BECOMING GOOD ANCESTORS

HOW WE BALANCE NATURE, COMMUNITY, AND TECHNOLOGY

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PREFACE

It was a fine, late summer day, and my wife and I were sitting in a pontoon boat moving upstream on the Hackensack River through the marshes of the Jersey Meadowlands. Fish were jumping. Manhattan was only five miles away to the east, across another river, the Hudson. The purpose of the trip was to see birds. We had passed a multitude of them, including snowy and great egrets, great blue herons, double-crested cormorants, greater and lesser yellowlegs, assorted seagulls, northern harriers, and a single Caspian tern, with its bright red beak. As our boat glided under a highway bridge, someone shouted, "Look!" There, sitting on a concrete bridge support not far above our heads was a large, female peregrine falcon, watching us calmly. Nearby, on other beams under the bridge, were two more peregrines, a male and another female.

Why begin my preface with this anecdote? Because a half-century earlier, the river was filthy, there were almost no fish in it, the only birds were seagulls feeding on garbage and hawks eating rats at the many dumps near the river, and the peregrine falcon was well on its way to what seemed certain extinction. Then, a fortuitous combination of events and people turned the situation around. The U.S. Clean Water Act eliminated unregulated garbage dumping. Andy Willner, of the American Littoral Society, started the New York/New Jersey Baykeeper;

and Bill Sheehan gave up his safe job as a cab driver and dispatcher to start the Hackensack Riverkeeper. These organizations mobilized concerned citizens throughout the regional watershed and became powerful forces to ensure that conservation gains were preserved. Meanwhile, Derek Ratcliffe, chief scientist of Britain's Nature Conservancy Council, discovered that DDT was the cause of the decline of the peregrines and other hawks and eagles, ultimately leading to widespread banning of the pesticide. And in the United States, Tom Cade, of Cornell, began an emergency program to release captive-reared peregrines into the wild. In 1974, when he released his first falcons, there were fewer than forty pairs nesting in the lower forty-eight states. By 1999, the number of nesting peregrines had grown to more than two thousand, and the bird was removed from the endangered species list. Nature is resilient if we give it a chance.

Victories like these are a true cause for celebration. But they are all too infrequent, occurring only when highly specific, defined problems have equally specific and defined solutions—regulate garbage dumps and other point sources of pollution; form effective, local nonprofit organizations to monitor local habitats and lobby for their protection; ban the use of toxic chemicals that are persistent in the environment; and breed replacements for the animals that the chemicals affected. Unfortunately, most of our problems these days are not so simple to understand or straightforward to solve, and they are growing in severity and number.

The complex interactions among society, technology, and the natural world in the twenty-first century may seem beyond our comprehension, yet there are underlying, destructive patterns that we can grasp. Some of them are: retreat from reality, alienation from nature, unthinking acceptance of new technology and rejection of the old, loss of our ability to discriminate between events we can control and those we cannot, denial of noneconomic values, and the disempowerment of local communities.

Becoming Good Ancestors is an examination of these destructive patterns through down-to-earth examples, and a discussion of how we can use what we learn to move ourselves and our society toward a more stable, less frantic, more responsible, and far more satisfying life. A life in which we are no longer compelled to damage ourselves and our environment. A life in which our parents and our children have a future. A life in which we hear more truth than lies. A life in which fewer species are endangered and more rivers run clean.

Such goals are not utopian pipe dreams. As the example of the Hackensack River and the peregrines shows, our society has an inherent sense of what is right and the creativity and persistence to make good things happen. It is now time to apply our intelligence guided by our moral judgment to the very largest difficulties we all face. We are in the eye of the future and should behave accordingly.

This book is an expanded, extensively revised, and updated version of my book *Swimming Lessons*, published in 2002. The chapters in *Swimming Lessons* first appeared as "Raritan Letters" in *Orion* magazine, and I thank *Orion* for giving me permission to reprint them. My editor at *Orion*, Aina Barten, worked with me on all of the Raritan Letters, providing her invaluable critical judgment of both the literary style and the content of what I had written. Emerson Blake, then the managing editor at *Orion*, was also immensely helpful and supportive.

My present editor at Oxford University Press, Peter Prescott, first suggested that I should turn the original book into something new, with greater cohesion and sharper focus—a book that would meet the real needs of the twenty-first century. And it was Peter who, with kindly but pointed criticism, prompted me to revisit every sentence and every claim in the older book, in a rewriting that took far longer than I had first anticipated. I thank him for his wisdom, his confidence, and his endurance.

