact with soils, forests, streams, and wildlife. No society that loved its children would create places like the typical suburb or shopping mall. No society that loved its children would casually destroy real neighborhoods and communities in order to build even more highways. No society that loved its children would build so many glitzy sports stadiums and shopping malls while its public schools fall apart. No society that loved its children would pave over a million acres of prime farmland each year for even more shopping malls and parking lots. No society that loved its children would knowingly run even a small risk of future climatic disaster. No society that loved its children would use the practice of discounting in order to ignore its future problems. No society that loved its children would leave behind a legacy of ugliness and biotic impoverishment.

Of course we do all of these things in the belief that they are the price we must pay to create a better world for children. But at some level, I believe, many teenagers understand that such arguments are phony. That may explain some of their unfocused anger, which is no more than a reflection of the incivility and rudeness that we inflict on them. They mirror the larger self-indulgence of a society organized for machines, quick gratification, and excessive individualism. They know that the study of literature counts for considerably less in this society than making it big in sports or as another "American Idol," or dealing drugs. They understand intuitively that the real curriculum is not what's taught in schools but what's written on the face of the land. It is remarkable, in fact, that they are not angrier.

What would it mean to make a society that did in fact love all of its children? Properly understood, this is a design problem that calibrates what we intend as parents with how we earn our living, conduct our daily lives, build homes, create communities, manage landscapes, and provision ourselves with food, energy, and materials. The health and well-being

of children, not the gross national product, is the best indicator of the health of our civilization. And I believe that it is the ultimate standard for ecological design. How do we design neighborhoods and cities that are good for children?

The starting point is the child's need for joy, safety, parental love, play, and the opportunity to safely explore the wider world. Such awareness must begin early in life with the development of what Edith Cobb once called "compassionate intelligence" rooted in "biological motivation deriving from nature's history" (Cobb 1977, 16). The child's "ecological sense of continuity with nature" is not mystical but is "basically aesthetic and infused with the joy in the power to know and to be" (Cobb 1977, 23). Childhood is the "point of intersection between biology and cosmology, where the structuring of our worldviews and our philosophies of human purpose takes place." In other words, our minds are rooted as much in the ecology in which our childhood is lived as in our ("over emphasized") animal instincts (Cobb 1977, 101). Similarly, Paul Shepard once argued that mind and body are imprinted in the most fundamental ways by the "pattern of place" experienced in childhood (Shepard 1996 93–108). For Shepard, the conclusion is that a child must have the opportunity to "soak in a place" and to "return to that place to ponder the visible substrate of his own personality" (Shepard1996, 106). Conversely, the child's sense of connection to the world can be damaged by ecologically impoverished surroundings. And it can be damaged as well by exposure to violence and poverty and even by too much affluence. It can be destroyed, in other words, when ugliness, both human and ecological, becomes the norm. Ecological design begins with the creation of places in which the ecology of imagination and ecological attachment can flourish. These would be safe urban and rural places that included biological diversity, wildness, flowing water, trees, animals, open fields, and room to roam—places where beauty is the standard.

At a larger scale the same logic applies to the ways children and adolescents are alienated from or bound to the surrounding region. Typical land-use patterns in recent decades taught young people that

- the highest and best use of land is for shopping malls, roads, and parking lots;
- land has little value beyond those of utility and economics;
- some land is expendable as landfills and waste dumps;
- the poor live on poor land, the well-to-do live on good land;

- roads to satisfy our cravings for mobility trump community needs;
- lawns are merely decoration maintained by use of chemicals and by fuels that will be exhausted in their lifetimes;
- prime farmland is far less important than development;
- biological diversity is less important than economic growth.

One consequence of the homogenized and utilitarian landscape is that most young people have learned little about how they are fed, clothed, and supplied with materials, and virtually nothing about better alternatives to meet their needs. By separating basic functions from daily lived experience, we have concealed a great deal of ecological reality from young people. Often this has come with a loss of real neighborhoods and real community. The things that we used to do for ourselves as competent citizens and neighbors we now purchase from one corporation or another at a considerable markup. It should astonish no one that civility, neighborliness, and communities have declined and that crime and anomie have risen. When living and livelihood become too widely separated, human bonds deteriorate because people no longer need each other as they once did. And when minds and landscapes are widely separated, whole categories of thought disappear, ecological competence declines, and awareness of our dependence on nature atrophies.

In an ecologically and esthetically impoverished landscape, it is harder for children and adolescents to find meaning and purpose for their lives. Consequently, many children grow up thinking themselves to be useless. In landscapes organized for convenience, commerce, mobility, and economic growth subsidized by cheap oil, in fact they are useless because we have little good work for them to do. Since we really do not need them to do real work, they learn few practical skills and little about responsibility. Their contacts with adults are frequently unsatisfactory. When they do work, it is all too often within a larger pattern of design failure. Flipping artery-clogging burgers made from chemically saturated feedlot cows, for example, is not good work, and neither is most of the other hourly work available to teenagers.

Over and over we profess love for our children, but the evidence says otherwise. We seldom work with them or mentor them or teach them practical skills. At an early age all too many are deposited in front of television and later in front of computers. And we are astonished to learn that in large numbers, neither do they respect adults nor are they equipped with many of the basic skills and aptitudes necessary to live responsible

and productive lives. Increasingly, they imitate the values they perceive in us with characteristic juvenile exaggeration.

Assuming that we could muster the good sense to solve the problem, what would we do? Part of the solution, I believe, is to rejoin mind and habitat at the landscape level by reconnecting living with livelihood. This can only be done in places where a large part of our needs for shelter, warmth, energy, economic support, health, creativity, and conviviality are met locally in competently used and well-loved landscapes. To some this will sound either utopian or nostalgic for some mythical past. It is neither. In fact, it is an honest admission that we've tried utopia on industrial terms, and it did not work. It is merely to recognize the fact that, for better or worse, the organization of our landscapes arranges our possibilities, informs our minds, and directs our attention. A landscape organized for the convenience of the automobile and consumption tells young people more about our real values than anything taught in school. Worse, it deflects and distorts their intelligence at a critical point in life. It is possible, however, to organize landscapes to teach usefulness, practical competence, social responsibility, ecological skill, the values of good work, and the higher possibilities of adulthood. And it is possible for children and young adults to be instructed by birds, animals, soils, plants, water, seasons, and the ecology of their places.

Farms, feedlots, mines, wells, clear-cuts, waste dumps, and factories are mostly out of sight and so out of mind. As a result we do not know the full costs of what we consume. Ignorant of the damage we do, we leap to the conclusion that we are much richer than we really are. Ecological poverty and poverty of mind and spirit are reverse sides of the same coin. When we get the design right, however, the manner in which we provision ourselves becomes a reminder of our larger relationships and obligations. The true aim of ecological design, then, is not merely to improve the various technologies and techniques by which we meet our physical needs, but to improve the integration of the human mind with its habitat and to fit in a larger order of things. "To live," in Wendell Berry's words,

> we must daily break the body and shed the blood of Creation. When we do this knowingly, lovingly, skillfully, reverently, it is a sacrament. When we do it ignorantly, greedily, clumsily, destructively, it is a desecration. In such desecration we condemn ourselves to spiritual and moral loneliness, and others to want. (Berry 1981, 281)

Ecological design in its fullest measure is not just smarter management by technicians but, rather, a wider awareness and visible manifestation of our awareness that we are part of a larger pattern of order and obligation. Frank Lloyd Wright once commented that he could design a house that would cause a married couple to divorce within a matter of weeks. By the same logic it is possible to create buildings and cities so badly as to cause a culture to disintegrate socially and come unhinged from nature. Compare the architecture of the modern world with that of earlier civilizations. The ancient cities of India, Greece, and Rome, for example, were planned, in Peter Wilson's words, as "representations of microcosm and macrocosm, projections of the human body and distillations of the universe" (Wilson 1988, 75). The architecture of houses and public buildings were means to "portray to people their relation to one another as well as to important features of their environment," a kind of "diagram of how the system works" (Wilson 1988, 153). Buildings were not simply machines, as le Corbusier would have it, but a map showing "how the individual, the various orders of groups, and the cosmos are linked and related" (Wilson 1988, 75). For all of their imperfections as places and cultures, inhabitants in such cities were oriented to larger patterns.

Compare this with sprawling cities of the twentieth century that give no clue about any cosmology larger than the gross national product. They have become sprawling wastelands, islands of sybaritic affluence surrounded by a sea of necrotic urban tissue. For the most part, our buildings, in which we spend over 90 percent of our time, are poorly built. They are often made of materials that are toxic. They are often oversized and use energy and materials inefficiently. They are mostly disconnected from any discernible sense of community or any larger ecological or spiritual pattern. And what do such cities and buildings teach us? They teach us in exquisite detail that we are alone and powerless in the world, that energy and materials are cheap and can be consumed with impunity, that the highest purpose of life is consumption, and that the world is chaotic and dangerous.

Architecture, in other words, is also a form of instruction that works well or badly but never fails to instruct. When we get the design of buildings and communities right, they will help to inform us about our place within larger patterns of energy and materials flows and bind our affections and attention to the care of particular places. Architecture practiced as the art of ecological design promotes ecological competence and reflects larger patterns of order.

Conclusion

The goal of ecological design is not merely to meet our physical needs within the boundaries of ecological carrying capacity but, more importantly, to inform our desires. Good design would instruct us in what we need and the terms of our existence on Earth. In other words, the systems we devise to provision ourselves with food, energy, materials, shelter, and health constitute a larger form of education. But if these systems are designed to educate, they must give quick feedback about the consequences of our decisions, and they must work at a comprehensible scale. They must be devised in ways that create competence and practical understanding. They must be resonant with our deeper needs for meaning embedded in ritual and celebration. And design intelligence and the practical competence necessary to maintain it must be faithfully transferred from one generation to the next.

Good design must also meet other standards imposed by the way the physical world works. It must result in systems that are flexible and resilient in the face of changing circumstances. Given limits to our knowledge and foresight, good design would never lead us to bet it all, to risk the unforeseeable, or to commit acts that are irrevocable when the consequences are potentially large. And it would reorient our sense of time, giving greater weight to our future prospects and to long-term ecological processes as well. It would never cause us to discount the future.

Finally, designing ecologically begins in the belief that the world is not meaningless but coherent in ways that are often mysterious to us. Our task is to discern, as best we are able, the larger patterns and scales in which we live and act faithfully within those boundaries. Design, in this larger sense, is not simply the making of things but rather a striving for wholeness. At its best, ecological design is the ultimate manifestation of love—a gift of life, harmony, and beauty to our children.

Chapter 19

Further Reflections on Architecture as Pedagogy

(1997)

AUTHOR'S NOTE 2010: *This is an amended version of a 1993 essay titled "Architecture as Pedagogy." It describes the origins of what became the Adam Joseph Lewis Center for Environmental Studies at Oberlin. The story is told in greater detail in* Design on the Edge *(Orr 2006).*

The worst thing we can do to our children is to convince them that ugliness is normal.
RENE DUBOS

THE CURRICULUM EMBEDDED in any building instructs as fully and as powerfully as any course taught in it. Most of my classes, for example, are taught in a building that I think Descartes would have liked. It is a building with lots of squareness and straight lines. There is nothing whatsoever that reflects its locality in northeast Ohio in what had once been a vast forested wetland (Sherman 1996). How it is cooled, heated, and lighted and at what true cost to the world is an utter mystery to its occupants. It offers no clue about the origins of the materials used to build it. It tells no story. With only minor modifications it could be converted to use as a factory or prison. When classes are over, students seldom linger for long. The building resonates with no part of

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our biology, evolutionary experience, or esthetic sensibilities. It reflects no understanding of ecology or ecological processes. It is intended to be functional, efficient, minimally offensive, and little more. But what else does it do?

First, it tells its users that locality, knowing where you are, is unimportant. To be sure, this is not said in so many words anywhere in this or any other building. Rather, it is said tacitly throughout the entire building. Second, because it uses energy wastefully, the building tells its users that energy is cheap and abundant and can be squandered with no thought for the morrow. Third, nowhere in the building do students learn about the materials used in its construction or who was downwind or downstream from the wells, mines, forests, and manufacturing facilities where those materials originated or where they eventually will be discarded. And the lesson learned is mindlessness, which is to say it teaches that disconnectedness is normal. And try as one might to teach that we are implicated in the larger enterprise of life, standard architectural design mostly conveys other lessons. What is taught in classes and the way buildings actually work are often at cross-purposes. Buildings are provisioned with energy, materials, and water, and they dispose of their waste in ways that say to students that the world is linear and that we are no part of the larger web of life. Finally, there is no apparent connection in this or any other building on campus to the larger set of issues having to do with climatic change, biotic impoverishment, and the unraveling of the fabric of life on Earth. Students begin to suspect, I think, that those issues are unreal or that they are unsolvable in any practical way or that they occur somewhere else.

Is it possible to design buildings and entire campuses in ways that promote ecological competence and mindfulness (Lyle 1994)? Through better design is it possible to teach our students that our problems are solvable and that we are connected to the larger community of life? As an experiment, I organized a class of students in 1992–1993 to develop what architects call a preprogram for an environmental studies center at Oberlin College. Twenty-five students and a dozen architects met over two semesters to develop the core ideas for the project. The first order of business was to question why we ought to do anything at all. Once the need for facilities was established, the participants questioned whether we ought to build new facilities or renovate an existing building. Students and faculty examined possibilities to renovate an existing building but decided on new construction. The basic program that emerged from the yearlong class called for an approximately 14,000-square-foot building that

- discharged no wastewater (i.e., drinking water in, drinking water out);
- generated more electricity than it used;
- used no materials known to be carcinogenic, mutagenic, or endocrine disrupters;
- used energy and materials with great efficiency;
- promoted competence with environmental technologies;
- used products and materials grown or manufactured sustainably;
- was landscaped to promote biological diversity;
- promoted analytical skill in assessing full costs over the lifetime of the building;
- promoted ecological competence and mindfulness of place;
- became, in its design and operations, genuinely pedagogical;
- met rigorous requirements for full-cost accounting.

We intended, in other words, a building that did not impair human or ecological health somewhere else or at some later time.

Following approval by college trustees in June of 1995, I hired two graduates from the class of 1993 to help coordinate the design of the project and to enlist students, faculty, and the wider community in the design process. We also hired architect John Lyle to facilitate design charettes, or planning sessions, that began in the fall of 1995. Some 250 students, faculty, and community members eventually participated in the 13 charettes in which the goals for the environmental studies center were developed and refined. From 26 architectural firms, we selected William McDonough + Partners in Charlottesville, Virginia. In addition to hiring John Lyle and the McDonough firm, we assembled a design team that included Amory Lovins and Bill Browning from the Rocky Mountain Institute, scientists from NASA's Lewis Research Center, ecological engineers John Todd and Michael Shaw, the landscape design firm Andropogon, structural and mechanical engineers, and a contractor. During the programming and schematic design phase, this team and representatives from the college met by conference call weekly and in regular working sessions.

A "front-loaded" team approach to architectural design was new to the college. Typically, architects do the basic design, assign it to engineers to heat and cool it, and as a last step, hand it off to landscapers to make it look like it belongs. By engaging the full design team from the beginning, we intended to improve the integration of building systems and technologies and the relationship between the building and its site. Early

on, we decided that the standard for technology in the building was to be "state of the shelf" but within state-of-the-art design. In other words, we did not want the risk of untried technologies, but we did want the overall product to be at the frontier of what it is now possible to do with ecologically smart design.

The building program called for major changes, not only in the design process, but also in the selection of materials, in the relationship to manufacturers, and in the way we counted the costs of the project. We intended to use materials that did not compromise human dignity or human health somewhere else. We also wanted to use materials that had as little embodied fossil energy as possible, hence giving preference to those locally manufactured or grown. In the process, we discovered how little is generally known about the ecological and human effects of building materials and how little the present tax and pricing system supports standards upholding ecological or human integrity. Unsurprisingly, we also discovered that building codes do little to encourage innovation and environmental quality.

Typically, buildings are a kind of snapshot of the state of technology at a given time. In this case, however, we intended for the building to remain technologically dynamic over a long period of time. In effect we proposed that the building adapt or learn as the state of technology changed and as our understanding of design became more sophisticated. We explored alternatives by which a third party would own, maintain, and operate the photovoltaic electric system, upgrading it as the technology improved. Unfortunately, in the late 1990s those possibilities were still undeveloped.

The same strategy applied to materials. McDonough + Partners regarded the building as a union of two different metabolisms, one industrial, the other ecological. Materials that might eventually decompose into soil were considered part of an ecological metabolism. Otherwise they were part of an industrial metabolism and might be leased from the manufacturer and eventually returned as a feedstock to be remanufactured into new product. That, too, proved to be way ahead of the times.

We intended, as well, to account for the life-cycle costs of the building, instead of following conventional practice, which accounts for only the "purchase price" of design and construction. In other words, we proposed to include all of those other costs to environment and human health not included in the prices of energy, materials, and waste disposal. The initial

costs of the project, accordingly, came in at the high end of "average" costs for public buildings built in the late 1990s. The premium was slightly higher because we included the costs of

- student, faculty, and community participation in the design process;
- student research into materials and technologies to meet program goals;
- higher performance standards (e.g., zero discharge and on-site electricity production);
- more-sophisticated technologies;
- greater efforts to integrate technologies and systems;
- a building maintenance fund in the project budget.

In the longer term, we aimed as well to conduct an audit of the building, including an estimate of the amount of CO_2 released by the construction.

AUTHOR'S NOTE 2010: *Ground breaking for the Lewis Center occurred in October 1998, and the basic building was completed in January 2000. Design adjustments made in the first 18 months after occupancy allowed us to fulfill the goals of the project within reasonable costs. The building now generates all of its electricity from two photovoltaic arrays. It purifies wastewater on-site. It successfully minimized or eliminated the use of toxic materials. My colleague John Petersen and three students designed a real-time monitoring system to display energy use and other significant ecological data. Their ingenuity and diligence led to the creation of a highly successful company, Lucid Designs, Inc. The Lewis Center is landscaped to include a small restored wetland and forest, pond, and amphitheater, as well as gardens and orchards. In short, the Lewis Center became a laboratory for the study of applied sustainability and the arts of ecological design applied to buildings, energy systems, performance monitoring, wastewater purification, and landscape management.*

Buildings, however, are only means. The more important effects of the project have been its impact on the lives and careers of those who participated in the project. Some of the students who devoted time and energy to the project describe it now as their "legacy" to the college. Because of their work on the project, many of them learned about ecological design and how to solve real problems by working with some of the best practitioners in the world. Pessimists who thought change was impossible, perhaps, became somewhat more optimistic. And some of the trustees and administrators who initially saw this as a risky project, perhaps, came to regard risks incurred for the right goals as worthwhile.

The Adam Joseph Lewis Center is now the template for a larger project

presently under way to (1) rebuild a 13-acre block in downtown Oberlin as a model of ecological design at the neighborhood scale and as a driver for post-carbon urban economic revitalization, (2) eliminate the use of fossil fuels in both the city and the college, (3) develop a 20,000-acre greenbelt for forestry and farming, and (4) engage students from the college, the public schools, a joint vocational school, and a community college in the transition.

Conclusion

By some estimates, humankind will build more in the next half century than it has built throughout all of recorded history. If we do this inefficiently and carelessly, the resulting ecological and human damage will be irreparable, and the dream of sustainability will have proved to be an unachievable fantasy. Ideas and ideals need to be rendered into working examples that make them visible, comprehensible, and compelling. But who will lead?

More than any other institutions in modern society, colleges and universities have a moral stake in the health, beauty, and integrity of the world our students will inherit. We have an obligation to provide them with tangible grounds for authentic hope and to equip them with the analytical skills and practical competence to lead in the transition to a sustainable future powered by sunlight. No generation ever faced a more daunting agenda. True. But none ever faced more exciting possibilities either.

Finally, the potential for ecologically smarter design in all of its manifestations in architecture, landscape design, community design, the management of agricultural and forest lands, manufacturing, and technology does not amount to a fix for all that ails us. Reducing the amount of damage we do to the world per capita will only buy us a few decades, perhaps a century if we are lucky. If we squander that reprieve, we will have succeeded only in delaying the eventual collision between unfettered human desires and the limits of the Earth. The default setting of our civilization needs to be reset to ensure that we build a sustainable world that is also humanly sustaining. This is not necessarily a battle between Left and Right or haves and have-nots, as it is often described. At a deeper level the issue has to do with art and beauty. In the largest sense, what we must do to ensure human tenure on the Earth is to cultivate a new standard that defines beauty as that which causes no ugliness somewhere else or at some later time.

Chapter 20

The Origins of Ecological Design

(2006)

The origins of ecological design can be traced back to our prehistoric ancestors' interest in natural regularities of seasons, sun, moon, and stars and later to the Greek conviction that humans, by the application of reason, could discern the laws of nature. Ecological design also rests on the theological conviction that we are obliged, not merely constrained, to respect larger harmonies and patterns. The Latin root word for the word *religion*—bind together—and the Greek root for *ecology*—household management—suggest a deeper compatibility and connection to order. Ecological design, further, builds on the science and technology of the industrial age but for the purpose of establishing a partnership with nature, not domination. The first models of ecological design can be found throughout the world in the vernacular architecture and the practical arts that are as old as recorded history. It is, accordingly, as much a recovery of old and established knowledge and practices as a discovery of anything new. The arts of building, agriculture, forestry, healing, and resilient economy were sometimes models of great ecological intelligence developed by cultures that we otherwise might dismiss as primitive. The art of applied wholeness was implicit in social customs such as the observance of the Sabbath and holy days, the Jubilee year, or the practice of potlatch, in which debts were forgiven and wealth was recirculated. It is evident still in all of those various ways by which com-

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munities and societies gracefully cultivate the arts of generosity, kindness, prudence, love, humility, compassion, gentleness, forgiveness, gratitude, and ecological intelligence.

In its specifically modern form, ecological design has roots in the Romantic rebellion against the more extreme forms of modernism, particularly the belief that humans armed with science and a bit of technology were lords and masters of Creation. Francis Bacon, perhaps the most influential of the architects of modern science, proposed the kind of science that would reveal knowledge by putting nature on the rack and torturing her secrets from her, a view still congenial to some who have learned to say it more correctly. The science that grew from Bacon, Galileo, and Descartes overthrew older forms of knowing, which were based on the view that we are participants in the forming of knowledge and that nature is not inert. The result was a science based on the assumptions that we stand apart from nature, that knowledge is to be judged by its usefulness in extending human mastery over nature, and that nature is best understood by reducing it into its components. "The natural world," in the words of E. A. Burtt, "was portrayed as a vast, self-contained mathematical machine, consisting of motions of matter in space and time and man with his purposes, feelings, and secondary qualities was shoved apart as an unimportant spectator" (Burtt 1954, 104). Our minds are so completely stamped by that particular kind of science that it is difficult to imagine any other way to know, in which comparably valid knowledge might be derived from different assumptions and something akin to sympathy and a "feeling for the organism" (Keller 1983).

Among the dissidents of modern science, Goethe, best known as the author of *Faust*, stands out as one of the first theorists and practitioners of the science of wholeness. In contrast to a purely intellectual empiricism, what physicist and philosopher Henri Bortoft calls the "onlooker consciousness," Goethe stressed the importance of observation grounded in intuition so that objects under investigation could communicate to the observer (Goethe 1952). Descartes, in contrast, reportedly began his days in bed by withdrawing his attention from the contaminating influence of his own body and the cares of the world, in order to think deeply. He aimed, thereby, to establish the methodology for a science of quantity established by pure logic. Goethe, on the other hand, practiced an applied science of wholeness in which "the organizing idea in cognition comes from the phenomenon itself, instead of from the self-assertive thinking of the investigating scientist" (Bortoft 1996, 240). Instead of the intellectual

inquisition proposed by Bacon and practiced subsequently, Goethe proposed something like a dialogue with nature by which scientists "offer their thinking to nature so that nature can think in them and the phenomenon disclose itself as idea" (Bortoft 1996, 242). Facilitation of that dialogue required "training new cognitive capacities" so that Goethean scientists, "far from being onlookers, detached from the phenomenon, or at most manipulating it externally . . . are engaged with it in a way which entails their own development," which requires overcoming a deeply ingrained habit of seeing things as only isolated parts, not in their wholeness (Bortoft 1996, 244). The mental leap, as Bortoft notes, is similar to that made by Helen Keller, who, blind and deaf, was nonetheless able to wake to what she called the "light of the world" without any preconceptions or prior metaphoric structure whatsoever. Goethe proposed, not to dispense with conventional science, but rather to find another, and complementary, doorway to the realm of knowledge in the belief that Truth is not to be had through any single method, nor by any one age or culture.

Implicit in Goethe's mode of science is the old view, still current among some native peoples, that the Earth and its creatures are kin and in some fashion sentient and that they communicate to us, that life comes to us as a gift, and that a spirit of trust, not fear, is essential to knowing anything worth knowing. That message, in Calvin Martin's words, "is riveting . . . offering a civilization strangled by fear, measuring everything in fear, the chance to love everything" and to rise above "the armored chauvinism" inherent in a kind of insane quantification (Martin 1992, 107, 113). It is, I think, what Albert Einstein meant in saying that

> a human being is part of a whole world, called by us the "Universe," a part limited in time and space. He experiences himself, his thoughts and feelings, as something separate from the rest—a kind of optical delusion of his consciousness. The striving to free oneself from this delusion is the one issue of true religion. Not to nourish it but to try to overcome it is the way to reach the attainable measure of peace of mind. (Calaprice 2005, 206)

Goethe earlier proposed a kind of jailbreak from the prison of Cartesian anthropocentricism and from beliefs that animals and natural systems were fit objects to be manipulated at will. His intellectual heirs include all of those who believe that the whole is more than the sum of its parts, including systems thinkers as diverse as mathematician and philosopher Alfred North Whitehead, politician and philosopher Jan Smuts, biologist Ludwig von Bertalanffy, economist Kenneth Boulding,

and ecologist Eugene Odum. Goethe's approach continues in the study of nonlinear systems in places like the Santa Fe Institute. Biologist Brian Goodwin, for one, calls for a "science of qualities" that complements and extends existing science (Goodwin 1994, 198). Conventional science, in Goodwin's view, is incapable of describing "the rhythms and spatial patterns that emerge during the development of an organism and result in the morphology and behavior that identify it as a member of a particular species . . . or the emergent qualities [that] are expressed in biological form are directly linked to the nature of organisms as integrated wholes" (Goodwin 1994, 198–99). Goodwin, like Goethe, calls for a "new biology . . . with a new vision of our relationships with organisms and with nature in general . . . [one] that emphasizes the wholeness, health, and quality of life that emerge from a deep respect for other beings and their rights to full expression of their natures" (Goodwin 1994, 232). Goodwin, Goethe, and other systems scientists aim for a more scientific science, predicated on a rigor commensurate with the fullness of life in its lived context.

While Goethe's scientific work focused on the morphology of plants and the physics of light, D'Arcy Thompson, one of the most unusual polymaths of the twentieth century and one who "stands as the most influential biologist ever left on the fringes of legitimate science," approached design by studying how and why certain forms appeared in nature (Gleick 1987, 199). Sir Peter Medawar said of Thompson's 1917 magnum opus, *On Growth and Form*, that it was "beyond comparison the finest work of literature in all the annals of science that have been recorded in the English tongue" (Gleick 1987, 200). Thompson seems to have measured everything he encountered, notably natural forms and the structural features of plants and animals. In so doing he discovered the patterns by which form arises from physical forces, not just by evolutionary tinkering as proposed by Darwin. Why, for example, does the honeycomb of the bee consist of hexagonal chambers similar to soap bubbles compressed between two glass plates? The answer, Thompson discovered, was found in the response of materials to physical forces, applicable as well to "the cornea of the human eye, dry lake beds, and polygons of tundra and ice" (Willis 1995, 72). By showing the physical and mechanical forces behind life forms at all levels, Thompson challenged the Darwinian idea that heredity determined everything. His work inspired subsequent work in biomechanics, evolutionary biology, architecture, and biomimicry, including that by Paul Grillo, Karl von Frisch, and Steven Vogel.

Frisch, for example, explored the ingenuity of architecture evolved

by birds, mammals, fishes, and insects. African termite mounds a dozen feet high, for example, maintain a constant temperature of about 78°F in tropical climates (Frisch 1974, 138–49). Nests are ventilated variously by permeable walls that exchange gases and by ventilation shafts opened and closed manually as needed with no other instructions than those given by instinct. Interior ducts move air and gases automatically by convection. The system is so ingeniously designed that chambers deep underground are fed a constant stream of cool, fresh air that rises as it warms before being ventilated to the outside. Termite nests are constructed of materials cemented together with the termites' own excretions, eliminating the problem of waste disposal. Desert termites, with no engineering degrees as far as we know, bore holes 40 meters below their nests to find water. Beavers construct dams 1000 feet or more in length; their houses are insulated to remain warm in subzero temperatures. Other animals, less studied, build with comparable skill (Tsui 1999, 86–131). Human ingenuity, considerable as it is, pales before that of many animals that design and build remarkably strong, adaptable, and resilient structures without toxic chemicals, machinery, hands with opposable thumbs, fossil fuels, and professional engineers.

The idea that nature is shaped by physical forces as much as by evolution is also evident in the work of Theodor Schwenk, who explored the role of water as a shaper of Earth's surfaces and biological systems. Of water Schwenk wrote:

> In the chemical realm, water lies exactly at the neutral point between acid and alkaline, and is therefore able to serve as the mediator of change in either direction. In fact, water is the instrument of chemical change wherever it occurs in life and nature. . . . In the light-realm, too, water occupies the middle ground between light and darkness. The rainbow, that primal phenomenon of color, makes its shining appearance in and through the agency of water. . . . In the realm of gravity, water counters heaviness with levity; thus, objects immersed in water take on buoyancy. . . . In the heat-realm water takes a middle position between radiation and conduction. It is the greatest heat conveyer in the earth's organism, transporting inconceivable amounts of warmth from hot regions to cooler ones by means of the process known as heat-convection. . . . In the morphological realm, water favors the spherical; we see this in the drop form. Pitting the round against the radial, it calls forth that primal form of life, the spiral. . . . In every area, water assumes the role of mediator. Encompassing both life and death, it constantly wrests the former from the latter. (Schwenk 1989, 24)

Moving water shapes landscapes. As ice it molds entire continents. At a micro scale, its movement shapes organs and the tiniest organisms. But at any scale it flows, dissolves, purifies, condenses, floats, washes, and conducts, and some believe that it even remembers. Our language is brim full of water metaphors, and we have streams of thought or dry spells. The brain literally floats on a water cushion. Water in its various metaphors is the heart of our language, religion, and philosophy. We are much given to the poetry of water as mists, rain, flows, springs, light reflected, waterfalls, tides, waves, storms. Some of us have been baptized in it. But all of us stand ignorant before the mystery that D. H. Lawrence called "the third thing," by which two atoms of hydrogen and one of oxygen become water, and no one knows what it is.

"Form patterns," Schwenk wrote, "such as those appearing in waves with new water constantly flowing through them, picture on the one hand the creation of form and on the other the constant exchange of material in the organic world" (Schwenk 1996, 34). Water is a shaper, but the physics of its movement is also the elementary pattern of larger systems "depicting in miniature the great starry universe" (Schwenk 1996, 45). Water is the medium by which and through which life is lived. Turbulence in air and water have the same forms and mechanics as vortices, whether in the ocean, the atmosphere, or space. Sound waves and waves in water operate similarly. Schwenk's great contribution to ecological design, in short, was to introduce water in its fullness as a geologic, biological, somatic, and spiritual force, a reminder that we are creatures of water, all of us eddies in one great watershed.

The profession of design as an ecological art probably begins with the great British and European landscapers such as Capability Brown (1716–1783), famous for developing pastoral vistas for the rich and famous of his day. Looking out from the massive ostentation of Blenheim Palace across the surrounding lakes, trees, and grazing sheep, you are witness not to the natural landscape but to Brown's version of the pastoral—an orderliness of considerable comfort to the creators of the British Empire. In American history the early beginnings of design as ecology are apparent in the work of the great landscape architect and creator of Central Park in New York, Frederick Law Olmsted, and, later, in that of Jens Jensen, who pioneered the use of native plants in designed landscapes of the Midwest. Ian McHarg, a brilliant revolutionary, merged the science of ecology with landscape architecture aiming to create human settlements in which "man and nature are indivisible, and . . . survival and health are contingent

upon an understanding of nature and her processes" (McHarg 1969, 27). His students, including Frederick Steiner, Pliny Fisk, Carol Franklin, and Anne Whiston Spirn, continue that vision armed with sophisticated methodological tools of geographic information systems and ecological modeling applicable to broader problems of human ecology.

While the degree of influence varied, many early efforts toward ecological design were inspired by the arts and crafts movement in Britain, particularly the work of William Morris and John Ruskin. In U.S. architecture, for example, Frank Lloyd Wright's attempt to define an "organic architecture" has clear resonance with the work of Morris and Ruskin as well as the transcendentalism of Ralph Waldo Emerson. Speaking before the Royal Institute of British Architects in 1939, Wright described organic architecture as "architecture of nature, for nature . . . something more integral and consistent with the laws of nature" (Wright 1993, 302, 306). In words Morris and Ruskin would have applauded, Wright argued that a building "should love the ground on which it stands," reflecting the topography, materials, and life of the place (Wright 1993, 307). Organic architecture is "human scale in all proportions" but is a blending of nature with human-created space so that it would be difficult to "say where the garden ends and where the house begins . . . for we are by nature ground-loving animals . . . insofar as we court the ground, know the ground, and sympathize with what it has to give us" (Wright 1993, 309). Wright's vision extended beyond architecture to a vision of the larger settlement patterns that he called "Broadacre City," arguing that organic architecture had to be more than an island in a society with other values. Wright, with his attempts to harmonize building and ecology and in his pioneering efforts to use natural materials and solar energy, is a precursor to the green building movement. And in his often random musings about an "organic society," he foreshadowed the present dialogue about ecological design and the sustainability of modern society.

Ecological design, however, is not just about calibrating human activities with natural systems. It is also an inward search to find patterns and order of nature written in our senses, flesh, and human proclivities. There is no line dividing nature outside from inside; we are permeable creatures inseparable from nature and natural processes in which we live, move, and have our being. We are also sensual creatures with five senses that we know of and others that we only suspect. At its best, ecological design is a calibration, not just of our sense of proportion that the Greeks understood mathematically, but also a finer calibration of the full range of our

sensuality with the built environment, landscapes, and natural systems. Our buildings are thoughts, words, theories, and entire philosophies crystallized for a brief time into physical form that reveals what's on our mind and what's not. When done right, they are a kind of dialogue with nature and our own deeper, sensual nature. The sights, smells, texture, and sounds of the built environment evoke memories, initiate streams of thought, engage, sooth, provoke, bind or block, open or close possibilities. When done badly, the result is spiritual emptiness characteristic of a great deal of modern design that reveals, in turn, a poverty of thought and perception and feeling manifest as ugliness.

We are creatures shaped inordinately by the faculty of sight, but seeing is anything but simple. Oliver Sacks once described a man blind since early childhood who, sight once restored, found it to be a terrible and confusing burden and preferred to return to blindness and his own inner world of touch. "When we open our eyes each morning," Sacks writes, "it is upon a world we have spent a lifetime learning to see" (Sacks 1993, 64). And we can lose not only the faculty of sight but the ability to see as well. Even with 20/20 vision, our perception is always selective because our eyes permit us to see only within certain ranges of the light spectrum and because personality, prejudice, interest, and culture further filter what we are able to see. Sacks notes that individual people can choose not to see, and I suspect the same is true for cultures as well. The affinity for nature, a kind of sight, is much diminished in modern cultures.

Collective vision cannot be easily restored by more clever thinking, but, as David Abram puts it, only "through a renewed attentiveness to this perceptual dimension that underlies all our logics, through a rejuvenation of our carnal, sensorial empathy with the living land that sustains us" (Abram 1996, 69). Abram describes perception as interactive and participatory, in which "perceived things are encountered by the perceiving body as animate, living powers that actively draw us into relation . . . both engender[ing] and support[ing] our more conscious, linguistic reciprocity with others" (Abram 1996, 90). Further, sight as well as language and thought are experienced bodily as colors, vibrations, sensations, and empathy, not simply as mental abstractions. The ideas that viewer and viewed are in a form of dialogue and that we experience perception bodily runs against the dominant strains of Western philosophy. For illustration, Plato's *Phaedrus* has Socrates say, "I'm a lover of learning, and trees and open country won't teach me anything whereas men in the town do." Plato's world of ideal forms existed only in the abstract. Similarly,

the Christian heaven exists purely somewhere beyond earthly and bodily realities. Both reflected the shifting balance between the animated sacred, participatory world and the linear, abstract, intellectual world. Commenting on the rise of writing and the priority of the text, Abram says that "the voices of the forest, and of the river began to fade . . . language loosen[ed] its ancient association with the invisible breath, the spirit sever[ed] itself from the wind, and psyche dissociate[d] itself from the environing air" (Abram 1996, 254). As a result, "human awareness folds in upon itself and the senses—once the crucial site of our engagement with the wild and animate earth—become mere adjuncts of an isolate and abstract mind" (Abram 1996, 267).

Through the act of design we are invited to see larger realities. The creators of Stonehenge, I think, intended worshippers to see, not just circles of artfully arranged stone, but the cosmos above and perhaps within. The Parthenon is a temple to the goddess Athena but also a visible testimony to an ideal existing in mathematical harmonies, proportion, and symmetry discoverable by human reason. The builders of Gothic cathedrals intended not just monumental architecture but a glimpse of heaven and a home for sacred presence. For all of the crass, utilitarian ugliness of the factories, slums, and glittering office towers, the designers and builders of the industrial world intended to reveal possibilities for abundance and human improvement in a world they otherwise deemed uncertain and violent, ruled by the laws of the jungle.

Finally, the practice of ecological design is rooted in the emerging science of ecology and the natural characteristics of specific places. The ecological design revolution is, not merely a more efficient recalibration of energy, materials, and economy in accord with ecological realities, but a deeper and more coherent vision of the human place in nature. Ecological design is, in effect, the specific terms of a declaration of coevolution with nature that begins in the science of ecology and the recognition of our dependence on the web of life (Capra 1996; Capra 2002). In contrast to the belief that nature is little more than a machine and its parts merely resources, for ecological designers nature is, as Aldo Leopold put it,

> a fountain of energy flowing through a circuit of soils, plants, and animals. Food chains are the living channels which conduct energy upward; death and decay return it to the soil. The circuit is not closed; some energy is dissipated in decay, some is added by absorption from the air, some is stored in soils, peats, and long-lived forests; but it is a sustained circuit, like a slowly

> augmented revolving fund of life. There is always a net loss by downhill wash, but this is normally small and offset by the decay of rocks. (Leopold 1966, 216)

Energy flowing through the "biotic stream" moves "in long or short circuits, rapidly or slowly, uniformly or in spurts, in declining or ascending volume," through what ecologists call food chains. For designers, the important point is that the internal processes of the biotic community, the ecological books, in effect, must balance so that energy used or dissipated by various processes of growth is replenished (Leopold 1953, 162). Leopold proposed three basic ideas (Leopold 1987, 218):

- that land is not merely soil;
- that the native plants and animals keep the energy circuit open; others may or may not;
- that man-made changes are of a different order than evolutionary changes and have effects more comprehensive than is intended or foreseen.

Ecological design, as Leopold noted, begins in the recognition that nature is not simply dead material or simply a resource for the expression of human wants and needs but, rather, "a community of soils, waters, plants, and animals, or collectively: the land" of which we are a part (Leopold 1966, 204). But Leopold did not stop at the boundary of science and ethics; he went on to draw out the larger implications. For reasons that are both necessary and right, the recognition that we are members in the community of life "changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it" (Leopold 1966, 204). The "upshot" is Leopold's classic statement that "a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold 1966, 224–25). We will be a long time understanding the full implications of that creed, but Leopold, late in his life, was beginning to ponder the larger social, political, and economic requisites of a fully functioning land ethic.

Like Leopold's land ethic, ecological design represents a practical marriage of ecologically enlightened self-interest with the recognition of the intrinsic values of natural systems. Once consummated, however, the marriage branches out into a myriad of possibilities. Economics rooted in the realities of ecology, for example, requires the preservation of natural capital of soils, forests, and biological diversity, which is to say economies that operate within the limits of the Earth's carrying capacity (Hawken

et al. 1999; Daly 1996). An ecological politics requires the recalibration of the complexities and timescales of ecosystems with the conduct of the public business. An ecological view of health would begin with the recognition that the body exists within an environment, not as a kind of isolated machine (Kaptchuk 2000). Religion grounded in the operational realities of ecology would build on the human role as steward and the obligation to care for the Creation (Tucker 2003). An ecological view of agriculture would begin with the realities of natural systems, aiming to mimic the way nature "farms" (Jackson 1980). An ecological view of business and industry would aim to create solar-powered industrial and commercial ecologies so that every waste product cycles as an input in some other system (McDonough and Braungart 2002). And an ecological view of education would, among other things, foster the capacity to perceive systems and patterns and promote ecological competence.

Ecology, the "subversive science," is the recognition of our practical connections to the physical world, but it does not stop there. The awareness of the many ways by which we are connected to the web of life would lead intelligent and scientifically literate people to protect nature and the conditions necessary to it, for reasons of self-interest. But our knowledge, always incomplete and often dead wrong, is often inadequate to the task of knowing what's in our interest, let alone discerning exactly what parts of nature we must accordingly protect and how to do it. Science notwithstanding, often we do not know what we are doing or why. More subversive still are questions concerning the interests and rights of lives and life across the boundaries of species and time. Since they cannot speak for themselves, their only advocates are those willing to speak on their behalf. Many clever arguments purport to explain why we should or should not be concerned about those whose lives and circumstances would be affected by our action or inaction. Like so many tin soldiers, arrayed across the battlefield of abstract intellectual combat, they assault frontally or by flank, retreat only to regroup, and charge again, each battle giving rise to yet another. But in the end, I think, such questions will be decided, not by intellectual combat and argumentation, however smart, but rather more simply and profoundly by affection—all of those human emotions that we try to capture in words like *compassion*, *sympathy*, and *love*. Love, in other words, neither requires nor hinges on intellectual argument. It is a claim that we recognize as valid but for reasons we could never describe satisfactorily. In the end it is a nameless feeling that we accept as both a limitation on what we do and a gift we offer. Pascal's observation that the

heart has reasons that reason does not know sums the matter. Love is a gift but the giver expects no return on the investment, and that defies logic, reason, and even arguments about selfish genes.