Many people have helped and inspired me in my work. I am especially grateful to my friends Wendell Berry, David Orr, and Wes Jackson, undergraduates too numerous to name, and my present graduate students Kristi MacDonald-Beyers and Joe Paulin. I also thank professor Kristen Conway-Gómez and the other faculty and students in the First Year Experience course at California State Polytechnic University, Pomona, for their insightful criticisms and suggestions.

As the readers will discover, my ideas are inseparable from my life and experiences, and this means inseparable from my children: Kate and her husband Dan, Jane and her husband Michael, Jon, and Sam. They are woven into my stories as they are woven into my existence, both of which are enriched beyond my power to thank or describe. And as they grow older, I have found their comments about what I

have written increasingly valuable. They have suggested new sources, criticized my ideas, helped me rewrite paragraphs that didn't work, ruthlessly deleted sections they didn't like, and laughed at me when they felt it was necessary. Rarely can a parent have been blessed by so much wisdom and love from his daughters and sons. No doubt they take their cue from their mother, Joan, my companion and guide for thirty-eight years. Joan, a distinguished ecologist, has read and improved every sentence of this book. Her love and care have supported me throughout its creation.

Needless to say, with friends and family like these, the only parts of *Becoming Good Ancestors* that are exclusively mine are any errors that may have remained.

New Brunswick, New Jersey
January 2008

BOOKMAP

This book has been twenty years in the making, piece by piece, and for more than half that time I didn't know it was going to be a book. Not surprisingly, the parts of the book fit together the way the parts of a life fit together—the connections are not necessarily obvious even though there are underlying themes that run throughout. I expect that my readers will want to know where they are headed in the pages that follow, so here is the bookmap for *Becoming Good Ancestors*.

The first section, "In Search of Honesty," continues an idea that I developed in my earlier book, *The Arrogance of Humanism*. The idea is that although we humans can use our unique brains and rational powers to create and do remarkable things, we can't do everything; not all limits we face are temporary. But the incredible successes of some of our inventions—from laptops to kidney transplants—have blinded us to the failures of others; the "Star Wars" missile shield and our indiscriminate use of genetic engineering in agriculture are but two examples. We pretend that we can brainstorm and invent our way out of every fix without making any fundamental adjustments in our lives. This is a fantasy. As long as we are honest with ourselves and recognize the difference between fantasy and reality, fantasy can help us find solace from harsh realities. When fantasies govern our actions, we forfeit control over our lives.

"Keeping Track of Our Losses," the second section, is a response to a world changing so rapidly that it is easy to lose sight of the things that have worked well in the past yet have been swept aside in the tsunami of what is called progress. Of course we can say good riddance to many of the evils in the lives people lived one hundred years ago, but can we afford to forget all the social inventions and practical ways of living that have helped us survive up to this point? Here I describe precious features of our former life that are disappearing—stability in the workplace; the ability to take time to make important decisions; the joy of maintaining deep relationships with people who are physically close enough to be seen, heard, and touched; the pleasure of reading the great and lesser works of our literature and being able to write in a way that does credit to our remarkable language. And I cast light on the dark mechanisms that help us forget them—ready adaptation to conditions that we ought to resist; galloping obsolescence that destroys perfectly useful inventions; and the increasingly rapid development of electronic substitutes for human beings. If we are aware of what we are losing and why we are losing it, we have a better chance to halt and reverse the cultural erosion that is taking place around us.

Part 3, "Toward a Sustainable Economics," is an account of what happens to us and to our environment when we translate all of our values into economic terms and subordinate all of our decisions to techno-economic imperatives and the ethics of globalization and growth. This is a wide-ranging section of the book—it goes from tuna-fishing fleets to Chinese turtle and tiger farms to corporations that live forever and seem beyond the law; from Baffin Island to Lenapehoking (now New Jersey) to the Venezuelan rain forest. Economics has stopped being practical, if it ever was, and has lost touch with the world we live in. When economic beliefs and practices are dissociated from their effects and consequences, and the feedback that fosters positive change disappears, bad things happen. If we stop looking at everything solely through an economic lens, it is much easier to see what we have to do.

"Relating to Nature in a Human-Dominated World," part 4, has more chapters than any other part of the book, yet it is least in need of a bookmap. I think that the unifying themes are simple and evident: First, we need regular, frequent, informal contact with nature to keep ourselves and our world healthy, but modern life increasingly walls us (especially our children) off from the living environment. Second, despite the amazing discoveries of our science and the more amazing claims of its publicists, many of nature's workings remain a mystery to us. Third, there are many ways to reconnect with nature. Fourth, nature can and usually does regenerate by itself if you let it; our substitutes for nature don't. And fifth, nature presents a parade of fascinating surprises. A few of the surprises that I discuss are: thousand-year-old black spruce trees in Quebec that are little more than a foot tall; a six-hundred-pound female Alaskan grizzly bear ordering her two cubs to stay away from a terrified hiker who has fallen down a few feet from her path; huge Louisiana alligators that, in the nineteenth century, refrained from attacking the little boys who often swam next to them and pelted them with mud for fun; and English lime (linden) trees that won't spread to apparently suitable parts of the countryside adjacent to their present stands if these adjacent areas are outside the boundaries of what once were the Neolithic forestlands where lime trees used to grow.

The last section, "Restoring the Community," is neither a hearkening back to good old communities that never existed nor an anticipation of utopian communities that never will exist. Rather, it is a recognition (perhaps prediction would be a better word) that in a world constrained by growing shortages of energy and raw materials, and fractured by the breakdown of globalization, local communities will regain a good deal of their former importance. In other words, local communities will be coming back, like it or not, and it will be greatly to our advantage if we learn the elements that make them good places in which to live, places that reconcile human freedom and responsibility in harmony with the environment. We also need to learn how to avoid or ameliorate those elements that can make local communities terrible. This is not going to be an easy task, and it certainly will be done in many ways, according to circumstances. There is no single blueprint for community restoration. However, we can be aware of the place of traditions; we can try to identify the social mechanisms that stabilized communities in the past; we can learn how to make our schools and universities more responsive and useful to the neighborhoods around them; and we can discover how to raise children who will be assets to their communities. Throughout the section on "Restoring the Community," and in the sections before it, my arguments are tied to one central assumption: The way we behave and the values we espouse are at least as important for repairing the world as the plans we make for improving the future. Finally, in the epilogue, I explore those tenets of conservative and liberal philosophies that will have to be brought together if community, national, and planetary restoration is to succeed, and I look at some early, practical ways in which this is being accomplished.

There is a great deal of overlap among the five sections: for example, nature and ecology appear throughout the book. The themes of these sections are related; they are all part of a larger whole, my vision of what we have to know and have to do to make our way of life sustainable, deeply enjoyable, and fulfilling—a life that will make us good ancestors for our descendants.

The vertigo of the twentieth century needs no permission of yours or mine to continue. The tornado has not consulted any of us, and will not do so. This does not mean that we are helpless. It only means that our salvation lies in understanding our exact position, not in flattering ourselves that we have brought the whirlwind into being by ourselves, or that we can calm it with a wave of the hand.

Thomas Merton, "A Letter to Pablo Antonio Cuadra Concerning Giants"

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ONE

IN SEARCH OF HONESTY

Never has failure been so ardently defended as though it were success.

John Ralston Saul, *Voltaire's Bastards*[1]

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PRETENDING

> For as high as [the ostrich's] body is, yet if they thrust their head and neck once into any shrub or bush, and get it hidden, they think then they are safe enough, and that no man seeth them.
>
> Pliny the Elder, *Natural History*[1]

My earliest memory—was I two? three?—is of a nurse or babysitter who was dressed in white and had a bad smell. When she came into my room, I would pretend to be asleep. She looked down at me (I could sense her presence), then, satisfied by my closed eyes and quiet, if shallow, breathing, would turn and leave the room. Soon her odor would go away, too, and I could breathe deeply again. This taught me a lesson of dubious value: when helpless in a situation, pretending can give you power. A small, weak child, I had controlled the movements of an enormous, smelly adult. It was some time later, I suppose, when I learned that pretending usually doesn't work. Although I can't recall the time or place, I know that on one grim day of disillusionment and reckoning I discovered that when I closed my eyes I didn't become invisible; I couldn't transport bullies to distant, foul places by imagining them there or alter the course of unwelcome events by pretending they were otherwise.