After all of the intellectualization is finished and all of the various arguments made, whether we choose to design with nature or not will come down to a profoundly simple matter of whether we love deeply enough, artfully enough, carefully enough to preserve the web of life. Ecological design is simply an informed love applied to the dialogue between humankind and natural systems. The origins of ecological design can be traced far back in time, but deeper origins are found in the recesses of the human heart.

Chapter 21

The Design Revolution: Notes for Practitioners

(2006)

When you build a thing you cannot merely build that thing in isolation, but must also repair the world around it, and within it so that the larger world at that one place becomes more coherent and more whole; and the thing which you make takes its place in the web of nature as you make it.
Christopher Alexander

The long-term goal of ecological design, in Aldo Leopold's words, is to go "from conqueror of the land-community to plain member and citizen of it." Drawing from Sim van der Ryn and Stuart Cowan (1996) and William McDonough and Michael Braungart (2002), the basic principles of ecological design are these:

- Use sunshine and wind.
- Preserve diversity.
- Account for all costs.
- Eliminate waste.
- Solve for pattern.
- Protect human dignity.
- Leave wide margins for error, malfeasance, and ignorance.

But there is no larger theory of ecological design, nor is there a textbook formula that works for practitioners across different fields and at varying

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scales. And neither should we presume agreement on what it means for humankind to become a "plain member and citizen" of the biotic community. In other words, we have a compass but no map. Samuel Mockbee, founder of the Rural Studio, enjoined his architectural students working with the poor in Hale County, Alabama, simply to make their work "warm, dry, and noble." Warm and dry are easier for the most part because we feel them somatically, but noble is hard because it requires us to make judgments about what we ought to do relative to some standard higher than creature comfort. But in the best sense of the word it implies decent, worthy, generous, magnificent, proud, and resilient. And it ought to be synonymous with ecological design as well.

Having no theory to expound, I present what follows as notes for something like a bull session on ecological design.

1. Beginnings

The human sense of order and affinity for design, forged through our long evolutionary history, goes back to our dawning sensations and experiences of life. The first safe haven we sense is our mother's womb. Our first awareness of regularity is the rhythm of our mother's heartbeat. Our first passageway is her birth canal. Our first sign of benevolence is at her breast. Our first awareness of self and other comes from sounds made and reciprocated. Our first feelings of ecstasy come from bodily release. The first window through which we see is our eye. The first tool we master is our own hand. The world is first revealed to us through the senses of touch and taste. Our first worldview is formed within small places of childhood. Our ancestors' first inkling that they were not alone was the empathetic encounter with animals. The first music they heard was sounds made by birds, animals, wind, and water. Their first source of wonder, perhaps, was the undimmed night sky. Their first models of shelter were those created by birds and animals. The first materials humans used for building were mud, grass, stone, wood, and animal skins. Their first metaphors were likely formed from daily experiences of nature. The first models for worship were found in what early humans perceived as cosmic harmony, often replicated in the design of dwelling places.

We are creatures shaped by such experiences and by the interplay between our senses and the world around us. We know of five senses and have reason to believe that there are others. Some evidence suggests, for example, that we have a rudimentary awareness of being watched.

Aboriginal peoples can walk with unerring accuracy through trackless landscapes in the dark of night. Across all cultures and times, good design is a close calibration of our sensuality with inspiration, creativity, place, form, and materials. Good design feels right and is a pleasure to behold and experience for reasons that we understand at an intuitive level but have difficulty explaining (Alexander 2001; Kellert 1996).

2. Evolution as Model/Nature as Standard

The starting point for ecological design is the 3.8 billion years of evolving life on Earth. Nature, for ecological designers, is not something just to be mastered but a tutor and mentor for human actions. Janine Benyus, author of *Biomimicry*, points out, for example, that spiders make biodegradable materials stronger than steel and tougher than Kevlar without fossil fuels or toxic chemicals (Benyus 1997). From nothing more than substances in seawater, mollusks make ceramic-like materials that are stronger and more durable than anything we presently know how to make. These and thousands of other examples are models for manufacturing, the design of technologies, farming, machines, and architecture that are orders of magnitude more efficient and elegant than our best industrial capabilities.

Ecological design, however, is not simply a mimicking of nature toward a smarter kind of industrialization but, rather, a deeper revolution in the place of humans in nature. In Wendell Berry's words, design begins with the questions "What is here? What will nature permit us to do here? What will nature help us do here?" (Berry 1987, 146). The capacity to question presumes the humility to ask, the good sense to ask the right questions, and the wisdom to follow the answers to their logical conclusions. Ecological design is not a monologue of humans talking to nature but a dialogue that requires the capacity to listen, discern, and learn from nature. When we get it right, the results, in John Todd's words, are "elegant solutions predicated on the uniqueness of place." The industrial standard, in contrast, is based on the idea that nature can be tortured into revealing her secrets, as Francis Bacon so revealingly put it, and then by brute force and human cleverness coerced to do whatever those with power intend. One size fits all, so industrial design looks the same and operates by the same narrow logic everywhere. But this is no great victory for humankind, because the mastery of nature, in truth, represents the mastery of some men over other men using nature as the medium, as C. S. Lewis once put it (Lewis 1947).

3. All Design Is Political

Design inevitably involves decisions about how society provides food, energy, shelter, materials, water, and waste cycling and distributes risks, costs, and benefits. In other words, design affects who gets what, when, and how—a standard definition of politics. The environment, then, is a mirror reflecting decisions that we make about energy, forests, land, water, biological diversity, resources, and the distribution of wealth, risks, and benefits. Often cast as "liberal" or "conservative," such decisions are, in fact, often about how the present generation orients itself to the interests of its children and grandchildren. One can arrive at a decent regard for their prospects as either a conservative or a liberal. These are not opposing positions so much as they are different sides of a single coin. But neither conservatives nor liberals have yet invested much energy, time, or thought to the design requirements of the transition to sustainability. The point is that harmonizing social and economic life with ecological realities will require choices about energy technologies, agriculture, land use, settlement patterns, materials, the handling of wastes, and water that are inescapably political and will distribute risks and benefits in one way or another.

Further, as the Greeks understood, design entails choices that enhance or retard civic life and the prospects for citizenship. But in our time "we are witnessing the destruction of the very idea of the inclusive city" and with it the arts of civility, citizenship, and civilization (Rogers 1997; Rogers and Power 2000). By including or excluding possibilities to engage each other in convivial dialogue, the creators of urban spaces enhance or diminish civility, urbanity, and the civic prospect. It is no accident, I think, that crime, loneliness, and low participation became epidemic as spaces such as town squares, street markets, front porches, corner pubs, and parks were sacrificed to the automobile, parking lots, and urban sprawl. Better architecture and landscape architecture alone cannot cure these problems, but they can create convivial spaces where people talk, argue, reason together, play, bargain, and learn the art of being citizens.

4. Honest Accounting

In an age much devoted to the theology of the market, disciples of the conventional wisdom believe it imprudent to design ecologically if the costs are even marginally more than the costs of conventional design. Based on incomplete and highly selective accounting, that view is almost

always wrong because it overlooks the fact that we—or someone—sooner or later will pay the full costs of bad design, one way or another. In other words, society pays for ecological design whether it gets the benefits of it or not. Honest accounting, accordingly, requires that we keep the boundaries of consideration as wide as possible over the long term and have the wit to deduct the collateral benefits that come from doing the right things in the right way. For example, ignoring the costs of wars fought for "cheap" oil, the costs of climate change and air pollution, and the health effects of urban sprawl, an SUV is cheap enough. But price and cost should not be confused. It is the height of folly to believe that we can eliminate forests, pollute, squander resources, erode soils, destroy biological diversity, remodel the biogeochemical cycles of the Earth, and create ugliness, human and ecological, without consequence. The truth is that, sooner or later, the full costs will be paid one way or another. The problem, however, is that the costs of environmental dereliction are diffuse and often can be deferred to some other persons and to some later time. But they do not thereby disappear. The upshot is that much of our apparent prosperity is phony and so too the intellectual and ideological justifications for it.

The standard of neoclassical economics applied to architecture, in particular, has been little short of disastrous. "The rich complexity of human motivation that generated architecture," in architect Richard Rogers and Anne Power's words, "is being stripped bare. Building is pursued almost exclusively for profit" (Rogers 1997, 67). By such logic we cannot afford to design well and build for the distant future. The results have been evident for a long time. In the mid-nineteenth century, John Ruskin noted, "Ours has the look of a lazy compliance with low conditions" (Ruskin 1989, 21). But even Ruskin could not have foreseen the blight of suburban sprawl, strip development, and urban decay driven by our near terminal love affair with the automobile and inability to plan sensibly. The true costs, however, are passed on to others as "externalities," thereby privatizing the gains while socializing the costs. The truth is, as it has always been, that phony prosperity is no good economy at all. False economic reckoning has caused us to lay waste to our countryside, abandon our inner cities and the poor, and build auto-dependent communities that are contributing mightily to destabilizing climate and rendering us dependent on politically volatile regions for oil.

An economy judged by the narrow industrial standards of efficiency will destroy values that it cannot embrace. Maximizing efficiency, mea-

sured as the output for a given level of input, creates disorder, that is to say, inefficiency at higher levels. The reasons are complex but have a great deal to do with our tendency to confuse means with ends. As a result efficiency often becomes an end in itself while the original purposes (prosperity, security, benevolence, reputation, etc.) are forgotten. The assembly line was efficient for the manufacturing firm, but its larger effects on workers, communities, and ecologies were often destructive, and the problems for which mass production was once a solution have been compounded many times over. Neighborliness is certainly an inefficient use of time on any given day, but not when considered as a design principle for communities assessed over months and years or generations. For engineers, freeways are efficient at moving people up to a point, but they destroy communities, promote pollution, lead to congestion, change foreign policies, and eliminate better alternatives, including design that eliminates some of the need for mobility. Walmart, similarly, is an efficient marketing enterprise, but it eliminates its competitors and many things that make for good communities, including jobs that pay decent wages that allow people to buy at any price. And, of course, nuclear weapons are wonderfully efficient devices as well. Ecological design, in contrast, implies a different standard of efficiency oriented toward ends, not means; the whole, not parts; and the long term, not the short term.

5. Design for Human Limitations

The limits of ecological design are those of nature and of human nature, including our incurable ignorance. The reasons for ignorance are many, as previously noted. Designers must also reckon with the uncomfortable probability that the amount of credulity in human societies remains constant. This is readily apparent by looking backward through the rearview mirror of history to see the foibles, fantasies, and follies of people in previous ages (Tuchman 1984). For all our pretensions to rationality, at some later time others will see us similarly. The fact is that humans presently are inclined to be as unskeptical and sometimes as gullible as those living in any other time—only the sources of our befuddlement change. People of previous ages read chicken entrails, relied on shamanism, consulted oracles. We, far more sophisticated but similarly limited, use computer models, believe experts, and exhibit a touching faith in technology to fix virtually everything. But who among us really understands how computers or computer models work? Who is aware of the many limits of

expertise or the ironic ways in which technology "bites back"? Has gullibility declined as science has grown more powerful? No, if anything, it is growing because science and technology are increasingly esoteric and specialized, hence removed from daily experience. Understanding less and less of either, we will believe almost anything. Gullibility feeds on mental laziness and is enforced by social factors of ostracism, social pressures for conformity, and the pathologies of groupthink that penalize deviance.

This line of thought raises the related and equally unflattering possibility noted above that stupidity may be randomly distributed up and down the social, economic, and educational ladder. There are likely as many thoroughgoing, fully degreed fools as there are undegreed fools. In other words, intelligence and intellectual clarity can be focused and sharpened a bit but can be neither taught nor conjured. The numerous examples of the undereducated or those who were outright failures in the academic sense include Albert Einstein, Winston Churchill, and Frank Lloyd Wright. One should conclude, however, not that formal schooling is useless, but that its effectiveness, for all of the puffery that adorns college catalogues and educational magazines, is considerably less than advertised. And there are those made more errant by the belief that their ignorance has been erased by the possession of facts, theories, and the adornment of weighty learnedness.

Nor does the outlook for intelligence necessarily brighten when we consider the limitations of large organizations. These too are infected with our debilities. Most of us live out our professional lives in organizations or work for them as clients and discover to our dismay that the collective intelligence of organizations and bureaucracies is often considerably less than that of any one of its individual employees. We are baffled by the discrepancy between smart people and the organizations that employ them which exhibit a collective IQ of less than, say, Kitty Litter. We understand human stupidity and dysfunction because we encounter it at a scale commensurate with our own. But confronted with large organizations, whether corporations, governments, or colleges and universities, we tend to equate scale, prestige, and power with perspicacity and infallibility. Nothing could be further from the truth. The intelligence of big organizations (oxymoron?) is limited by the obligation to earn a profit, enlarge their domain, preserve entitlements, or maintain a suitable stockpile of prestige.

Our frailties infect design professions as well. Buildings and bridges sometimes fall down (Levy and Salvadori 1992). Clever designs can induce

an astonishing level of illness and destruction. Beyond some limit, design becomes guesswork. British engineer A. R. Dykes puts it this way: "Engineering is the art of modeling materials we do not wholly understand, into shapes we cannot precisely analyze so as to withstand forces we cannot properly assess, in such a way that the public has no reason to suspect the extent of our ignorance." In various ways the same is true in other design professions and virtually every other field of human endeavor.

The point is simply to say that human limitations will dog designers at every turn. They will infect every design, every project, and the evolution of every system, however clever. From this there are, I think, two conclusions to be drawn. The first is simply that design, whether of bridges, buildings, communities, factories, or farms and food systems, ought to maximize the capacity of a system to withstand disturbance without impairment, which is to say its resilience. Ecological design does not assume human infallibility, or that technologies will work as intended, or that some deus ex machina will magically rescue us from our own folly. Rather it does things at a manageable scale aiming for flexibility, redundancy, and multiple checks and balances characteristic of healthy ecosystems, and in so doing, it avoids transgressing thresholds of the irreversible and irrevocable (Lovins and Lovins 1982, chapter 13; Lovins 2002).

Forewarned about human limitations, we might further conclude that a principal goal of designers ought to be the improvement of our collective intelligence by promoting mindfulness, transparency, and ecological competence. The public is less aware of how it is provisioned with food, energy, water, materials, security, and shelter and how its wastes are handled than people of any previous time. Industrial design cloaked the ecological fine print of what are often little better than Faustian bargains providing luxury and convenience now, while deferring ruin to some later time. Ecological design, on the contrary, ought to demystify the world, making us mindful of the ecological fine print by which we live, move, and have our being.

Design is always a powerful form of education. Only the terminally pedantic believe that learning happens just in schools and classrooms. The built environment in which we spend over 90 percent of our lives is at least as powerful in shaping our ideas and views of the world as anything learned in a classroom. Suburbs, shopping malls, freeways, parking lots, and derelict urban spaces have considerable impacts on how we think, what we think about, and what we can think about. The practice of design as a form of public instruction ought to free the ecological imagination

from the tyranny of imposed forms and relationships characteristic of the fossil fuel–powered industrial age. Architecture, landscape architecture, and planning carried out as a form of pedagogy aim to instruct about energy, materials, history, rhythms of time and seasons, and the ecology of the places in which we live. It would help us become mindful of ecological relationships and engage our places creatively.

6. Vernacular

Many of the best examples of ecological design have been created by people at the periphery of power, money, and influence and living in out-of-the-way places. The truth is that practical adaptation to the ecologies of particular places over long periods of time has often resulted in spectacularly successful models of vernacular design (Rudofsky 1964). It may well be that the ecological design revolution will be driven, at least in part, by experience accumulated from the periphery, not from the center, and led by people skilled at solving the practical problems of living artfully by their wits and good sense in particular places. The success of vernacular design across all cultures and times underscores the possibility that design intelligence may be more accurately measured at the level of the community or culture, rather than at the individual level.

7. The Standard

The esthetic standard for ecological design is to work so artfully as to cause no ugliness, human or ecological, somewhere else or at some later time. The standard, in other words, requires a robust sense of esthetics that rises above the belief that beauty is wholly synonymous with form alone. Every great designer from Vitruvius (90–20 BC) through Frank Lloyd Wright demonstrated that beauty in the large sense had to do with the effects of buildings on the human spirit and our sense of humanity. But the standards for beauty must be measured on a global scale and longer time horizon so that beauty includes the upstream effects at wells, mines, and forests where materials originate as well as the downstream effects on climate, human health, and ecological resilience. Things judged truly beautiful will in time be regarded as those that raised the human spirit without compromising human dignity or ecological functions elsewhere. Architecture and landscape architecture, in other words, are a means to higher ends, not ends in themselves.

8. Education of Designers

As much art as science, the design professions are not simply technical disciplines, having to do with the intersection of form, materials, technology, and real estate. The design professions such as architecture, landscape architecture, and urban planning are first and foremost practical liberal arts with technical aspects. Long ago Vitruvius proposed that architects "be educated, skilful with the pencil, instructed in geometry, know much history, have followed the philosophers with attention, understand music, have some knowledge of medicine, know the opinions of the jurists, and be acquainted with astronomy and the theory of the heavens" (Vitruvius 1960, 5–6). That is a start of a liberal and liberating education. Design education, therefore, ought to be a part of a broad conversation that includes all of the liberal arts. This is what George Steiner means by saying that

> architecture takes us to the border. It has perennially busied the philosophic imagination, from Plato to Valery and Heidegger. More insistently than any other realization of form, architecture modifies the human environment, edifying alternative and counter-worlds in relationships at once concordant with and opposed to nature. (Steiner 2001, 251–52)

In countless ways all design, even the best, damages the natural world. Extraction and processing of materials depletes landscapes and pollutes. Building construction, operation, and demolition creates large amounts of debris. Agriculture inevitably simplifies ecosystems. A new breed of ecological designers, accordingly, must be even more intellectually agile and broader, capable of orchestrating the wide array of talents and fields of knowledge necessary to design outcomes that can be sustained within the ecological carrying capacity of particular places.

9. Design as a Healing Profession

The design professions are a form of the healing arts, an ideal with roots again in Vitruvius's advice that architects ought to pay close attention to sunlight, the purity of water, air movements, and the effects of the building site on human health. The word *healing* has a close affinity with other words such as *holy* and *wholeness*. A larger sense of the profession of architecture, which architect Thomas Fisher (2001) deems a "calling," would aim for the kind of wholeness that creates not just buildings but integral homes and communities. Compare, for example, the idea that

"architecture applies only to buildings designed with a view to aesthetic appeal" (Pevsner 1990, 15) with architecture defined as "the art of place-making" and creation of "healing places" (Day 2002, 10, 5). In the former sense, design changes with trends in fashionable forms and materials. It is often indifferent to place, people, and time. The goal is to make monumental, novel, and photogenic buildings and landscapes that often express only the ego and power of the designer and owner. In contrast, the making of healing places signals a larger allegiance to place that means, in turn, a commitment to the health of other places. Place making is an art and science disciplined by locality, culture, and ecology requiring detailed knowledge of local materials, weather, topography, and the nature of particular places and a creative dialogue between past, present, and future possibilities. It is slow work in the same way that carefulness has a different clockspeed than carelessness. Place making uses local resources, thereby buffering local communities from the ups and downs of the global economy, unemployment, and resource shortages.

Practiced as a healing art, architecture, for example, would result in buildings and communities that would not compromise the health of people and places. Architects would aim to design buildings and neighborhoods in which community and conviviality could thrive. At larger scales the challenge is to extend healing to urban ecologies. Half of humankind now lives in urban areas, a percentage that will rise in coming decades to perhaps 80 percent. Cities built in the industrial model to accommodate the automobile are widely recognized as human, ecological, and, increasingly, economic disasters. Given a choice, people abandon such places in droves. But we have good examples of cities as diverse as Copenhagen, Chattanooga, and Curitiba that have taken charge of their futures to create livable, vital, and prosperous urban places—what Peter Hall and Colin Ward (1998) have called "sociable cities." In order to do that, however, designers must see their work as fitting in a larger human and ecological tapestry.

As a healing art, ecological design aims toward harmony, which is the proper relation of parts to the whole. Is there a design equivalent to the Hippocratic oath in medicine that has informed medical ethics for two millennia? Are there things that designers should not design? What would it mean for designers to "do no harm"?

Looking ahead, the challenge to the design professions is to join ecology and design in order to create buildings, communities, cities, landscapes, farms, industries, and entire economies that accrue natural capital

and are powered by current sunlight—perhaps, one day, having no net ecological footprint. The standard is that of the healthy, regenerative ecosystem. In the years ahead we will discover a great deal that is new and rediscover the value of vernacular traditions such as front porches, village squares, urban parks, corner pubs, bicycles, pedestrian-scaled communities, small and winding streets, local stores, riparian corridors, urban farms and wild areas, and well-used landscapes.

Design practiced as a healing art is not a panacea for the failures of the industrial age. However well designed, a world of 7 to 10 billion human beings with unlimited material aspirations will sooner than later overwhelm the carrying capacity of natural systems as well as our own management abilities. There is considerable evidence that humans already exceed the limits of many natural systems. Further, ecological design does not require building; often the best design choices require adaptive reuse or more intense and creative uses of existing infrastructure. Sometimes it means doing nothing at all, a choice that requires a clearer and wiser distinction between our needs and wants.

What ecological designers can do, and all they can do, is to help reduce our ecological impacts and buy us time to reckon with the deeper sources of our problems, which have to do with age-old questions about how we relate to each other across the boundaries and sometimes chasms of gender, ethnicity, nationality, culture, and time and how we fit into the larger community of life. Ecological design, as a healing art, is a necessary but insufficient part of a larger strategy of healing, health, and wholeness, which brings me to the soul of the matter.

10. Design for Spirit

For designers it is significant that humans are inescapably spiritual beings, if only intermittently religious. Our choice is not whether we are spiritual or not but whether our spiritual energy is directed to authentic purposes or not. But much of the modern world, however, has been assembled as if people were machines without deeper needs for order, pattern, and roots. Modern designers filled the world with buildings and developments divorced from their context, existing as if in some alien realm disconnected from ecology, history, culture, people, and place. Ecological design, on the other hand, is a process by which we grow into a particular place, becoming citizens of the life-community in that place. It is a process by which dwellings and landscapes and the uses we make of them become

part of a larger story. As a kind of storytelling, design is a celebration of the life that connects us with the nature of the places in which we live and work and grounds us in the still larger story of the human journey.

Ecological design is not a formula but rather a complex process of adapting human intentions to ecological realities. It is art as much as science, ethics as much as economics, ecology as much as engineering. And it is a messy, uncertain, difficult, sometimes contentious process demanding a high order of competence, creativity, and goodwill. Properly done, it changes routines of institutional decision making and management. Rules of finance and budgeting, for example, that worked in the industrial era, when the natural capital of soils, forests, water, and climate stability was assumed to be free, no longer do so. Designing ecologically requires the integration of expertise across many disciplines, perspectives, and professions, such as energy specialists, ecological engineers, materials scientists, lighting consultants, ecologically adept landscape architects, and engineers who understand buildings as whole systems, and those who will live and work there.

Finally, beyond performance of the obvious functions such as durable shelter, usefulness, and beauty, what more do we want from our buildings, landscapes, and communities? We should want our buildings, neighborhoods, communities, and cities to honor the ecologies and cultures of the places in which they are built. They should promote rootedness, not anomie. They ought to foster an awareness of connections and ecological competence. They ought to make us smarter and more competent people, not dumb us down. They ought to be designed to regenerate natural capital of soils, trees, and biological diversity. They ought to foster possibilities for real human engagement. They ought to be paid for fairly and not offload costs on others. But these, too, are means to still larger ends.

PART 5

On Energy and Climate

∴ AUTHOR'S NOTE 2010: ∴

"Man's conquest of nature," C. S. Lewis once wrote, was an illusion. "All of nature's apparent reverses have been but tactical withdrawals. We thought we were beating her back when she was luring us on" (Lewis 1947). What Jacob Bronowski once called "the ascent of man" has been powered by carbon in soils and forests, and more recently by ancient sunlight in the form of coal and oil. Every advance along the way seemed to be permanent. But nature, as Lewis has it, was luring us on, and now the trap is nearly sprung in the form of spiraling climatic destabilization, ocean acidification, and loss of species. We have precious little time to stabilize the Earth's vital signs and move civilization to safer ground. Climate destabilization is the largest challenge to global civilization ever, but with luck it may prove to be an opportunity to build the foundation for a more durable and decent world order.

Chapter 29

Pascal's Wager and Economics in a Hotter Time

(1992)

In weighing the question concerning the existence of God, seventeenth-century philosopher and mathematician Blaise Pascal (1941) proceeded in a manner perhaps instructive for other and more mundane questions. "Reason," he declared, "can decide nothing here." Nonetheless, "you must wager. It is not optional." You have, he believed, "two things to lose, the true and the good; and two things to stake, your reason and your will, your knowledge and your happiness; and your nature has two things to shun, error and misery." What would you lose by believing that God exists and living a life accordingly? Pascal's answer was, "If you gain, you gain all; if you lose, you lose nothing." By doing so you would become "faithful, honest, humble, grateful, generous, a sincere friend, truthful." The opposite decision, that God did not exist, and a life lived in pursuit of "poisonous pleasures, glory and luxury," whatever its short-term gains, would bring misery. In other words, if you chose not to believe and it turned out that God did exist, you would have hell to pay. On the other hand, if God did not exist and you had lived a life of faith, you would have sacrificed only a few fleeting pleasures but

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gained much more. Pascal's argument for faith, then, rested on the sturdy foundation of prudential self-interest aimed to minimize risk.

The world now faces a somewhat analogous choice. On one side a large number of scientists believe that the planet is warming rapidly. If we continue to spew out heat-trapping gases, such as carbon dioxide, methane, chlorofluorocarbons, and nitrous oxide, these scientists say, we will warm the planet intolerably within the next century. The consequences of dereliction and procrastination may include killer heat waves, drought, sea level rise, superstorms, vast changes in forests and biota, considerable economic dislocation, and increases in disease: a passable description of hell. But like Pascal's wager, no one can say with absolute certainty what will happen until the consequences of our choice, whatever they may be, are upon us. Nonetheless, "we must wager. It is not optional" (Pascal 1941).

Others, however, claim to have looked over the brink and have decided that hell may not be so bad after all, or at least that we should research the matter further. Yale University economist William Nordhaus (1990b), for example, believes that a hotter climate will mostly affect "those sectors [of the economy] that interact with unmanaged ecosystems" such as agriculture, forestry, and coastal activities. The rest of the economy, including that which operates in what Nordhaus (1990b) called "a carefully controlled environment," which includes shopping malls and presumably the activities of economists, will barely notice that things are considerably hotter. "The main factor to recognize," Nordhaus asserted, "is that the climate has little economic impact upon advanced industrial societies" (Nordhaus 1990a, 193).

Nordhaus concluded that "approximately 3 percent of U.S. national output originates in climate-sensitive sectors and another 10 percent in sectors modestly sensitive to climatic change." There may even be, he noted, beneficial side effects of global warming: "The forest products industry may also benefit from CO_2 fertilization." (It is, I think, no mistake that he did not say "forest" but rather "forest products industry.") Construction, he thinks, will be "favorably affected" as will "investments in water skiing." In sum, Nordhaus's "best guess" is that the impact of a doubling of carbon dioxide "is likely to be around one-fourth of one percent of national income." He admits the estimate has a "large margin of error" (Nordhaus 1990a, 195).

Nordhaus, however, wishes not to be thought to favor climate change. Rather, the point he tried to make is that "those who paint a bleak picture of desert Earth devoid of fruitful economic activity may be exaggerating

the injuries and neglecting the benefits of climate change" (Nordhaus 1990b, 196). Whether a hotter Earth, but one not "devoid of fruitful economic activity," might, however, be devoid of poetry, laughter, sidewalk cafés, forests, or even economists he does not say. But he did note that there are a number of technological responses to our plight, including "climate engineering . . . shooting particulate matter [books on economics?] into the stratosphere to cool the earth or changing cultivation patterns in agriculture." Nordhaus, an economist, gave no estimate of the costs, benefits, or even feasibility of these "options." He did, however, estimate the cost of reducing carbon dioxide emissions by 50 percent as $180 billion per year. Faced with such costs, Nordhaus expressed the view that "societies may choose to adapt," which in his words means "population migration, capital relocation, land reclamation, and technological change" (Nordhaus 1990b, 201), solutions for which he again has given no cost estimate. What about those who cannot adapt, migrate, buy expensive remedies, or relocate their capital? Nordhaus does not say, and one suspects that he does not say because he has not thought much about it.

The complications Nordhaus has noticed have to do with "how to discount future costs and how to allow for uncertainty." A discount rate of, say, 8 percent or higher would lead us to do nothing about warming for a few decades while the problem grows gradually or perhaps rapidly worse. A rate of 4 percent or less "would give considerable weight today to climate changes in the late twenty-first century." What is Nordhaus's solution? "The efficient policy," he argued, "would be to invest heavily in high-return capital now and then use the fruits of those investments to slow climate change in the future" (Nordhaus 1990b, 205). He described this as a "sensible compromise" between what he asserts is a "*need* for economic growth" and "the *desire* for environmental protection" [emphasis added], that is, one more binge, virtue later.

To his credit, Nordhaus has acknowledged that "most climatologists think that the chance of unpleasant surprises rises as the magnitude and pace of climatic change increases" (Nordhaus 1990b, 206). He has also noted that the discovery of the ozone hole came as a "complete surprise," suggesting the possibility of more surprises ahead. But in the end he has come down firmly in favor of what he calls "modest steps" that "avoid any precipitous and ill-designed actions that [we] may later regret," actions that he does not specify, making it impossible to know whether they would be in fact precipitous, ill-designed, or regrettable. Nordhaus has stated the belief that "reducing the risks of climatic change is a worthwhile

objective" but one, in his opinion, not more important than "factories and equipment, training and education, health and hospitals, transportation and communications, research and development, housing and environmental protection" (Nordhaus 1990b, 209) and so forth. He seems not to have noticed the close relationship between heat, drought, and climate instability, on one hand, and the economy, public health, human behavior under stress, and even what he has called "environmental protection," on the other.

One might dismiss Nordhaus's analysis as an aberration were it not characteristic of the recklessness masquerading as caution that prevails in the highest levels of government and business here and elsewhere and were he not as influential at these levels as he certainly is. Nordhaus's views on global warming are neither an aberration within his profession nor without consequence where portentous choices are made. Nordhaus's opinions about global warming, for example, weighed heavily in the 1991 report issued by the National Academy of Sciences' Adaptation Panel (National Academy of Sciences 1991). The panel, which included Nordhaus, approached global warming as an investment problem requiring the proper discount rate. However, for those whose interests were discounted, such as the poor and future generations, the problem appears differently, as one of power and intergenerational responsibilities. The panel, moreover, assumed a great deal about the adaptability of complex, mass, technological societies under what may be extreme conditions. In citing "the proven adaptability of farmers," for example, are they referring to the 4 million failed farms in the past 50 years? Or to those 1.5 million farms presently at or close to the margin? Or are they referring to the overdependence of agriculture and food distribution systems on the very fossil energy sources that are now heating the Earth? Or perhaps to present rates of soil loss and groundwater depletion due to current farm practices? Can farmers adapt if warming is sudden? Since people live "in both Riyadh and Barrow," the panel drew the implication that humans are almost infinitely adaptable, while admitting that some cities will have to be abandoned and people in poorer countries may be substantially harmed. The panel smartly hedged its bets by admitting that the warming could be sudden and catastrophic but quickly dismissed these possibilities. They did not ask what could happen beyond their 50-year horizon, nor did they ask about the effects on American society of making such portentous decisions in the same way that investment decisions are made

about building bridges or shopping malls. It is therefore a matter of concern that such analysis gives considerable aid and comfort to those with all too much to gain by ignoring the risks involved in climate change or the benefits of a farsighted energy policy. Accordingly, we should attempt to understand how such thought comes to pass, whose ends it serves, and what consequences it risks.

By comparison, it is instructive to note that atmospheric physicists, climate experts, and biologists agree almost without exception that the theory of global warming is beyond dispute. It is widely agreed that heat-trapping gases in the atmosphere do in fact trap heat. If we put enough of these in the atmosphere, we will trap a great deal of heat. There is further agreement that if the warming turns out to be rapid, the consequences will in all probability be widely catastrophic, even though we cannot predict these with absolute certainty. Disagreement focuses on matters having to do with rates, thresholds, and the effects of feedbacks that might enhance or retard rates of warming. However these are decided, there is no doubt at all that by increasing heat-trapping gases to levels higher than any in the past 600,000 years and at rates far more rapid than characteristic of past climate shifts, we are conducting an unprecedented experiment with the Earth and its biota. This experiment need not, and should not, be carried out. But like Pascal's wager, certainty about the consequences will come only after all bets are called in.

Given what is at stake, errors of fact and logic committed by Nordhaus and the Adaptation Panel deserve close attention. For example, the belief that decline in agriculture and forestry would be of little consequence because they are only 3 percent of the U.S. economy is equivalent to believing that since the heart is only a few percent of bodyweight, it can be removed or damaged without consequences for one's health. Both Nordhaus and the Adaptation Panel regard the economy as linear and additive without straws that break the back of the camel, surprises, thresholds of catastrophe, or even places where angels would fear to go. The biological facts underlying the research are also suspect. There are many reasons to believe that "CO_2 fertilization" will not enhance farm and forest productivity as Nordhaus and the Adaptation Panel believe. Changes in rainfall, temperature, and biological conditions would more likely reduce growth. Higher temperatures mean higher rates of respiration, hence the release of still more carbon and methane. The rate of climate change may well be many times faster than that to which plants and animals can adapt. This

will mean at some unknown date a dieback of forests and the release of even more carbon through fire and rapid decay. It will also mean a sharp reduction in biological diversity.

Economic estimates used by Nordhaus and the Adaptation Panel are also questionable. Both ignore a large and growing body of evidence that the actions necessary to minimize global warming would be good for the economy, human health, and the land. Studies by the U.S. Environmental Protection Agency, the Electric Power Research Institute, and independent researchers [Author's note 2010: and more recently McKinsey & Company] all point to the same conclusion: energy efficiency, which reduces the emission of carbon dioxide, is not only inexpensive, it is in fact a prerequisite of economic vitality. The U.S. economy is roughly one half as energy efficient as that of the Japanese. This fact translates into a 5 percent cost disadvantage for comparable U.S. goods and services (Lovins 1990). Instead of an annual cost that Nordhaus estimates at $180 billion, more reliable studies have shown a net savings of approximately $200 billion from improvements in energy efficiency. This, in Lovins's words, is not a free lunch but a lunch we are paid to eat. However, estimates by Nordhaus or the Adaptation Panel do not include the costs of relocating millions of people, the costs of failing to do so, the costs entailed in diking coasts, the costs of international conflicts over water, the costs of importing food when the plains states become drier, or the costs of changes in diseases due to climate change. Nor does Nordhaus or the Adaptation Panel say what the cost might be if global warming turns out to be rapid and full of even worse surprises.

The practice of discounting the future creates other costs that cannot be quantified but that will be assessed. If they had included the preferences of, say, the third generation hence in the equation, their conclusions would have been quite different. Nordhaus and the Adaptation Panel chose not to do so, however, by assuming that investments in more of the same kinds of activities that created the problem in the first place were "worthy goals." On closer examination, most of these will intensify the problem of global warming and dig us in still deeper while ignoring opportunities to invest in energy efficiency and renewables that would reduce the emission of heat-trapping gases in an economically sound manner.

The economic estimates of Nordhaus and the Adaptation Panel are not to be trusted, because their economy is an abstraction independent of biophysical realities, comparable, say, to an airline pilot who regarded the law of gravity as merely an interesting but untested theory. Their

economics are not to be trusted because they fail to acknowledge the vast and unknowable complexity of planetary systems, which cannot be "fixed" by any technology without courting other risks. Their economics cannot be trusted because they are not very good economics. They have ignored the relationship between economic prosperity and energy efficiency, as well as that between energy efficiency and the emission of greenhouse gases. Their economics are not to be trusted because the problem of global warming is not first and foremost one of economics, as they believe, but rather one of judgment, wisdom, and love for the Creation. Their economics cannot be trusted because they do not include flesh-and-blood people who, under conditions of a rapidly changing climate, will not act with the rationality presumed in abstract models concocted in air-conditioned rooms. Real people stressed by heat, drought, economic decline, and perhaps worse will curse and kill more often and celebrate and love less often. And they will mourn the loss of places disfigured by heat, drought, and death that were once familiar, restoring, and consoling.

Finally, the economics of Nordhaus and the Adaptation Panel cannot be trusted because they would have us risk this and more for another decade or two of business as usual, which as we now know does not mean sustainable prosperity or basic fairness. This is a foolish risk for reasons Pascal described well. If it turns out that global warming would have been severe and we forestalled it by becoming more energy efficient and making a successful transition to renewable energy, we will have avoided disaster. If, however, it turns out that factors as yet unknown minimized the severity and impact of warming while we became more energy efficient in the belief that it might be otherwise, we will not have saved the planet, but we will have reduced acid rain, improved air quality, decreased oil spills, reduced the amount of strip-mining, reduced our dependence on imported oil and thereby improved our balance of payments, become more technologically adept, and improved our economic competitiveness. In either case we will have set an instructive and farsighted precedent for our descendants and for the future of the Earth. If we gain, we gain all; if we "lose," we still gain a great deal. On the other hand, if we do as Nordhaus and the members of the Adaptation Panel would have us do, and the warming proves to be rapid, there will be hell to pay.

Chapter 30

The Carbon Connection

(2007)

Having seen pictures of the devastation did not prepare me for the reality of New Orleans. Mile after mile of wrecked houses, demolished cars, piles of debris, twisted and downed trees, and dried mud everywhere. We stopped every so often to look into abandoned houses in the ninth ward and along the shore of Lake Pontchartrain to see things close up: mud lines on the walls, overturned furniture, moldy clothes still hanging in closets, broken toys, a lens from a pair of glasses . . . once cherished and useful objects rendered into junk. Each house with a red circle painted on the front to indicate results of the search for bodies. Some houses showed the signs of desperation: holes punched through ceilings as people tried to escape rising water. The smell of musty decay was everywhere, overlaid with an oily stench. Despair hung like Spanish moss in the dank, hot July air.

Ninety miles to the south, the Louisiana delta is rapidly sinking below the rising waters of the Gulf. This is no "natural" process, but rather the result of decades of mismanagement of the lower Mississippi that became federal policy after the great flood of 1927. Sediment that built the richest and most fecund wetlands in the world is now deposited off the continental shelf—part of an ill-conceived effort to tame the river. The result is that the remaining wetlands, starved for sediment, are both eroding and compacting, sinking below the water and perilously close to no return. Oil extraction has done most of the rest by cutting channels that crisscross the marshlands, allowing the intrusion of salt water and storm surges. Wakes from boats have widened the original channels considerably fur-

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ther, unraveling the ecology of the region. The richest fishery in North America and a unique culture that once thrived in the delta are disappearing and with it the buffer zone that protects New Orleans from hurricanes. "Every 2.7 miles of marsh grass," in Mike Tidwell's words, "absorbs one foot of a hurricane's storm surge" (Tidwell 2003, 57).

And the big hurricanes will come. Kerry Immanuel, an MIT scientist and once greenhouse skeptic, researched the connection between rising levels of greenhouse gases in the atmosphere, warmer sea temperatures, and the severity of storms. He's a skeptic no longer for reasons he described in *Nature* (Immanuel 2005). The hard evidence on this and other parts of climate science has moved beyond the point of legitimate dispute. Carbon dioxide, the prime greenhouse gas, is at the highest level in at least the last 650,000 years. CO_2 continues to accumulate by more than 2.5 parts per million per year, edging closer and closer to what some scientists believe is the threshold of runaway climate change. British scientist James Lovelock compares our situation to being on a boat upstream from Niagara Falls with the engines about to fail (Midgley 2006, vii).

If this were not enough, the evidence now shows a strong likelihood that sea levels will rise more rapidly than previously thought. The third report of the Intergovernmental Panel on Climate Change (2001) predicted about a 1-meter rise in the twenty-first century, but more recent evidence puts this figure at 6 to 7 meters—the result of accelerated melting of the Greenland ice sheet and polar ice, along with the thermal expansion of water.

Nine hundred miles to the northeast as a sober crow would fly it, Massey Energy, Arch Coal, and other companies are busy leveling the mountains of Appalachia to get at the upper seams of coal in what was one of the most diverse and relatively undisturbed forests in the U.S. and one of the most diverse ecosystems anywhere. Throughout the coalfields of West Virginia and Kentucky they have already leveled 456 mountains across 1.5 million acres and intend to damage a good bit more. Coal is washed on-site, leaving billions of gallons of a dilute asphalt-like gruel laced with toxic flocculants and heavy metals. An estimated 225 such containment ponds are located over abandoned mines in West Virginia, held back from the communities below only by earthen dams prone to failure either by collapse or by draining down through old mine tunnels that honeycomb the region. One did fail in October 11, 2000, in Martin County, Kentucky, when the slurry broke through a thin layer of shale and into mines and out into hundreds of miles of streams and rivers. The

result was the permanent destruction of waterways and property values of people living in the wake of an ongoing and mostly ignored disaster. This is typical of the coalfields. They are a third world colony within the United States; a national sacrifice zone in which fairness, decency, and the rights of old and young alike are discarded as so much overburden on behalf of the national obsession with "cheap" electricity. For his role in trying to enforce even the flimsy laws that might have held Massey Energy slightly accountable for its flagrant and frequent malfeasances, the Bush administration tried unsuccessfully to fire Jack Spadaro from his position as a mine safety inspector in the Interior Department but eventually forced him to retire.