Healthy children come to know the difference between pretending that is relaxing, stabilizing, healing, necessary—we call it fantasy—and pretending that is dangerous. A hot fire burns, even if we pretend that it won't. In our personal lives most (but unfortunately not all) of us learn to instantly distinguish harmless from harmful pretending so that we do not pretend in a way that endangers our lives or physical well-being.[2] Strangely enough, this discrimination does not seem to apply to many common beliefs that we share within our society. For at least the past fifty years, probably longer, we have been working hard as a high-tech civilization to ignore the limits of safe pretending.[3]

To be fair to ourselves, our pretending is not exactly of the childhood fantasy variety—it is not derived from magical thinking, like the remarkable abilities of Harry Potter or the superhuman destructive powers granted to the players of electronic video games. Instead, our pretending springs from very real, solid beginnings, and this is what makes it so difficult to recognize and to control. When reality transitions seamlessly into pretending, and when both are certified by experts as true, how do we know where to draw the line?

In the next few pages, I give three case studies of this most dangerous kind of pretending, in which the initial reality camouflages the subsequent fantasy: genetic engineering in medicine and agriculture, the use of scientific models to predict future events, and the "Star Wars" research to develop ways of shooting down incoming enemy ballistic missiles. Although superficially dissimilar, these case studies have a number of features in common. There is an initial, well-intentioned, even benevolent goal that no right-minded person could reject—curing all genetic diseases and ending world hunger; predicting how long our beach stabilization measures or nuclear waste storage facilities will remain effective and safe; preventing the annihilation of cities by nuclear-tipped warheads loosed by a rogue power. In each case, there have been enough successes or partial successes to give some credence to our hopes. And in each it is finally a few of the experts themselves who say, "Enough! Our pretending is causing real damage, and it's time to stop."

The first case study is genetic engineering. In my last year of college, I was fortunate to have as one of my teachers a visiting professor from England, Francis Crick of Watson and Crick fame, who taught part of an upper-level biochemistry course on the structure and function of macromolecules, especially deoxyribonucleic acid, or DNA. Those were exciting days. Crick, a master teacher, explained his and Watson's model of DNA with brilliant clarity. The structure of DNA, the sequence of its four kinds of component molecules (bases), was like a book, in that it contained information that was then copied into a sister molecule, RNA. RNA, in turn, used this information to direct the synthesis of the many different proteins that formed or helped to synthesize all the molecular parts of the cell. This was the "central dogma" of molecular biology: DNA makes RNA makes protein. Genes are made of DNA, and the genetic "code" of the DNA molecule, it appeared, is the same for all organisms—plants, animals, microbes. Decipher the DNA code of one, several, or perhaps all the genes of a species, and the possibilities for manipulation and control of the growth, metabolism, form, and behavior of that organism are limitless. At least that's what we believed.

In the 1960s and '70s, the central dogma gave birth to the new field of genetic engineering. At the core of genetic engineering was transgenics, the semicontrolled transfer of genes from one individual to another, even across species boundaries. In the decades that followed, bacterial genes were moved into corn and soybeans; goats were engineered to express the silk-making genes of spiders; human genes were transferred to sheep, pigs, salmon, and other creatures. Genes have been deleted, added, and, to some extent, modified to achieve the desired results. The very nature of a species and the boundaries between species have come to be seen, at least to uncritical eyes, to be as malleable as soft clay. Genetic engineering, as portrayed by many of its practitioners and believed by much of the lay public, appears to have a limitless potential to modify humans and other life forms in desired directions—to cure most major diseases, to improve physique, to raise IQ, to overcome the limits of the most basic biological processes (such as photosynthesis), and to alter for the better any other biological attribute seen as undesirable. The student genetic engineering club at my college calls itself "Designer Genes."

Yet such claims fall far short of reality. Despite the enormous popular enthusiasm whipped up by the press and the financial markets, only a small proportion of the simplest possible genetic manipulations among the many that have been tried have worked at all. And many of these have turned out to be disappointing, dangerous, or both. The central dogma concerning the importance of DNA remains largely true, and its discovery is rightly celebrated as one of the greatest feats of twentieth-century science, but the precise control attributed to it is mostly imaginary. It has become increasingly apparent that DNA is only a part of the story—itself subject to other regulating and modifying influences in the cell, influences that we dimly understand. Rather than being at the top of a simple linear chain of command, the DNA of the gene should be seen as one piece of an interacting complex of regulatory systems and feedback loops, with no single element "running" the cell, let alone the entire organism.