Jack is in the first plane to take off from Yeager Field in Charleston, along with the chief attorney for the largest corporation in the world. Hume Davenport, founder of SouthWings, Inc., is the pilot of the four-seat Cessna. The ground recedes below us as we pass over Charleston and the Kanawha River lined with barges hauling coal to power plants along the Ohio River and points more distant. Quickly on the horizon to the west is the John Amos plant owned by American Electric Power that, by one estimate, releases more mercury to the environment than any other facility in the U.S. as well as hundreds of tons of sulfur oxides, hydrogen sulfide, and CO_2. For a few minutes we can see the deep green of wrinkled Appalachian hills below, but very soon the first of the mountaintop removal sites appears. It is followed by another and then another. The pattern of ruin spreads out below us for many miles stretching to the far horizon on all points of the compass. From a mile above, trucks with 12-foot-diameter tires and draglines that could pick up two Greyhound buses at a single bite look like Tonka toys in a sandbox. What is left of Kayford Mountain comes into sight. It is surrounded by leveled mountains, and a few still being leveled. "Overburden," the mining industry term for dismantled mountains, is dumped into valleys covering hundreds of miles of streams—an estimated 1500 miles in the past 25 years. Many more miles will be buried if the coal companies have their way. Coal slurry ponds loom above houses, towns, and even elementary schools. When the earthen dams break on some dark rainy night, those below will have little if any warning before the deluge hits.

Jack Spadaro is our guide to the devastation. He is a heavyset, rumpled, and bearded man with the knack for describing outrageous things calmly and with clinical precision. A mining engineer by profession, he spent several frustrating decades trying to enforce the laws, such as they are,

against an industry with friends in high places in Charleston, Congress, and the White House. In a flat, unemotional monotone he describes what we are seeing below. Aside from the destruction of the Appalachian forest, the math is all wrong. The slopes are too steep, the impoundments too large. The angles of slope, dam, weight, and proximity of houses and towns are the geometry of tragedies to come. He points out the Marsh Fork elementary school situated close to a coal-loading operation and below a huge impoundment back up the hollow. In the event of a dam failure, the evacuation plan calls for the principal to use a bullhorn to initiate the evacuation of the children ahead of the 50-foot wall of slurry that will be moving at maybe 60 miles an hour. If all works according to the official evacuation plan, they will have 2 minutes to get to safety, but there is no safe place for them to go. And so it is in the coalfields—ruin at a scale for which there are no adequate words; ecological devastation to the far horizon of topography and time. We say that we are fighting for democracy elsewhere, but no one in Washington or Charleston seems aware that we long ago deprived some of our own of the rights to life, liberty, and property.

On the circle back to Yeager Field in Charleston, Tom Hyde, a corporate attorney, calls this a "tragedy." We all nod, knowing the word does not quite describe the enormity of the things we've just seen or the cold-blooded nature of it. In our 1-hour flight we saw maybe 1 percent of the destruction now metastasizing through four states. Until recently it was all but ignored by the national media. But we have known of the costs of mining at least since Harry Caudill published *Night Comes to the Cumberlands* in 1963, but we have yet to summon the moral energy to resolve the problem or pay the full costs of the allegedly cheap electricity that we use.

Under the hot afternoon sun we board a 15-person van to drive out to the edge of the coalfields to see what it looks like on the ground. On the way to Kayford Mountain, we take the interstate south from Charleston and exit at a place called Sharon onto winding roads that lead to mining country. Trailer parks, small evangelical churches, truck repair shops, and small often lovingly tended houses line the road intermixed with those abandoned long ago when underground mining jobs disappeared. The two-lane paved road turns to gravel and climbs toward the top of the hollow and Kayford Mountain. Within a mile or two the first valley fill appears. It is a green V-shaped insertion between wooded hills. Reading the signs made by water coursing down its face, Jack Spadaro notes that

this one will soon fail. Valley fills are mountains turned upside down: rocky mining debris, trees illegally buried, along with what many locals believe to be more sinister things brought in by unmarked trucks in the dead of night. He adds that some valley fills may contain as much as 500 million tons of blasted mountains and run for as long as 6 miles. We ascend the slope toward Kayford, passing by the no-trespassing signs that appear around the gate that leads to the mining operations.

Larry Gibson, a diminutive bulldog of a man fighting for his land, meets us at the summit, really a small peak on what was once a long ridge. The family has been on Kayford since the eighteenth century, operating a small coal mine. Larry is the proverbial David fighting Goliath, but he has no slingshot unless it is that of moral authority spoken with a fierce, inborn eloquence. Those traits and the raw courage he shows every day have made Larry a poster child for the movement, with his picture in *Vanity Fair*, *National Geographic*, and other newsstand magazines. Larry's land has been saved so far because he made 40 acres of it into a park and has fought tooth and nail to save it from the lords of Massey Energy. They have leveled nearly everything around him and have punched holes underneath Kayford because the mineral rights below and the ownership of the surface were long ago separated in a shameless scam perpetrated on illiterate and trusting mountain people.

Larry describes what has happened, using a model of the area that comes apart more or less like the mountains around him have been dismantled. As he talks, he illustrates what has happened by taking the model apart piece by piece, leaving the top of Kayford rather like a knob sticking up amidst the encircling devastation. So warned, we walk down the country lane to witness the advancing ruin. Fifteen of us stand for maybe half an hour on the edge of the abyss, watching giant bulldozers and trucks at work below us. Plumes of dust from the operations rise up several thousand feet. The next set of explosive charges is ready to go on an area about the size of a football field. Every day some 3 million pounds of explosives are used in the 11 counties south of Charleston. This is a war zone. The mountains are the enemy, profits from coal the prize, and the local residents and all those who might have otherwise lived here or would have been re-created here are the collateral damage.

We try to wrap our minds around what we are seeing, but words do no justice to the enormity of it. The oldest mountains on Earth are being turned into gravel for a pittance, their ecologies radically simplified, forever. Perhaps as a defense mechanism from feeling too much or being

overwhelmed by what we've seen, we talk about lesser things. In the late afternoon drive back to Charleston, we pass by the coal-loading facilities along the Kanawha River. Mile after mile of barges lined up to haul coal to hungry Ohio River power plants, the umbilical cord between mines, mountains, and us—the consumers of cheap electricity.

Over dinner that night we hear from two residents of Mingo County who describe what it is like to live in the coalfields. Without forests to absorb rainwater, flash floods are a normal occurrence. A 3-inch rain can become a 10-foot wall of water cascading off the flattened mountains and down the hollows. The mining industry calls these "acts of God," and the thoroughly bought public officials agree, leaving the victims with no recourse. Groundwater is contaminated by coal slurry and the chemicals used to make coal suitable for utilities. Well water is so acidic that it dissolves pipes and plumbing fixtures. Cancer rates are off the charts, but few in Charleston or Washington care enough to notice. Coal companies are major buyers of politicians, and the head of Massey Energy, Donald Blankenship, has been known to spend lots of money to buy precisely the kind of representatives he likes—the sort that can accommodate themselves to exploitation of land and people and the profits to be made from it. His campaign to ravage the rest of West Virginia is titled "For the Sake of the Kids."

Pauline and Carol from the town of Sylvester, both in their seventies, are known as the "dust busters" because they go around the town wiping down flat surfaces with white cloths that are then covered with coal dust from a nearby loading facility. These are presented as evidence of foul air at open hearings to the irritated and unmovable servants of the people. Black lung and silicosis disease is now common among young and old alike exposed to the dust from surface operations but who have never set foot in a mine. They have little or no voice in government; they are considered to be expendable. Pauline, a fiercely eloquent woman, whose husband was wounded and captured by the Germans in the Battle of the Bulge in 1944, rhetorically asks, "Is this what he fought for?" The clock reads 9:30 PM; we quit for the day.

To permanently destroy millions of acres of Appalachia in order to extract maybe 20 years of coal is not just stupid; it is a derangement at a scale for which we as yet do not have adequate words, let alone the good sense and the laws to stop it. Unlike deep mining, mountaintop removal employs few workers. It is destroying the wonders of the mixed mesophytic forest of northern Appalachia once and for all, including habitat for

dozens of endangered species. It contaminates groundwater with toxics and heavy metals and renders the land permanently uninhabitable and unusable. Glib talk of the economic potential of flatter places for commerce of one kind or another is just that: glib talk. Coal companies' efforts to plant grass and a few trees here and there are like putting lipstick on a corpse. The fact of the matter is that one of the most diverse and beautiful ecosystems in the world is being destroyed and rendered uninhabitable forever, along with the lives and culture of the people who have stayed behind in places like Sylvester and Kayford. We justify this on the grounds of necessity and cost. But virtually every competent independent study of energy use done in the past 30 years has concluded that we could cost-effectively eliminate half or more of our energy use and strengthen our economy, lower costs of asthma and lung disease, raise our standard of living, and improve environmental quality. More complete accounting of the costs of coal would also include the rising tide of damage and insurance claims attributable to climate change. Some say that if we don't burn coal, the economy will collapse and we will all have to go back to the caves. But with wind and solar power growing by 25 percent plus per year and the technology of energy efficiency advancing rapidly, we have good options that make burning coal unnecessary. And before long we will wish that we had not destroyed so much of the capacity of the Appalachian forests and soils to absorb the carbon that makes for bigger storms and more severe heat waves and droughts.

No one in a position of authority in West Virginia politics, excepting that noble patriarch of good sense, Ken Hechler, asks the obvious questions. How far does the plume of heavy metals coming from coal-washing operations go down the Kanawha, Ohio, and Mississippi and into the drinking water of communities elsewhere? What other economy, based on the sustainable use of forests, nontimber products, ecotourism, and human craft skills, might flourish in these hills? What is the true cost of "cheap" coal? Why do the profits from coal mining leave the state? Why is so much of the land owned by absentee corporations like the Pocahontas Land Company? Once you subtract the permanent ecological ruin and crimes against humanity, there really isn't much to add, as a country song once put it. Those touting "clean coal" ought to spend some time in the coalfields and talk to the residents in order to understand what those words really mean at the point of extraction. And for those who assume that the carbon from burning coal can be safely and permanently seques-

tered underground at an affordable cost, I have oceanfront property to sell you in Arizona.

Nearly 1000 miles separate the coalfields of West Virginia from the city of New Orleans and Gulf coast, yet they are a lot closer than that. The connection is carbon. Coal is mostly carbon, and for every ton burned, 3.6 tons of CO_2 eventually enters the atmosphere, raising global temperatures, warming oceans and thereby creating bigger storms, melting ice, and raising sea levels. For every ton of coal extracted from the mountains, perhaps 100 tons of what is tellingly called "overburden" is dumped, burying streams and filling the valleys and hollows of West Virginia, Kentucky, and Tennessee. And between the hills of Appalachia and the sinking land of the Louisiana coast, tens of thousands of people living downwind from coal-fired power plants die prematurely each year from inhalation of small particles of smoke laced with heavy metals that penetrate deeply into lungs.

Like all life-forms, we search out great pools of carbon to perpetuate ourselves. It is our mismanagement of carbon that threatens the human future, and this is an old story. Humans have long fought for the control of carbon found in rich soils and deep forests and later in fossil fuels. The root of all evil does not begin with money, but with the carbon in its various forms that money can buy. The exploitation of carbon is the original sin, leading quite possibly to the heat death of a great portion of life on Earth, including us. This is what James Lovelock calls "the revenge of Gaia" (Lovelock 2006).

Chapter 31

2020: A Proposal

(2000)

AUTHOR'S NOTE 2010: *This essay first appeared as my column in* Conservation Biology *and subsequently in* The Chronicle of Higher Education.

We all live by robbing Asiatic coolies, and those of us who are "enlightened" all maintain that those coolies ought to be set free; but our standard of living, and hence our "enlightenment" demands that the robbery shall continue.
GEORGE ORWELL

By a large margin 1998 was the warmest year ever recorded. The previous year was the second warmest. A growing volume of scientific evidence indicates that, given present trends, the combustion of fossil fuels, deforestation, and poor land-use practices will cause a major, and perhaps self-reinforcing, shift in global climate (Houghton 1997). With climatic change will come severe weather extremes, super storms, droughts, killer heat waves, rising sea levels, spreading disease, accelerating rates of species loss, and collateral political, economic, and social effects that we cannot imagine. We are conducting, as Roger Revelle once noted, a one-time experiment on the Earth that cannot be reversed and should not be run.

The debate about climatic change has, to date, been mostly about scientific facts and economics, which is to say a quarrel about unknowns and numbers. On one side are those (greatly appreciated by the fossil fuel industry) who argue that we do not yet know enough to act and

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that acting prematurely would be prohibitively expensive. On the other side are those who argue that we do know enough to act and that further procrastination will make subsequent action both more difficult and less efficacious. In an election year in the United States, which happens to be the largest emitter of greenhouse gases, the issue is not likely to be discussed in any constructive manner. And the U.S. Congress, caught in a miasma of ideology and partisanship, is in deep denial, unable to ratify the Kyoto Accord that called for a 7 percent reduction of 1990 CO_2 levels by 2012. Even that level of reduction, however, would not be enough to stabilize climate.

To see our situation more clearly, we need a perspective that transcends the minutiae of science, economics, and current politics. Since the effects, whatever they may be, will fall most heavily on future generations, understanding their likely perspective on our present decisions would be useful to us now. And how are future generations likely to regard various positions in the debate about climatic change? Will they applaud the precision of our economic calculations that discounted their prospects to the vanishing point? Will they think us prudent for delaying action until the last-minute scientific doubts were quenched? Will they admire our heroic devotion to inefficient cars and sport utility vehicles, urban sprawl, and consumption? Hardly. They are more likely, I think, to judge us much as we now judge the parties in the debate on slavery prior to the Civil War.

Stripped to its essentials, defenders of the idea that humans can hold other humans in bondage developed four lines of argument. First, citing Greek and Roman civilization, some justified slavery by arguing that the advance of human culture and freedom had always depended on slavery. "It was an inevitable law of society," according to John C. Calhoun, "that one portion of the community depended upon the labor of another portion over which it must unavoidably exercise control" (Miller, W. L., 1998, 132). And "freedom," the editor of the *Richmond Inquirer* once declared, "is not possible without slavery" (Oakes 1998, 141). This line of thought, discordant when appraised against other self-evident doctrines that "all men are created equal," is a tribute to the capacity of the human mind to simultaneously accommodate antithetical principles. Nonetheless, it was used by some of the most ardent defenders of "freedom" right up to the Civil War.

A second line of argument was that slaves were really better off living here in servitude than they would have been in Africa. Slaves, according to Calhoun, "had never existed in so comfortable, so respectable, or so

civilized a condition as that which [they] enjoyed in the Southern States" (Miller, W. L., 1998, 132). The "happy slave" argument fared badly with the brute facts of slavery that became vivid for the American public only when dramatized by Harriet Beecher Stowe in *Uncle Tom's Cabin* published in 1852.

A third argument for slavery was cast in cost-benefit terms. The South, it was said, could not afford to free its slaves without causing widespread economic and financial ruin. This argument put none too fine a point on the issue; slavery was simply a matter of economic survival for the ruling race.

A fourth argument, developed most forcefully by Calhoun, held that slavery, whatever its liabilities, was up to the various states, and the federal government had no right to interfere with it because the Constitution was a compact between independent political units. Beneath all such arguments, of course, lay bedrock contempt for human equality, dignity, and freedom. Most of us, in a more enlightened age, find such views repugnant.

While the parallels are not exact between arguments for slavery and those used to justify inaction in the face of prospective climatic change, they are, perhaps, sufficiently close to be instructive. First, those saying that we do not know enough yet to limit our emission of greenhouse gases argue that human civilization, by which they mean mostly economic growth for the already wealthy, depends on the consumption of fossil fuels. We, in other words, must take substantial risks with our children's future for a purportedly higher cause: the material progress of civilization now dependent on the combustion of fossil fuels. Doing so, it is argued, will add to the stock of human wealth that will enable subsequent generations to better cope with the messes that we will leave behind.

Second, proponents of procrastination now frequently admit the possibility of climatic change but argue that it will lead to a better world. Carbon enrichment of the atmosphere will speed plant growth, enabling agriculture to flourish, increasing yields, lowering food prices, and so forth. Further, while some parts of the world may suffer, a warmer world will, on balance, be a nicer and more productive place for succeeding generations.

Third, some, arguing from a cost-benefit perspective, assert that energy conservation and solar energy are simply too expensive now. We must wait for technological breakthroughs to reduce the cost of energy efficiency and a solar-powered world. Meanwhile we continue to expand our dependence

on fossil fuels, thereby making any subsequent transition still more expensive and difficult.

Finally, arguments for procrastination are grounded in a modern-day version of states' rights and extreme libertarianism, which makes squandering fossil fuels a matter of individual rights, devil take the hindmost.

The fit between slavery and our present use of fossil fuels is by no means perfect, but it is close enough to be suggestive. Of course we do not intend to enslave subsequent generations, but we will leave them in bondage to degraded climatic and ecological conditions that we will have created. Further, they will know that we failed to act on their behalf with alacrity even after it became clear that our failure to use energy efficiently and develop alternative sources of energy would severely damage their prospects. In fact, I am inclined to think that our dereliction will be judged as a more egregious moral lapse than that which we now attribute to slave owners. For reasons that one day will be regarded as no more substantial than those supporting slavery, we knowingly bequeathed the risks and results of climatic change to all subsequent generations, everywhere. If not checked soon, that legacy will include severe droughts, heat waves, famine, changing disease patterns, rising sea levels, and political and economic instability. It will also mean degraded political, economic, and social institutions burdened by bitter conflicts over declining supplies of fossil fuels, water, and food. It is not far-fetched to think that human institutions, including democratic governments, will break under such conditions.

Other similarities exist. Both the use of humans as slaves and the use of fossil fuels allow those in control to command more work than would otherwise be possible. Both inflate wealth of some by robbing others. Both systems work only so long as something is underpriced: the devalued lives and labor of a bondsman or fossil fuels priced below their replacement costs. Both require that some costs be ignored: those to human beings stripped of choice, dignity, and freedom or the cost of environmental "externalities," which cast a long shadow on the prospects of our descendants. In the case of slavery, the effects were egregious, brutal, and immediate. But massive use of fossil fuels simply defers the costs, different but no less burdensome, onto our descendants, who will suffer the consequences with no prospect of manumission. Slavery warped the politics and cultural evolution of the South. But our dependence on fossil fuels has also warped and corrupted our politics and culture in ways too numerous to count. Slaves could be manumitted, but the growing

numbers of victims of global warming have no reprieve. We leave behind steadily worsening conditions that cannot be altered in any time span meaningful to humans.

Both slavery and fossil fuel–powered industrial societies require a mass denial of responsibility. Slave owners were caught in a moral quandary. Their predicament, in James Oakes's words, was "the product of a deeply rooted psychological ambivalence that impels the individual to behave in ways that violate fundamental norms even as they fulfill basic desires" (Oakes 1998, 120). Regarding slavery, George Washington confessed, "I shall frankly declare to you that I do not like even to think, much less talk, of it." As one Louisiana slave owner put it, "a gloomy cloud is hanging over our whole land." Many wished for some way out of a profoundly troubling reality. Instead of finding a decent way out, however, the South created a culture of denial around the institutions of bondage. They were enslaved by their own system until it came crashing down around them in the Civil War.

We, too, find ourselves in a quandary. A poll conducted for the American Geophysical Union revealed that most Americans believe that global warming is real and that its consequences will be tragic and irreversible. But the response of Congress and much of the business community has been to deny that the problem exists and continue with business as usual. Proposals for higher gasoline taxes, increasing fuel efficiency, or limits on use of automobiles, for example, are regarded as politically impossible as the abolition of slavery in the 1830s. Unless we take appropriate steps soon, our system, too, will end badly.

We now know that heated arguments made for the enslavement of human beings were both morally wrong and self-defeating. The more alert knew this early on. Benjamin Franklin noted that slaves "pejorate the families that use them; the white children become proud, disgusted with labor, and being educated in idleness, are rendered unfit to get a living by industry" (Finley 1980, 100). Thomas Jefferson knew all too well that slavery degraded slaves and slave owners alike, while providing no sustainable basis for prosperity in an emerging capitalist economy. In a rough parallel, it is possible that the extravagant use of fossil fuels has become a substitute for intelligence, exertion, design skill, and foresight. On the other hand, we have every reason to believe that vastly improved energy efficiency and an expeditious transition to a solar-powered society would be to our advantage, morally and economically. Energy efficiency

could lower our energy bill in the U.S. alone by as much as $200 billion per year (Hawken et al. 1999). It would reduce environmental impacts associated with mining, processing, transportation, and combustion of fossil fuels and promote better technology. Elimination of subsidies for fossil fuels, nuclear power, and automobiles would save tens of billions each year (Myers 1998). In other words, the "no regrets" steps necessary to avert the possibility of severe climatic change, taken for sound ethical reasons, are the same steps we ought to take for reasons of economic self-interest. History rarely offers such a clear convergence of ethics and self-interest.

If we are to take this opportunity, however, we must be clear that the issue of climatic change is not, first and foremost, a matter of economics, technology, or science but, rather, a matter of principle that is best seen from the vantage point of our descendants. The same historical period that gave us slavery also gave us the principles necessary to abolish it. What Thomas Jefferson called "remote tyranny" was not merely tyranny remote in space but in time as well—what Bill McDonough has termed "intergenerational remote tyranny." In a letter to James Madison written in 1789, Jefferson argued that no generation had the right to impose debt on its descendants, for were it to do so, the future would be ruled by the dead, not the living.

A similar principle applies in this instance. Drawing from Jefferson, Aldo Leopold, and others, such a principle might be stated thusly:

> No person, institution, or nation has the right to participate in activities that contribute to large-scale, irreversible changes of the Earth's biogeochemical cycles or undermine the integrity, stability, and beauty of the Earth's ecologies—the consequences of which would fall on succeeding generations as an irrevocable form of remote tyranny.

That principle will likely fall on uncomprehending ears in Congress and in most corporate boardrooms. Who, then, will act on it? Who ought to act? Who can lead? What institutions represent the interests of our children and succeeding generations on whom the cost of present inaction will fall? At the top of my list are those that purport to educate and thereby to equip the young for useful and decent lives. Education is done in many ways, the most powerful of which is by example. The example the present generation needs most from those who propose to prepare them for responsible adulthood is a clear signal that their teachers and

mentors are themselves responsible and will not, for any reason, encumber their future with risk or debt—ecological or economic. And they need to know that our commitment is more than just talk. This principle can be stated in these words:

> The institutions that purport to induct the young into responsible adulthood ought themselves to operate responsibly, which is to say that they should not act in ways that might plausibly undermine the world their students will inherit.

Accordingly, I propose that every school, college, and university stand up and be counted on the issue of climatic change by beginning now to develop plans to reduce and eventually eliminate or offset the emission of heat-trapping gases by the year 2020. Opposition to such a proposal will, predictably, follow along three lines. The first line of objection will arise from those who argue that we do not yet know enough to act. In other words, until the threat of climatic change is clear beyond any possible doubt (and also less easily reversed), we cannot act. Presumably, these same people do not wait until they smell smoke in the house at 2 AM to purchase fire insurance. A "no regrets" strategy relative to the far-from-remote possibility of climatic change is, by the same logic, a way to insure our descendants against the possibility of disaster otherwise caused by our carelessness.

A second line of objection will come from those who will argue that even so, educational institutions on their own cannot afford to act. To be certain, there will be initial expenses, but there are also quick savings from reducing energy use. In fact, done smartly, implementation of energy efficiency and solar technology can save money. Moreover, it is now possible to use energy service companies that will finance the work and pay themselves from the stream of savings, making the transition budget neutral. The real problem here has less to do with costs than with moral energy and the failure to imagine possibilities in places where imagination and creativity are reportedly much valued.

A third kind of objection will come from those who agree with the overall goal of stabilizing climate but will argue that our business is education, not social change. This position is premised on the quaint belief that what occurs in educational institutions must be uncontaminated by contact with the affairs of the world and that we have no business objecting to how that world does its business. It is further assumed that education occurs only in classrooms and must be remote from anything having

practical consequences. Were the effort to eliminate the use of fossil fuels, however, done as a 20-year effort in which students worked with faculty, staff, administration, energy engineers, and technical experts, the educational and institutional benefits would be substantial.

How might the abolition of fossil fuels occur? In outline, the basic steps are straightforward, requiring

- thorough audit of current institutional energy use;
- preparation of detailed engineering plans to upgrade energy efficiency and eliminate waste;
- development of plans to harness renewable energy sources sufficient to meet campus energy needs by 2020;
- competent implementation.

These steps ought to engage students, faculty, administration, staff, and representatives of the surrounding community. They ought to be taken publicly as a way to educate a broad constituency about the consequences of our present course and the possibilities and opportunities for change.

The longer-term goal of this effort is to begin, from the grassroots, the long-delayed transition to energy efficiency and solar power. Perhaps our leaders will follow one day when they are wise enough to distinguish the public interest from narrow short-run private interests. Someday, too, all of us will come to understand that true prosperity neither permits nor requires bondage of any human being, in any form, for any reason, now or ever.

Chapter 32

Baggage: The Case for Climate Mitigation

(2009)

Adapt to species loss, ice sheet disintegration, increased intensity of floods, storms, droughts and fires? Such talk is disingenuous and futile. For the sake of justice and equity, for our children, grandchildren and nature we have no choice but to focus on mitigation.

James Hansen

On June 24 of 1812 Napoleon invaded Russia but with no very clear idea of what he intended to do. His motives, we can assume, included the usual testosterone-driven potpourri of territorial expansion, plunder, power, adventure, and glory. The opponent was said to be the czar of Russia, Alexander I, a mercurial sort much given to religious zealotry and the conviction that he was but a humble instrument of God or vice versa.

From the beginning, the campaign was difficult. Water, forage for horses, and food were scarce. Storms turned roads into quagmires one day, and on the next, soldiers baked in the extreme summer heat. To make matters worse, a confused Alexander did not give adequate opportunity for manly combat. Instead the Russian armies led by the capable General Mikhail Barclay de Tolly avoided battle by retreating eastward toward

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Moscow, drawing Napoleon's Grande Armée deeper into the endless Russian plains. The result was to lengthen French supply lines, rendering them vulnerable to attack and the normal breakdowns of horse-drawn transport. Only on September 7 did Barclay's replacement, the elderly General Mikhail Kutuzov, deign to give combat on the outskirts of Moscow at the village of Borodino. The battle distinguished neither general, but Napoleon prevailed in a manner of speaking, and the way to Moscow lay open.

On arrival, however, Napoleon and his Grande Armée discovered two-thirds of the city had been burned by the retreating Russians, and the exotic glories, pleasures, and practical usefulness of Moscow were thereby considerably diminished. Nonetheless they set about with considerable alacrity to loot what remained and settled in to a more or less uneventful 5-week occupation. With no enemy willing to give battle, and longing for the delights of warmer, safer, and more civilized places, Napoleon decided to go home. A considerably less grand Grande Armée departed Moscow October 19, weighted down with everything of value that its soldiers could haul—jewelry, women's finery, household furnishings, artwork, musical instruments—booty of every sort and description. One participant saw "soldiers wheeling barrows loaded with everything they had been able to pile on them . . . their senseless greed had closed their eyes to the fact that two thousand miles and many battles lay between them and their destination" (de Ségur 1980, 136).

The long journey home was not Napoleon's finest hour. First, by its brutality and arrogance the Grande Armée had managed to ignite the hostility of the Russian peasantry, a fairly difficult thing to do. The result was unending guerrilla attacks on Napoleon's flanks and rear. Second, winter set in with a vengeance. Temperatures plummeted below zero and stayed there. Under assault by peasant guerrillas, the Russian army, and bitter cold, the once formidable soldiers began to shed their plunder. Roads westward were littered with candelabras, women's finery, furniture, artwork, and assorted treasures for hundreds of miles. As the situation became desperate, Napoleon's soldiers became more like a mob and threw away everything that was not absolutely essential to life and limb and the westward stampede. For most, however, it was too late. Of the nearly 600,000 men who invaded Russia, fewer than 100,000 got out alive.

The story is perhaps useful to illustrate what harsh reality can do to clarify priorities. Sometimes you can't take it all with you. Wishful thinking

and denial do not change the weather. Sometimes you get out of a jam by the narrowest of margins, if you get out at all. But it is always smarter to avoid them in the first place.

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The awareness that humans could alter the climate of Earth has dawned slowly on our consciousness. In 1896 Svante Arrhenius deflected his anguish over a failed marriage into remarkably tedious and, as it turned out, accurate calculations about the effect of CO_2 emissions on climate. It was an oddly therapeutic thing to do, but it had no more effect on public attention than the smallest cloud on a distant horizon. Another 69 years would pass before scientists warned a U.S. president of the potential for serious climate disruption, and still another 30 years would pass before the first report from the Intergovernmental Panel on Climate Change.

Facing climate destabilization, our choices are said to be adaptation, mitigation, and suffering. The suffering from climate change–driven weather events and rising seas has already begun and will likely grow more extreme in decades ahead but is beyond the scope of this article. Accordingly I will consider only adaptation and mitigation. The advocates of each appear to come from different scientific backgrounds. Adaptationists, I think, come mostly from backgrounds in wildlife conservation, agriculture, urban planning, and landscape architecture, while mitigationists represent the various branches of atmospheric and climate science. The differences are telling.

The argument for adaptation to the effects of climate change rests on a chain of logic that goes something like this:

1. Climate change is real but will be
2. slow and moderate enough to permit orderly adaptation to changes
3. that we can foresee and comprehend and which
4. will, in a few decades, plateau around a new, manageable stable state,
5. leaving the gains of the modern world mostly intact, albeit powered by advanced technology, wind, solar, and as yet undreamed technology.

In other words, the developed world can adapt to climatic changes without sacrificing much. The targets for adaptation include developing heat and drought-tolerant crops for agriculture, changing architectural standards to withstand greater heat and larger storms, and modifying infrastructure to accommodate larger storm events as well as prolonged

heat and drought (Morello and Goodman 2009). These are imminently sensible and obvious measures that we must take. But beyond some point there are limits to what can be done and the places in which such measures can be effective. With predicted changes in temperature, rainfall, and sea level rise, it is not likely that we can "promote ecosystem resiliency" or adapt to such changes with "no regrets" as some suggest. To the contrary, ecological resilience and biological diversity will almost surely decline as climatic changes now under way accelerate, and going forward we will surely have a great many regrets—but of the "why did we not do more to stop it earlier" sort. Accordingly, more extreme adaptive measures called "geoengineering" are being discussed. These include proposals to fertilize oceans with iron to increase carbon uptake or injecting SO_2 into the upper atmosphere to increase the reflective albedo and thereby provide temporary cooling. But since the effects of geoengineering are largely unstudied and its risks largely unknown, it is a "true option of last resort," in the words of one analysis. The authors conclude that "the best and safest strategy for reversing climate change is to halt the buildup of greenhouse gases" (Victor et al. 2009, 76).

Proponents of mitigation, then, give priority to limiting the emission of heat-trapping gases as quickly as possible to reduce the eventual severity of climatic disruption. The essence of the case for mitigation is that

1. growing scientific evidence indicates that the effects of climate change will be greater and will occur faster than previously thought;
2. the duration of climate effects will last for thousands of years, not decades;
3. we are in a very tight race to avoid causing irreversible changes that would seriously damage or destroy civilization;
4. the effects of climate destabilization can be contained perhaps only by emergency action to stabilize and then reduce CO_2 levels.

Practically, climate mitigation means reversing the addition of carbon to the atmosphere by making a rapid transition to energy efficiency and renewable energy. Arguments for mitigation, in other words, are rather like those for turning the water off in an overflowing tub before mopping. Those advocating mitigation believe that we are in a race to reduce the forcing effects of heat-trapping gases before we cross various thresholds—some known, some unknown—tipping us into irretrievable disaster beyond the ameliorative effects of any conceivable adaptation.

Of course, neither adaptation nor mitigation alone will be sufficient, and sometimes they may overlap. But in a world of limited resources,

money, and time, we will be forced often to choose between the two. In such choices, the major issues in dispute have to do with estimates of the pace, scale, and duration of climatic disruption. And here the scientific evidence tilts the balance strongly toward mitigation for five reasons.

First, the record shows that climate change (1) is occurring much faster than previously thought, (2) will affect virtually every aspect of life in every corner of Earth, and (3) will last far longer than we'd once believed (Archer 2009; Solomon et al. 2009). The small cloud that Arrhenius saw on the distant horizon in 1896 is growing into a massive storm dead ahead. The effects of climatic destabilization, in other words, will be global, pervasive, permanent, and steadily—or rapidly—worsening. Given the roughly 30-year lag between what comes out of our tailpipes and smokestacks and the climate change we see, today's climate change–driven weather effects are being driven by emissions that occurred in the late 1970s. What is in store 30 years ahead, when the forcing effects of our present 392 ppm CO_2 will be manifest? Or further out when, say, the warming and acidifying effects of 450 ppm CO_2 or higher on the oceans have significantly diminished their capacities to absorb carbon? No one knows for certain, but trends in predictive climate science suggest that they will be much worse than once thought.

The implications for climate response strategies are striking. For example, it is now obvious that impacts will change with higher levels of climate forcing, which is to say that they are targets that will often move faster than we can anticipate and will become manifest in surprising ways. To what climatic conditions do we adapt? What happens when previous adaptive measures become obsolete, as they will? Similarly, at every level of climate forcing, the changes will be difficult to anticipate, which raises questions of where and when to intervene effectively in complex, nonlinear ecological and social systems. Are there places in which no amount of adaptation will work for long? Given what is now known about the pace of sea level rise, for example, what adaptive strategies can possibly work in New Orleans or South Florida, or much of the U.S. East Coast or in those regions that will likely become progressively much hotter and dryer and perhaps one day mostly inhabitable under drastically worsened conditions?

Second, the implications of the choice between adaptation and mitigation fall, not just on those able perhaps to adapt, for a time, to climatic destabilization, but on those who lack the resources to adapt and on future generations who will have to live with the effects of whatever atmospheric

chemistry we leave behind. The choice between mitigation and adaptation, in other words, is one about ethics and justice in the starkest form. A few wealthy communities in the developed world may be able to avoid the worst for a time, but unless the emission of heat-trapping gases is soon reduced everywhere, worsening conditions will hit hardest those least able to adapt. The same can be said far more emphatically about future generations.

There is, third, a "stitch in time saves nine" kind of economic argument for giving priority to mitigation. Stabilizing climate now will be expensive and fraught with difficulties for certain, but it will be much cheaper and easier to do it sooner than it will be later under much more economically difficult and ecologically harrowing conditions. Nicholas Stern (2007), for one, estimates "that if we don't act [soon], the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever" (Stern 2007, xv).

Fourth, efforts to adapt to climate change will run against institutional barriers, established regulations, building codes, and a human tendency to react to, rather than anticipate, events. There are, in economist Robert Repetto's words, "many reasons to doubt whether adaptive measures will be timely and efficient, even in the U.S. where the capabilities exist" (Repetto 2008, 5). In the best of all possible worlds, effective adaptation to the changes to which we are already committed would be complicated and difficult. In the real world of procrastination, denial, politics, and paradox, however, anything like thorough adaptation is not likely. It will, rather, be piecemeal, partial, sometimes counterproductive, wasteful, temporary, and ultimately mostly ineffective. In contrast, measures pressing energy efficiency and renewable energy—as complicated as they are—are much more straightforward and measurable hence achievable. And they have the advantage of resolving the causes of the problem, which has to do with anthropogenic changes in the carbon cycle.

Finally, beyond some fairly obvious and prudent measures, federal, state, and foundation support for climate adaptation gives the appearance that we are doing something serious about the climatic catastrophe looming ahead. The political and media reality, however, is that efforts toward climatic adaptation will be used by those who wish to do as little as possible, to block doing what is necessary to avert catastrophe.

Climate scientist James Hansen believes that "our global climate is nearing tipping points. Changes are beginning to appear, and there is a potential for explosive changes with effects that would be irreversible—if

we do not rapidly slow fossil fuel emissions over the next few decades" (Hansen pers. comm.). The conclusion, in economist Nicholas Stern's words, is that "adaptation will be necessary on a major scale, but the stronger and the more timely the mitigation, the less will be the challenge of adaptation" (Stern 2009, 71). In other words, adaptation must be a second priority to effective and rapid mitigation that contains the scale and scope of climatic destabilization. When they compete for funding and attention, the priority must be given to efforts toward a rapid transition to energy efficiency and deployment of renewable energy. Until we get our priorities right, the emission of greenhouse gases will continue to rise beyond the point at which humans could ever adapt. "The only true adaptation," in George Woodwell's words, "is mitigation" (Woodwell pers. comm.).

Napoleon made a series of bad decisions, beginning with that to invade Russia. But having done so and having gotten as far as Moscow in the fall of 1812, he made two decisions that proved fatal to his army and to the French empire. One was to tarry in Moscow for 5 weeks with the Russian winter approaching. The second was to permit his soldiers to load up with plunder that encumbered their escape, weighed down their knapsacks and wagons, undermined discipline, and diverted their attention from the serious business of escaping disaster.

Of course all metaphors and historical analogies have their limits. But rather like Napoleon's Grand Armée, we, too, are in a race. For our part, we were first warned of climate change over a century ago and have lingered in increasingly dangerous territory in the belief that we can return to safer ground on our terms with all of the booty seized at the apogee of the fossil-fueled industrial era. It's not likely that we can do so and return to safer ground. According to James Hansen et al. (2008), that means a rapid return to CO_2 levels of about 350–300 ppm. If we wait too long to prevent climate change, we will, perhaps sooner than later, create conditions beyond reach of any conceivable adaptive measures. With sea level rise now said to be on the order of 1 to 2 meters by 2100, for example, we cannot save many low-lying places and many species we would otherwise prefer to save. And sea levels and temperatures will not stabilize until long after the year 2100.

There will be unavoidable and tragic losses in the decades ahead, but far fewer if we act to contain the scope and scale of climate change now. That is to say that there is some baggage accumulated in the fossil fuel

era of our recent history that we cannot take with us. No matter what we do to adapt, we cannot save some coastal cities, we will lose many species, and ecosystems will be dramatically altered by changes in temperature and rainfall. Our best course is to reduce the scale and scope of the problem with a sense of wartime urgency. And we better move quickly and smartly while the moving's good.

Chapter 33

Long Tails and Ethics: Thinking about the Unthinkable

(2010)

It is a mistaken belief that one can philosophize without having been compelled to philosophize by problems outside philosophy.
Karl Popper

We have long lived in the faith that "nature does not set booby traps for unwary species," as Robert Sinsheimer (1978) once noted. Whether nature does or not, we humans do, and we have nearly trapped ourselves by exploiting large pools of carbon found in soils, forests, coal, oil, and gas. The result is a rapid change in the chemistry of the atmosphere, leading to rising temperatures, destabilization of virtually every part of the biosphere, and the looming prospect of global catastrophe. The effect of climatic disruption now gathering momentum is a tsunami of change that will roll across every corner of the Earth, affect every sector of every society, and worsen problems of insecurity, hunger, poverty, and societal instability. We live now in the defining moment of our species that will determine whether

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we are smart enough, competent enough, and wise enough to escape from a global trap entirely of our own making.

The first scientific evidence that human activity could alter atmospheric chemistry came from the laborious calculations of Svante Arrhenius in 1896. Compared with the later findings of the Intergovernmental Panel on Climate Change, his numbers are surprisingly accurate. His overall conclusion, however, was less accurate. Arrhenius, a Swede, thought a warmer Earth to be a good thing on the whole, a conclusion that has not stood the test of time. But it would be another 69 years before the President's Science Advisory Committee in 1965 delivered the first official warning of the possible scale and scope of global warming (Weart 2003, 44).

Nearly a half century later, we know that global warming, in the words of John Holdren, President Obama's science advisor, "is already well beyond dangerous and is careening toward completely unmanageable" (Holdren 2008, 20). Further, the destabilization of climate is now believed to be more or less permanent in human timescales. Geophysicist David Archer puts it this way:

> The climate impacts of releasing fossil fuel CO_2 to the atmosphere will last longer than Stonehenge. Longer than time capsules, longer than nuclear waste, far longer than the age of human civilization so far. The CO_2 coming from a quarter of that ton will still be affecting the climate one thousand years from now, at the start of the next millennium. (Archer 2009, 1)

In other words, even if we were to stop emitting carbon immediately, sea levels would continue to rise for at least another thousand years and temperatures would continue to rise with collateral effects one can scarcely imagine (Solomon et al. 2009). In short, because of our past actions the Earth likely will become a hotter, more barren, and more capricious place for time spans we typically associate with the half-life of nuclear waste. The climatic destabilization we have incurred is not a solvable problem but a steadily worsening condition with which humans will have to contend for a long time to come. Early and effective action to end our use of coal, oil, and natural gas and switch to renewable energy can only contain the eventual scale, scope, and duration of climatic destabilization but will not remedy the situation in any way that could reasonably be called a solution. That's the science. But the gap between science and the public discourse about climate destabilization seems as wide and seemingly as unbridgeable as the Grand Canyon itself. We are, to say

the least, quite unaccustomed to thinking about matters so total and so permanent.