Richard Lewontin, a senior molecular biologist at Harvard and a member of the U.S. National Academy of Sciences has said: "The bottom line is that life in all its manifestations is complex and messy and cannot be understood or influenced by concentrating attention on a particular molecule of rather restricted function."[4] Nowhere is this wisdom more studiously ignored than in the claims and promises of genetic engineers that our knowledge of the sequence of the human genome will lead to cures of most diseases. Lewontin has commented frankly about these claims:

> Unfortunately, it takes more than DNA to make a living organism. . . . According to the vision [of the genetic engineers], we will locate on the human chromosomes all the defective genes that plague us, and then from the sequence of the DNA we will deduce the causal story of the disease and generate a therapy. Indeed, a great many defective genes have already been roughly mapped onto chromosomes and, with the use of molecular techniques, a few have been very closely located and, for even fewer, some DNA sequence information has been obtained. But causal stories are lacking and therapies do not yet exist; nor is it clear, when actual cases are considered, how therapies will flow from a knowledge of DNA sequences.[5]

Why are the hopes of the public being raised so recklessly? There are many reasons, of course, including the unrealistic expectations that the public has of scientists. But I do not think it is cynical to cite another motive. I quote Lewontin again from the same reference: "No prominent molecular biologist of my acquaintance is without a financial stake in the biotechnology business." Sheldon Krimsky, a bioethicist at Tufts

University and former member of the National Institutes of Health Recombinant DNA Advisory Committee, has carefully documented the spectacular increase in recent years in the number of academic biotechnologists who are on the boards or scientific advisory committees of or own stock in the for-profit companies that are supporting their research. Krimsky asks:

> Can this pattern of behavior continue without any detriment to science? An editorial contributor to the *Journal of the American Medical Association* wrote: "When an investigator has a financial interest in or funding by a company with activities related to his or her research, the research is lower in quality, more likely to favor the sponsor's product, less likely to be published, and more likely to have delayed publication."[6]

The British molecular biologist and biophysicist Mae-Wan Ho has described the biological reasons that underlie the multiple failures and dangers of genetic engineering and related technologies such as cloning. In her very important and lucid book *Genetic Engineering: Dream or Nightmare?* Ho explains some of the biological challenges to genetic engineering. They include the instability of transgenes, overlapping genes, gene amplification and inactivation, environmentally induced changes in gene expression, inheritance that does not involve the DNA code, and even, possibly, the inheritance of acquired characteristics. She asks: "Would anyone think of investing in genetic-engineering biotechnology if they knew how fluid and adaptable genes and genomes are? The notion of an isolatable, constant gene that can be patented as an invention for all the marvellous things it can do is the greatest reductionist myth ever perpetrated."

In other words, the idea that these patented transgenic organisms (and there are now many) are genetically stable and capable of performing consistently as desired for long periods of time and through many generations, like a patented machine, is not biologically warranted. Ho also carefully evaluates the hazards of genetic engineering, particularly the increased risk of spreading antibiotic resistance among disease organisms and human and animal populations, and the risk that gene-transfer technologies will create new varieties of virulent pathogens. Citing the molecular geneticist Joe Cummins, Ho pointed out that "the powerful promoter from cauliflower mosaic virus, which is routinely used to drive gene expression in transgenic plants is closely related to the human hepatitis B virus and also has sequence homologies to human retroviruses such as the AIDS virus," and she warned that "two kinds of potential hazards can be envisioned: the reactivation of dormant viruses, and recombination between the CaMV promoter and other viruses . . . to generate new super-infectious viruses or viruses with a broadened host range."[7]

Genetic engineers have not reacted kindly to Ho's book. For example, in 2002, the genetic engineer M. Tepfer criticized Ho's fears of the CaMV promoter as "implausible"; yet in a 2004 paper, Tepfer and his colleagues admitted that "the multiple complexities and uncertainties involved in this work introduce an element of risk that cannot be ignored."[8]