We rely on analogies and metaphors to understand things otherwise inexplicable. But what analogies, metaphors, or manner of thinking clarifies the issues posed by climatic destabilization? We will first turn to the familiar beginning with the standard metaphor of our age rooted in the image of the machine—devices of our own making that are accordingly understandable, purposeful, and repairable. Machine thinking leads some to regard climate destabilization as a solvable problem and, of course, as an opportunity to build a better world. In one recent view, "solving climatic change" is described as a new pathway to prosperity. "We can have it all," the author opines, "growth in the economy, a thriving business environment, and a solution to the climate crisis." Would that it were so. Machine thinking is rooted in the Enlightenment era's faith in progress, so machines beget better machines that beget still better ones. And better machines and more cleverness, it is assumed, will restore climate stability without disrupting our manner of living. But the Earth and its enveloping atmosphere are not simply machines and accordingly are not repairable. Nor is their "malfunction" a solvable problem as we understand those words.

Reliance on the discipline of economics rooted in the metaphor of "invisible hands" doesn't clarify our plight much either. Humans are not the rational calculators assumed in economic models. And the common use of discounting marginalizes the prospect of future disasters, so a new shopping mall is privileged over investments that reduce the scale of catastrophe, say, 50 years hence. Neither are the "pre-analytic assumptions" about human mastery of nature, infinite substitutability of technology for scarce natural resources, and the beneficence of economic growth useful for adapting economic activity to the limits of the Earth.

What about Biblical narratives? There is, for one, a similarity of sorts between the story of Adam and Eve's eviction from paradise and that which we are now writing about our own self-eviction from the 10,000-year paradise that geologists call the Holocene into a hotter world that some call the Anthropocene. Perhaps a better story is to be found in narratives about End Times. Theologian Jack Miles (2001), for instance, wonders what we will do once we discover that achieving sustainability is beyond our capacities and that we are living in the End Times, although not as told by rabid End-Timers like Pastor Tim LaHaye, coauthor of the

"Left Behind" books. Would our demise turn out to be our finest hour or simply a nasty and brutish final scene?

Perhaps climate destabilization bears a resemblance to the issue of abortion writ large. Where the public debate about abortion has been focused on an individual fetus, climate destabilization carries with it the possibility of aborting many species forever and many generations of humans that would otherwise have lived. But in Jonathan Schell's words,

> how are we to comprehend the life or death of the infinite number of possible people who do not yet exist at all? . . . To kill a human being is murder, but what crime is it to cancel the numberless multitude of unconceived people? In what court is such a crime to be judged? Against whom is it committed? . . . What standing should they have among us? (Schell 2000, 116)

This is a case of what Hannah Arendt once called "radical evil," which Schell interprets as evil that "goes beyond destroying individual victims and, in addition, destroys the world that can in some way respond to—and thus in some measure redeem—the deaths suffered" (Schell 2000, 145). Climate destabilization, like nuclear war, has the potential to destroy all human life on Earth and in effect "murder the future" (Schell 2000, 168). But never having lived, those not born will not suffer, will know no deprivation, and can make no claims against those who aborted the opportunity they might otherwise have had to live. Willfully caused extinction is a crime as yet with no name. There would be no judge, no jury, no sentence—simply a void and a great silence that would once again descend on Earth.

There are other metaphors and analogies that we could summon to help us begin to comprehend the full gravity of our situation, but all will be found wanting in one way or another. We are now in the era that biologist E. O. Wilson has called "the bottleneck," for which we have no precedent and no very useful example. I have faith that humankind will emerge someday, chastened but improved. But deliverance will require more than astute science and a great deal more than smarter technology—both necessary but insufficient. Science can describe our situation down to parts per trillion and help to create better technologies, but it can give us no clear reason why we should want to survive, why we deserve to be sustained on Earth, or why we should worry about the lives or well-being of generations whose existence now hangs in the balance. That is, rather,

the function of deeper senses that we catalog with words like *morality*, *ethics*, and *spirituality*. But what kind of morality or ethics is remotely adequate when measured against the time spans necessary to restabilize Earth systems? I do not know. But with each turn of the screw, it will be tempting to avoid asking such questions and give in to trade-offs that privilege the living and damn those who reside only in the abstraction we call the future. And, for sure, there is no easy or, perhaps, good case to be made for current destitution except a bit more of it for the wealthy.

I do not presume to know what the content of that morality might be. Whatever it is, I doubt that it will be born in "deep thinking" characteristic of the academy or from philosophers debating esoteric points of obscure doctrines. I think the birth will be harder than that: messy and painful, which is to say a philosophy born of necessity and of stories of real people caught in the acts of struggle, generosity, and failure. Perhaps it won't be philosophy at all but rather a kind of practical worldview that emerges from the recognition of realities we've created and with which humankind must now contend for centuries to come. Let me suggest three illustrations of such a process.

The first is taken from a friend who recently spent several months as a patient in a cancer ward. During hours of treatment, he witnessed the growth of community among his fellow cancer patients. Once reticent to say much about themselves, under the new reality of a life-threatening disease they gradually became more talkative and open to thinking about their lives and listening to the experiences of other patients. Living in the shadow of death, they were more open to ideas and people, including some that they formerly regarded as threatening or incomprehensible. They were less prone to arrogance and more sympathetic to the suffering of others. They were less sure of once strongly held convictions and more open to contrary opinions. No longer masters of their lives, their schedules, or even their bodies, many achieved a higher level of mastery by letting go of illusions of invulnerability, and, in the letting go, they reached a more solid ground for hope and the kind of humble but stubborn resilience necessary for beating the odds or at least for living their final days with grace.

Another possible narrative can be drawn from the experience of people overcoming addiction. Alcoholics Anonymous, for example, offers a 12-step process to overcome addiction that begins with self-awareness and leads to a public confession of the problem, a reshaping of intention, the stabilizing influence of a support group, and a reclaiming of self-

mastery to higher ends. The power of this narrative line is in the similarity between substance addiction and its collateral damages and our societal addictions to consumption, entertainment, and energy and their destructive effects on our places, selves, and children.

A third narrative comes from the haunting story of the Native American Crow Chief Plenty Coups, told by philosopher Jonathan Lear. Under the onslaught of white civilization, the world of the Plains tribes collapsed and their accomplishments disappeared, along with their culture, sense of purpose, and meaning. At the end of his life, Plenty Coups told his story to a trapper, Frank Linderman, saying, "But when the buffalo went away the hearts of my people fell to the ground, and they could not lift them up again. After this nothing happened" (Lear 2006, 2). Of course many things happened, but without the traditional bearings by which they understood reality or themselves, nothing happened that the Crow people could interpret in a familiar framework. Lear describes Chief Plenty Coups' courageous efforts to respond to the collapse of his civilization with "radical hope" but without the illusion that they could ever recreate the world they had once known. There were others, like Sitting Bull, who pined for vengeance and a return to a past before the juggernaut of American civilization swept across the Plains. Likewise, Ghost Dancers hoped fervently to restore what had been, but Plenty Coups knew that the Crow culture, organized around the hunt and warfare, would have to become something inconceivably different. The courage necessary to fight had to be transformed into the courage to face and respond creatively and steadfastly to a new reality with "a traditional way of going forward" (Lear 2006, 154). What makes his hope radical, Lear says, "is that it is directed toward a future goodness that transcends the current ability to understand what it is. Radical hope anticipates a good for which those who have the hope as yet lack the appropriate concepts with which to understand it" (Lear 2006, 104).

It is clear by now that we have quite underestimated the magnitude and speed of the human destruction of nature, but the rapid destabilization of climate and the destruction of the web of life are just symptoms of larger issues, the understanding of which runs hard against our national psyche and the Western worldview generally. It is easier, I think, to understand the reality of dilemmas in places that have historic ruins and are overlaid with memories of tragedies and misfortunes that testify to human fallibility, ignorance, arrogance, pride, overreach, and sometimes evil. Amidst shopping malls, bustling freeways, and all of the accoutrements, paraphernalia,

enticements, and gadgetry of a booming fantasy industry, it is harder to believe that sometimes things don't work out because they simply cannot or that limits to desire and ambition might really exist. When we hit roadblocks, we have a national tendency to blame the victim or bad luck but seldom the nature of the situation or our beliefs about it. What Spanish philosopher Miguel de Unamuno called "the tragic sense of life" has little traction just yet in the U.S. because it runs against the national character, and we don't read much philosophy anyway (de Unamuno 1977).

A tragic view of life is decidedly not long faced and resigned, but neither is it giddy about our possibilities. It is merely a sober view of things, freed from the delusion that humans should be about "the effecting of all things possible" or that science should put nature on the rack and torture secrets out of her, as we learned from Francis Bacon. It is a philosophy that does not assume that the world or people are merely machines or that minds and bodies are separate things, as we learned from Descartes. It is not rooted in the assumption that what can't be counted does not count, as Galileo believed. The tragic sense of life does not assume that we are separate atoms, bundles of individual desires, unrelated hence without obligation to others or what went before or those yet to be born. Neither does it assume that the purpose of life is to become as rich as possible for doing as little as possible, or that being happy is synonymous with having fun. The tragic view of life, on the contrary, recognizes connections, honors mystery, acknowledges our ignorance, has a clear-eyed view of the depths and heights of human nature, knows that life is riddled with irony and paradox, and takes our plight seriously enough to laugh at it.

Whether aware of it or not, all of us are imprinted with the stamp of Bacon and the others who shaped the modern worldview. The problem, however, is not that they were wrong but rather that we believed them too much for too long. Taken too far and applied beyond their legitimate domain, their ideas are beginning to crumble under the weight of history and the burden of a reality far more complex and wonder-filled than they knew and could have known. Anthropogenic climate destabilization is a symptom of something more akin to a cultural pathology. So, dig deep enough and the "problem" of climate is not reducible to the standard categories of technology and economics. It is not merely a problem awaiting solution by one technological fix or another. It is, rather, embedded in a larger matrix; a symptom of something deeper. Were we to "solve" the "problem" of climate change, our manner of thinking and being in the world would bring down other curses and nightmares now waiting

in the wings. Perhaps it would be a nuclear holocaust, or terrorism, or a super plague, or as Sun Microsystems founder Bill Joy warns, an invasion of self-replicating devices like nanotechnologies, genetically engineered organisms, or machines grown smarter than us that will find us exceedingly inconvenient. There is no shortage of such plausible nightmares, and each is yet another symptom of a fault line so deep that we hesitate to call it by its right name.

The tragic sense of life accepts our mortality, acknowledges that we cannot have it all, and is neither surprised nor dismayed by human evil. The Greeks who first developed the dramatic art of tragedy knew that we are ennobled, not by our triumphs or successes, but by rising above failure and tragedy. Sophocles, for example, portrays Oedipus Rex as a master of the world—powerful, honored, and quite full of himself but also honest enough to search out the truth relentlessly. In his searching, Oedipus falls from the heights, and that is both his undoing and his making. Humbled, blind, old, and outcast, Oedipus is a far nobler man than he had been at the height of his kingly power. Tragedy, the Greeks thought, was necessary to temper our pride, to rein in the tug of hubris, and to open our eyes to hidden connections, obligations, and possibilities.

We are now engaged in a global debate about what it means to become "sustainable." But no one knows how we might secure our increasingly tenuous presence on the Earth or what that will require of us. We have good reason to suspect, however, that the word *sustainable* must imply something deeper than merely the application of more technology and smarter economics. It is possible and perhaps even likely that more of the same "solutions" would only compound our tribulations. The effort to secure a decent human future, I think, must be built on the awareness of the connections that bind us to each other, to all life, and to all life to come. And, in time, that awareness will transform our politics, laws, economy, lifestyles, and philosophies.

Chapter 34

Hope (in a Hotter Time)

(2007)

Fraudulent hope is one of the greatest malefactors, even enervators, of the human race, concretely genuine hope its most dedicated benefactor.
Ernst Bloch

We like optimistic people. They are fun, often funny, and very often capable of doing amazing things otherwise thought to be impossible. Were I stranded on a life raft in the middle of the ocean and had a choice between an optimist and pessimist as a companion, I'd want an optimist, providing he did not have a liking for human flesh. Optimism, however, is often rather like a Yankee fan believing that the team can win the game when it's the bottom of the ninth, they're up by a run, with two outs, a two-strike count against a .200 hitter, and Mariano Rivera in his prime is on the mound. He or she is optimistic for good reason. The Red Sox fans, on the other hand, believe in salvation by small percentages and hope for a hit to get the runner home from second base and tie the game. Optimism is the recognition that the odds are in your favor; hope is the faith that things will work out whatever the odds. *Hope* is a verb with its sleeves rolled up. Hopeful people are actively engaged in defying the odds or changing the odds. Optimism leans back, puts its feet up, and wears a confident look, knowing that the deck is stacked.

I know of no good reason for anyone to be optimistic about the human future, but I know many reasons to be hopeful. How can one be optimistic,

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for example, about global warming? First, it isn't a "warming," but rather a total destabilization of the planet brought on by the behavior of one species: us. Whoever called this "warming" must have worked for the advertising industry or the northern Siberian bureau of economic development. The Intergovernmental Panel on Climate Change—the thousand-plus scientists who study climate and whose livelihoods depend on authenticity, replicability, data, facts, and logic—put it differently. A hotter world means rising odds of

- more heat waves and droughts;
- more and larger storms;
- bigger hurricanes;
- forest dieback;
- changing ecosystems;
- more tropical diseases in formerly temperate areas;
- rising ocean levels, faster than once thought;
- losing many things nature once did for us;
- losing things like Vermont maple syrup;
- more and nastier bugs;
- food shortages due to drought, heat, and more and nastier bugs;
- more death from climate-driven weather events;
- refugees fleeing floods, rising seas, drought, and expanding deserts;
- international conflicts over energy, food, and water.

And, if we do not act quickly and wisely, runaway climate change to some new stable state most likely without humans.

Some of these changes are inevitable, given the volume of heat-trapping gases we've already put into the atmosphere. There is a lag of several decades between the emission of carbon dioxide and other heat-trapping gases, and the weather headlines, and there is still another lag until we experience their full economic and political effects. The sum total of the opinions of climate experts goes like this:

- We've already warmed the planet by 0.8°C.
- We are committed to another approximately 0.6°C warming.
- It's too late to avoid trauma.
- But it's probably not too late to avoid global catastrophe, which includes the possibility of runaway climate change.
- There are no easy answers or magic bullet solutions.
- It is truly a global emergency.

The fourth item above is anyone's guess, since the level of heat-trapping gases is higher than it has been in the past 650,000 years and quite likely

for a great deal longer. We are playing a global version of Russian roulette, and no one knows for certain what the safe thresholds of various heat-trapping gases might be. Scientific certainty about the pace of climate change over the past three decades has a brief shelf life, but the pattern is clear. As scientists learn more, it's mostly worse than they previously thought. Ocean acidification went from being a problem a century or two hence to being a crisis in a matter of decades. Melting of the Greenland and the West Antarctic ice sheets went from being a distant likelihood to a nearer-term possibility of a century or two. The threshold of perceived safety went down from perhaps 560 ppm CO_2 to perhaps 450 ppm CO_2. And so forth.

Optimism in these circumstances is like whistling as one walks past the graveyard at midnight. There is no good case to be made for it, but the sound of whistling sure beats the sound of the rustling in the bushes beside the fence. But whistling doesn't change the probabilities one iota, nor does it much influence any goblins lurking about. Nonetheless, we like optimism and optimistic people. They soothe, reassure, and sometimes they motivate us to accomplish a great deal more than we otherwise might. But sometimes optimism misleads, and on occasion badly so. This is where hope enters.

Hope, however, requires us to check our optimism at the door and enter the future without illusions. It requires a level of honesty, self-awareness, and sobriety that is difficult to summon and sustain. I know a great many smart people and many very good people, but I know far fewer people who can handle hard truth gracefully without despairing. In such circumstances it is tempting to seize on anything that distracts us from unpleasant things. The situation is rather like that portrayed in the movie *A Few Good Men* in which Jack Nicholson playing a beleaguered Marine Corps officer tells the prosecuting attorney (Tom Cruise), "You can't handle the truth!" T. S. Eliot, less dramatically, noted the same tendency: "Human kind cannot bear very much reality" (*Four Quartets*, "Burnt Norton").

Authentic hope, in other words, is made of sterner stuff than optimism. It must be rooted in the truth as best we can see it, knowing that our vision is always partial. Hope requires the courage to reach farther, dig deeper, confront our limits and those of nature, work harder, and dream dreams. Optimism doesn't require much effort, since you're likely to win anyway, but hope has to hustle, scheme, make deals, and strategize. But how do we find authentic hope in the face of climate change, the biological holocaust now under way, the spread of global poverty, seemingly unsolvable

human conflicts, terrorism, and the void of world leadership adequate to the issues?

I've been thinking about the difference between optimism and hope since being admonished recently to give a "positive" talk at a gathering of ranchers, natural resource professionals, and students. Presumably the audience was incapable of coping with the bad news it was assumed that I would otherwise deliver. I gave the talk that I intended to give and the audience survived, but the experience caused me to think more about what we say and what we can say to good effect about the kind of news that we reckon with daily.

The view that the public can only handle happy news, nonetheless, rests on a chain of reasoning that goes like this:

- We face problems which are solvable, not dilemmas which can be avoided with foresight but are not solvable, and certainly not losses which are permanent;
- people, and particularly students, can't handle much truth;
- so resolution of different values and significant improvement of human behavior otherwise necessary are impossible;
- greed and self-interest are in the driver's seat and always will be;
- so the consumer economy is here to stay;
- but consumers sometimes want greener gadgets;
- and capitalism can supply these at a goodly profit and itself be greened a bit, but not improved otherwise;
- and so . . . matters of distribution, poverty, and political power are nonstarters;
- therefore, the focus should be on problems solvable at a profit by technology and policy changes;
- significant improvement of politics, policy, and governance are unlikely and probably irrelevant because better design and market adjustments can substitute for governmental regulation and thereby eliminate most of the sources of political controversy—rather like Karl Marx's prediction of the withering away of the state.

Disguised as optimism, this approach is, in fact, pessimistic about our capacity to understand the truth and act well. So we do not talk about limits to growth, unsolvable problems, moral failings, unequal distribution of wealth within and between generations, emerging dangers, impossibilities, technology gone awry, or necessary sacrifices. "Realism" requires us to portray climate change as an opportunity to make a great deal of money, which it may be for some, but without saying that it might not be for most

or mentioning its connections to other issues, problems, and dilemmas or the possibility that the four horsemen are gaining on us. We are not supposed to talk about coming changes in our "lifestyles," a telling and empty word implying fashion, not necessity or conviction.

Ultimately, this approach is condescending to those who are presumably incapable of facing the truth and acting creatively, courageously, and even nobly in dire circumstances. Solving climate change, for example, is reduced to a series of wedges representing various possibilities that would potentially eliminate so many gigatons of carbon without any serious changes in how we live. There is, accordingly, no wedge called "suck it up," because that is considered to be too much to ask of people who have been consuming way too much, too carelessly, for too long. The "American way of life" is thought to be sacrosanct. In the face of a global emergency, brought on in no small way by the profligate American way of life, few are willing to say otherwise. So we are told to buy hybrid cars but not asked to walk, travel by bikes, or go less often, even at the end of the era of cheap oil. We are asked to buy compact fluorescent light bulbs but not to turn off our electronic stuff or not buy it in the first place. We are admonished to buy green but seldom asked to buy less or repair what we already have or just make do. We are encouraged to build LEED-rated buildings that are used for maybe 10 hours a day for 5 days a week, but we are not told that we cannot build our way out of the mess we've made or to repair existing buildings. We are not told that the consumer way of life will have to be rethought and redesigned to exist within the limits of natural systems and better fitted to our human limitations. And so we continue to walk north on a southbound train, as Peter Montague once put it.

And maybe, told that its hindquarters are caught in a ringer, the public would panic or, on the other hand, become so despairing that it would stop doing what it otherwise would do that could save us from the worst outcomes possible. This is an old view of human nature epitomized in the work of Edward Bernays, a nephew of Sigmund Freud and the founder of modern advertising. Public order, he thought, had to be engineered by manipulating people to be dependent and dependable consumers. People who think too much or know too much were, in his view, a hazard to social stability.

Maybe this is true and maybe gradualism is the right strategy. Perhaps the crisis of climate and those of equity, security, and economic sustainability will yield to the cumulative effects of many small changes without

any sacrifice at all. Maybe changes now under way are enough to save us. Maybe, small changes will increase the willingness to make larger changes in the future. And state-level initiatives in California, Florida, and northeastern states are changing the politics of climate. Wind and solar are growing at 40+ percent per year, taking us toward a different energy regime. A cap and trade bill will soon pass in Congress, and maybe that will be enough. Maybe we can win the game of climate roulette at a profit and never have to confront the nastier realities of global capitalism and inequity or confront the ecological and human violence that we've unleashed in the world. But I wouldn't bet the Earth on it.

For one, the remorseless working out of the big numbers gives us little margin for safety and none for delay in reducing CO_2 levels before we risk triggering runaway change. "Climate," as Wallace Broecker once put it, "is an angry beast and we are poking it with sticks," and we've been doing that for a while. So call it prudence, precaution, insurance, common sense, or what you will, but this ought to be regarded as an emergency like no other. Having spent any margin of error we might have had 30 years ago, we now have to respond fast and effectively or else. That's what the drab language of the fourth report from the Intergovernmental Panel on Climate Change is saying. What is being proposed, I think, is still too little, too late—necessary but not nearly sufficient. And it is being sold as "realism" by people who have convinced themselves that they have to understate the problem in order to be credible.

Second, climate roulette is part of a larger equation of exploitation of people and nature, violence, inequity, imperialism, and intergenerational exploitation, the parts of which are interlocked. In other words, heat-trapping gases in the atmosphere are a symptom of something a lot bigger. To deal with the causes of climate change, we need a more thorough and deeper awareness of how we got to the brink of destroying the human prospect and much of the planet. It did not happen accidentally but is, rather, the logical working out of a set of assumptions, philosophy, world-view, and unfair power relations that have been evident for a long time. The wars, gulags, ethnic cleansings, militarism, and the destruction of forests, wildlife, and oceans throughout the twentieth century were earlier symptoms of the problem. We've been playing fast and loose with life for a while now, and it's time to discuss the changes we must make in order to conduct the public business fairly and decently over the long haul.

The upshot is that the forces that have brought us to the brink of climate disaster and biological holocaust and are responsible for the spread

of global poverty—the crisis of sustainability—remain mostly invisible and in charge of climate policy. The fact is that climate stability, sustainability, and security are impossible in a world with too much violence, too many weapons, too much unaccountable power, too much stuff for some, too little for others, and a political system that is bought and paid for behind closed doors. Looming climate catastrophe, in other words, is a symptom of a larger disease.

What do I propose? Simply this: that those of us concerned about climate change, environmental quality, and equity treat the public as intelligent adults who are capable of understanding the truth and acting creatively and courageously in the face of necessity—much as a doctor talking to a patient with a potentially terminal disease. There are many good precedents for telling the truth. Abraham Lincoln, for one, did not pander, condescend, evade, or reduce moral and political issues to economics, jobs, and happy talk. Rather he described slavery as a moral disaster for slaves and slave owners alike. Similarly, Winston Churchill in the dark days of the London blitzkrieg in 1940 did not talk about defeating Nazism at a profit and the joys of urban renewal. Instead he offered the British people only "blood, toil, tears, and sweat." And they responded with heart, courage, stamina, and sacrifice. At the individual level, faced with a life-threatening illness, people more often than not respond heroically. Every day, soldiers, parents, citizens, and strangers do heroic and improbable things in the full knowledge of the price they will pay.

Telling the truth means that the people must be summoned to a level of extraordinary greatness appropriate to an extraordinarily dangerous time. People, otherwise highly knowledgeable of the latest foibles of celebrities, must be asked to be citizens again, to know more, think more, take responsibility, participate publicly, and, yeah, suck it up. They will have to see the connections between what they drive and the wars we fight; the stuff they buy and crazy weather; the politicians they elect and the spread of poverty and violence. They must be taught to see connections between climate, environmental quality, security, energy use, equity, and prosperity. They must be asked to think and to see. As quaint and naive as that may sound, people have done it before and it's worked.

Telling the truth means that we will have to speak clearly about the causes of our failures that have led us to the brink of disaster. If we fail to deal with causes, there are no Band-Aids that will save us for long. The problems can in one way or another be traced to the irresponsible exercise of power that has excluded the rights of the poor, the disenfranchised,

and every generation after our own. That this has happened is in no small way a direct result everywhere of money in politics, which has aided and abetted the theft of the public commons, including the airwaves where spreading misinformation is a growing industry. Freedom of speech, as Lincoln said in 1860, does not include the "right to mislead others, who have less access to history, and less leisure to study it." But the rights of capital over the media now trump those of honesty and fair public dialogue and will continue to do so until the public reasserts its legitimate control over the public commons, including the airwaves.

Telling the truth means summoning people to a higher vision than that of the affluent consumer society. Consider the well-studied but little-noted gap between the stagnant or falling trend line of happiness in the last half century and that of rising GNP. That gap ought to have reinforced the ancient message that, beyond some point, more is not better. If we fail to see a vision of a livable decent future beyond the consumer society, we will never summon the courage, imagination, or wit to do the obvious things to create something better than what is in prospect. So, what does a carbon neutral society and increasingly sustainable society look like? My list consists of communities with

- front porches;
- public parks;
- local businesses;
- windmills and solar collectors;
- local farms and better food;
- better woodlots and forests;
- local employment;
- more bike trails;
- summer baseball leagues;
- community theaters;
- better poetry;
- neighborhood book clubs;
- bowling leagues;
- better schools;
- vibrant and robust downtowns;
- with sidewalk cafes;
- great pubs serving microbrews;
- more kids playing outdoors;
- fewer freeways, shopping malls, sprawl, television;
- no more wars for oil or anything else.

Nirvana? Hardly! Humans have a remarkable capacity to screw up good things. But it is still possible to create a future that is a great deal better than what is in prospect. Ironically, what we must do to avert the worst effects of climate change are mostly the same things we would do to build sustainable communities, improve environmental quality, build prosperous economies, and improve the prospects for our children.

Finally, I am an educator and earn my keep in the quaint belief that if people only knew more, they would act better. Some of what they need to know is new, but most of it is old, very old. On my list of things people ought to know in order to discern the truth are a few technical things like (1) the laws of thermodynamics that tell us that economic growth only increases the pace of disorder, the transition from low entropy to high entropy; (2) the basic sciences of biology and ecology—for example, how the world works as a physical system; and (3) the fundamentals of carrying capacity, which apply equally to yeast cells in a wine vat, lemmings, and humans. But they ought to know, too, about human fallibility, gullibility, and the inescapable problem of ignorance. So I propose that schools, colleges, and universities require their students to read Marlowe's *Dr. Faustus*, Mary Shelley's *Frankenstein*, Melville's *Moby Dick*, and the book of Ecclesiastes. I would hope that they would be taught how to distinguish those things that we can do from those that we should not do. And they should be taught the many disciplines of applied hope that include the skills necessary to grow food, build shelter, manage woodlots, make energy from sunlight and wind, develop local enterprises, cook a good meal, use tools skillfully, repair and reuse, and talk sensibly at a public meeting.

Hope, authentic hope, can be found only in our capacity to discern the truth about our situation and ourselves and summon the fortitude to act accordingly. We have it on high authority that the Truth will set us free from illusion, greed, and ill will and perhaps, with a bit of luck, from self-imposed destruction.

Chapter 35

At the End of Our Tether? The Rationality of Nonviolence

(2008)

Somebody must begin it.
William Penn

Perhaps humankind will do the right thing, as Winston Churchill once said of Americans, but only after it has exhausted all other possibilities. In human relations, we've tried brute force, and that is the story of empires rising and falling and the lamentable catalogue of folly that we call history. In 1648 the creators of the Westphalian system of sovereign nation-states improved things slightly by creating a few rules to govern interstate anarchy in Europe. The architects of the post–World War II world improved things a bit more with the creation of international institutions such as the World Bank, the International Monetary Fund, and the United Nations. But war and militarization have a stronger hold on human affairs than ever, and sooner or later,

The title is adapted from H. G. Wells (1946, 1). Wells wrote, "This world is at the end of its tether. The end of everything we call life is close at hand and cannot be evaded." This article was originally published in 2008.

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violence—whether by states, by terrorist groups, or simply by demented individuals—will devour the human prospect.

In the last few centuries we applied the same mindset to nature. We've bullied, bulldozed, and re-engineered her down to the gene, and that got us into more trouble and perplexities than anyone can comprehend. It is now proposed that we manage nature even more intensely—but the same goal with smarter methods will only delay the inevitable. Either way, we are rapidly creating what climate scientist James Hansen calls a "different planet" and one we are not going to like. We can quibble about the timing of disaster, but, given our present course, there is no good argument about its inevitability.

Whether to nature or human affairs, we continue to apply brute force with more powerful and sophisticated technology and expect different results—a definition, according to some, of insanity. True or not, it is a prescription for the destruction of nature and civilization that is woven into our politics, economies, and culture. The attempt to master nature and to control destiny through force has not worked and will not work, because the world, whether that of nature or that of nations, as Jonathan Schell puts it, is "unconquerable" (Schell 2003). The reasons are to be found in the mismatch between the human intellect and the complexity of nonlinear systems, and no amount of research, thought, or computation can fill that void of ignorance, which is only to acknowledge the limits of human foresight and the inevitability of surprises, unforeseen and unforeseeable results, unintended consequences, paradox, irony, and counterintuitive outcomes. But the limits of human intelligence do not prevent us from discerning something about self-induced messes.

So what kind of messes have we made for ourselves? Some are problems that are, by definition, solvable with enough rationality, money, and effort. The problem of powering the world by current sunlight, for example, is solvable given enough effort and money. But some situations are dilemmas, which by definition are not solvable by any rational means—although with enough foresight and wisdom they can be avoided or resolved at a higher level. British economist E. F. Schumacher once described the difference between "convergent" and "divergent" problems in much the same terms. In the former, logic tends to converge on a specific answer, while the latter "are refractory to mere logic and discursive reason" and require something akin to a change of heart and perspective (Schumacher 1977, 128). Donella Meadows, in a frequently cited article on the alchemy of

change, concluded that of all possible ways to change social systems, the highest leverage comes, not with policies, taxes, numbers, and the usual menu of rational choices, but with change in how we think (Meadows 1997). The crucial issues we face are not so much problems as they are dilemmas. They cannot be solved by the application of more technology and smartness, but they can be transcended by a change of mindset.

Two dilemmas stand astride our age. The first has to do with age-old addiction to force in human affairs. We don't know exactly how or when violence became the method of choice, or the precise point at which it became wholly counterproductive (Schmookler 1984). But no tribe or nation that did not prepare for war could survive for long once its neighbors did. And since it makes no sense to have a good army if you don't use it from time to time, preparation for war tended to make its occurrence more likely. If it was ever rational, however, the bloody carnage of the past 100 years should have convinced even the dullest among us that violence within and between societies is now self-defeating and colossally stupid. Violence and threats have always tended to create more of the same—a deadly dance of action and reaction. The development of nuclear and biological weapons and the even more heinous weapons now in development have changed everything—everything but our way of thinking, as Einstein once noted. In an age of terrorism, the scale of potential destruction and the proliferation of small weapons of mass destruction mean that there is no sure means of security, safety, or deterrence anywhere for anyone. The conclusion is inescapable: from now on—whatever the issues—there can be no winners in any violent conflict, only losers. Nonetheless, the world now spends $1.2 trillion each year on weapons and militarism and is, unsurprisingly, less secure than ever. The United States alone spends 46 percent of the total, or $17,000 per second, more than the next 22 nations combined. It maintains over 737 military bases worldwide, but it is presently losing two wars while threatening to start a third. Economist Joseph Stiglitz estimates that the total cost of the Iraqi misadventure alone will be $2 trillion. Beyond the economic cost, it will surely leave a legacy of yet more terrorism, violence, and ruin in all of its many guises.

The word *realism* has always been a loaded word. In world politics it is contrasted with *idealism*, believed by realists to be the epitome of woolyheadedness. In realist theory, the power realities of interstate politics required military strength and the aggressive protection of the national interest defined as power. Realists were the architects of empires, world

wars, cold wars, arms races, mutual assured destruction, the Vietnam War, and now the fiasco in Iraq. But one of the preeminent realists of the post–World War II era, Hans Morgenthau, was more of an idealist than commonly appreciated. He once proposed that governments give control of nuclear weapons to "an agency whose powers are commensurate with the worldwide destructive potentials of those weapons" (Joffe 2007). George Kennan, another post–World War II realist, similarly proposed international measures to prevent both nuclear war and ecological decline—ideas that are anathema to influential neoconservative realists now.

The second dilemma is the insolvability of long-term economic growth in a finite biosphere. As ecological economists like Herman Daly have said for decades, the economy is a subsystem of the biosphere, not an independent system. The "bottom line," therefore, is set by the laws of entropy and ecology, not by economic theory. The effort to make the economy sustainable by making it smarter and greener is all to the good, but altogether inadequate. It is incrementalism when we need systemic change that begins by changing the goals of the system. Economic growth can and should be smarter, and corporations ought to reduce their environmental impacts, and with a bit of effort and imagination it is possible for most of them to do so. Could we, however, organize all of the complexities of an endlessly growing global economy to fit within the limits of the biosphere in a mostly badly governed world in which greed, corruption, corporate competition, and consumerism dominate? As you read these words, the answer is being written in the disappearing forests of Sumatra, in the mountains being flattened in Appalachia, in the 1000 MW per week of new coal plants being built in China, in the billion dollars of advertisements spent each year to stoke the fires of Western-style consumption, in glitzy shopping malls, in the fantasy world of Dubai, in the temporizing of governments virtually everywhere, and by the corporate pursuit of short-term profit. Progress toward a truly green economy is incremental, not transformational, change—and a great deal of it is of the smoke-and-mirrors sort. If we had hundreds of years to make the necessary changes, we might muddle our way to a sustainable economy, but we don't have that much time. If we intend to preserve civilization, the inescapable conclusion is that we need a more fundamental economic transformation, and that means three things that presently appear to be utterly impossible: (1) a transition from economic growth (creation of more stuff) to development which genuinely improves the quality of life for everyone, first in wealthy nations and eventually everywhere; (2) the transformation

of the consumer economy into one oriented first and foremost to needs not wants; and hardest of all, (3) summoning the compassion and wisdom to fairly distribute wealth, opportunity, and risk. The fact that these three seem wholly inconceivable to most of us indicates the scale of the challenge ahead and the necessity of a different manner of thinking.

Both dilemmas are intertwined at every point. To maintain economic growth, the powerful must have access to the oil and resources of poor third world nations whether they like it or not. Global trade, often to the disadvantage of poor nations, requires the use of military forces to patrol the seas, enforce inequities, strike quickly, and maintain pliant governments willing to plunder their own people and lands. The result is animosity that fuels global terrorism and ethnic violence. The power of envy and the desperate search for "a better life" requires the "haves" to build higher fences to keep the poor at bay. Profit and the fear of possible insurrection and worldwide turmoil drive the search for more advanced Star Wars kind of technology—robot armies, space platforms, and constant electronic surveillance. But, as Gandhi said repeatedly, our wealth and weapons make us cowards, and our fears condone the injustices that underpin our way of life and fuel the hostility that will some day bring it down.

In sum, (1) the time to heal our conflict with Earth and those between nations and ethnic groups is short; (2) both are dilemmas, not merely problems; (3) neither can be resolved by applying more of the kind of thinking that created them; (4) the connection between the two is our addiction to violence; and (5) neither can be solved without solving the other.

We are at the end of our tether and no amount of conventional rationality or smartness is nearly rational enough or smart enough. We need deeper, transformational change. The remorseless working out of big numbers, whether climate change, the loss of biological diversity, or the combination of hatred and the proliferation of heinous weaponry, is wreaking havoc on our pretensions of control. This is not the time for illusions or evasion; it is time for transformation.

Self-described realists will argue that, however necessary, humans are not up to change at this scale and pace—muddling along is the best that we can do. And for those inclined to wager, that is certainly the smart bet. But if that is all that can be said, we have no good reason for hope and might best prepare for our denouement. On the other hand, transformational change is not only necessary, but it may be possible as well. Do we have good reasons to transform the growth economy and transcend

the use of force in world politics? Is the public ready for transformation? Is this an opportune time (a "teachable moment") to do so? Do we have better nonviolent alternatives?

There is a great deal of evidence to suggest a more hopeful view of possibilities than most "realists" are inclined to see. A recent BBC poll of attitudes in 21 countries, for example, shows that a majority, including a majority of Americans, are willing to make significant sacrifices to avoid rapid climate change—even though no "leader" has thought to ask them to do so. Can we craft a fair and ecologically sustainable economy that also sustains us spiritually? The present economy has failed miserably on all three counts. As Richard Layard puts it, "we are as a society no happier than fifty years ago. Yet every group in society is richer" (Layard 2005, 223). Beyond some minimal level, in other words, economic growth advances neither happiness nor well-being. But the outlines of a nonviolent economy are beginning to emerge in the rapid deployment of solar and wind technology, in a growing anticonsumer movement, in the slow food and slow money movements, and in fields like biomimicry and industrial ecology. In world affairs, the manifest failure of neoconservative realism in the Middle East and elsewhere may have created that teachable moment when we come to our senses and overthrow that outworn and dangerous paradigm for something far more realistic—security for everyone. And at least since Gandhi, we have known that there are better means and ends for the conduct of politics.

The transformative idea of nonviolence can no longer be dismissed as an Eastern oddity, a historical aberration, or the height of naïveté. At the end of our tether it is rather the core of a more realistic and practical global realism. There is no decent future for humankind without transformation of both our manner of relations and our collective relationship with the Earth. Gandhi stands as the preeminent modern theorist and practitioner of the art of nonviolence. His life and thought were grounded in the practice of ahimsa, a Sanskrit word that means unconditional love. To denote the practice of ahimsa, Gandhi coined the word *satyagraha*, which combines the Sanskrit word *sat*, meaning truth, with *graha*, meaning "holding firm to" (Schell 2003, 119). Gandhi honed the philosophy of nonviolence into an effective tool of change in India as Martin Luther King Jr. later did in the United States, but we've never known what to do with persons like Gandhi and King. On one hand we occasionally pay them lip service in public speeches and name holidays in their honor, but on the other hand we ignore what they had to say about how we live and how we conduct the

public business. The time has come to pay closer attention to what they said and did and fathom what that means for us now.

The beginning of a more realistic realism is in the recognition that violence of any sort is a sure path to ruin on all levels and that the practice of nonviolence is a viable alternative—indeed our only alternative to collective suicide. But that implies changing a great deal that we presently take for granted, beginning with the belief in an unmovable and implacably evil enemy. Richard Gregg, an associate of Gandhi, for example, said that the goal of the practitioner of nonviolence

> is not to injure, or to crush and humiliate his opponent, or to "break his will" . . . [but] to convert the opponent, to change his understanding and his sense of values so that he will join wholeheartedly [to] seek a settlement truly amicable and truly satisfying to both sides. (Gregg 1935, 51)

As with war, the practice of nonviolence requires training, discipline, self-denial, strategy, courage, stamina, and heroism. Its aim is not to defeat but to convert and thereby resolve the particulars of conflict at a higher level. For Gandhi it required its practitioners, first, to transcend animosity and hatred to reach a higher level of being in "self-restraint, unselfishness, patience, gentleness" (Fischer 1962, 326). The aim is not to win conflict but to change the mind-set that leads to conflict and ultimately form a "broad human movement which is seeking not merely the end of war but [the end of] our equally non-pacifist civilization." In Gandhi's words, "true ahimsa should mean a complete freedom from ill will and anger and hate and an overwhelming love for all" (Fischer 1962, 207).

Gandhi applied the same logic to the industrial world of his day, regarding it as a "curse . . . depend[ing] entirely on [the] capacity to exploit" (Fischer 1962, 287). Its future, he thought, was "dark," not only because it engendered conflict between peoples, but because it cultivated "an infinite multiplicity of wants . . . [arising from] want of a living faith in a future state, and therefore also in Divinity" (Fischer 1962, 289).

The philosophy, strategy, and tactics of nonviolence have been updated to our own time and situation by many scholars, including Anders Boserup and Andrew Mack (1975), Richard Falk and Saul Mendlovitz (World Order Models Project), Michael Shuman and Hal Harvey (1993), Gene Sharp (1973, 2005), and the Dalai Lama (1999). Clearly we do not lack examples, precedents, alternatives, and better ideas than those now regnant. It is time—long past time—to take the next steps in rethinking and remodeling our economy and foreign policies to fit a higher view of

the human potential. The first steps will be the hardest of all because the impediment is not intellectual but something else that lies deeper in our psyche. Over the millennia violence became an addiction of sorts. Our heroes are mostly violent men. Our national holidays mostly celebrate violence in our past. Most of our proudest scientific achievements have to do with the violent domination of nature. There is something in us that seems to need dependably loathsome adversaries even if, sometimes, they have to be conjured. And to that end we built massive institutions to plan and fight wars, giant corporations to supply the equipment for war, and a compliant media to sell us war as a patriotic necessity. In the process we made economies and societies dependent on arms makers and merchants of death and changed how we think and how we talk. We often speak violently and think in metaphors of combat and violence, so we "kill time" or "make a killing" in the market or wage futile wars on drugs, poverty, and terrorism. Worse, our children are being schooled to think violently by electronic games, television, and movies. We have made no comparable effort to build institutions for the study and propagation of peace and conflict resolution or to cultivate the daily habits of peace. We have barely begun to imagine the possibility of a nonviolent economy in which no one profits from war or violence in any form. And so it is surprising that we are continually surprised when our collective obsession with violence manifests yet again in violence down the street or in some distant place.

The transformation to a nonviolent world will require courageous champions at all levels—public officials, teachers, communicators, philanthropists, artists, statespersons, philosophers, and corporate executives. But it will most likely be driven by ordinary people who realize that we are all at the end of our tether and it is time to do something a great deal smarter and more decent. And "somebody must begin it."