In a well-documented case, the risks of creating genetically modified organisms were proven to be very real. At the Cooperative Research Center (CRC) for the Biological Control of Pest Animals and the John Curtin School of Medical Research at the Australian National University, both in Canberra, researchers produced a genetically altered mousepox virus designed to control rodent populations in Australia. To their horror, the recombinant virus wiped out all the experimental animals, even those that had been vaccinated against it. The leader of the research team, CRC director Bob Seamark, said: "This is the public's worst fears about GMOs come true. . . . We . . . had shown that a commonly used technique could overwhelm resistance and render vaccination useless." Anabelle Duncan, a former head of the United Nations inspectors in Iraq and chief of molecular scientists at Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) commented: "This shows that something we had thought was hard—increasing the pathogenicity of a virus—is easy." The only positive aspect of this terrifying episode is the honesty and public-spirited behavior of the scientists who conducted the research.[9]

The Australian researchers destroyed the deadly recombinant mousepox virus before it could escape to the outside environment. Unfortunately, because of the enormous number of recombinant organisms being tested by many laboratories in many venues, genetic hazards are not always discovered in time. In the so-called ProdiGene Incidents, corn engineered by a small Texas company to produce drugs for diabetes and diarrhea contaminated soybean fields in Iowa and Nebraska, as well as a Nebraska grain elevator. The U.S. Department of Agriculture ordered the 500,000 bushels of contaminated soy in the grain elevator destroyed, and 155 acres of contaminated fields in Iowa burned. The Grocery Manufacturers of America, speaking for an alarmed food industry, called for a moratorium on food crops genetically modified for drug production, pending strict government regulation.[10] But even the limited safety protocols that are in place are not necessarily followed.[11]

Some biotechnologists are scrupulously honest about the implications of their work. For example, in an article in the March 30, 2001, issue of *Science*, MIT's Rudolf Jaenisch and the Roslin Institute's Ian Wilmut (the cloner of Dolly) described the "drastic defects that occur during development" and the "high failure rates" that are part and parcel of the cloning of mammals; and they warn that the cloning of humans would be "dangerous and irresponsible," and will remain so for the "foreseeable future."[12] But these scientists may be exceptions. Commenting on biotechnology's frantic rush to create new organisms, Ho writes, "What the public is up against is a selective blindness to evidence among the genetic engineers and a single-minded commitment to look solely for the exploitable, which is the hallmark of bad science." In other words, most genetic engineers are pretending that their technology works as claimed, is stable, and is safe—that the euphoria of 1960 is still scientifically justified, in spite of what we have learned since then. Nor is the public entirely blameless in the matter. Especially in the United States, we have been all too willing to make the effortless choice of following the biotechnologists into uncharted territory, eyes and minds tight shut, delusions intact.

One of the most blatantly unrealistic forms of pretending is the faith that agricultural biotechnology, including genetic engineering to produce genetically modified organisms (GMOs), will end hunger. Peter Rosset, an expert on agricultural technology and codirector of Food First/The Institute for Food and Development Policy, in Oakland, California, has submitted this claim to critical analysis. There is no relationship, he finds, between the prevalence of hunger in a given country and the density of its population. "For every densely populated and hungry nation such as Bangladesh or Haiti, there is a sparsely populated and

> underpinnings of biospheric services that will be degraded and destroyed by our progressing use of energy and materials.[4]

For a little while there will be more conglomeration and centralization, and a few decades of additional damage—but the days of globalization seem numbered. Now is the time to prepare ourselves for the world that will likely follow, a world of increasing smallness, fragmentation, and decentralization, a world with re-empowered communities and exciting possibilities but also great problems—not Utopia.

It may seem premature to anticipate the demise of globalization while giant corporations are merging or swallowing each other up at a frightening rate, and new technologies that shrink the earth and enhance our ability to change it are announced almost daily. Yet remember the Soviet Empire in 1970: the tightness of its control over each and every individual and nation in its vast domain was unprecedented in human history. Who would have predicted that it would all be over twenty years later? The philosopher of history John Ralston Saul has written, "Nothing seems more permanent than a long-established government about to lose power, nothing more invincible than a grand army on the morning of its annihilation."[5]

After globalization comes to an end, are we likely to find large numbers of healthy communities well-stocked with public-spirited, self-sufficient women and men, communities in balance with other, similar communities, all contained within ecologically reasonable bioregions? Will we have enough good, wholesome food to eat, snug houses, roofs that don't leak, and the health to enjoy these blessings? Will we find, as Frodo did at the end of *The Lord of the Rings*, "a sweet fragrance on the air . . . the sound of singing . . . over the water," and see "the grey rain-curtain turned all to silver glass and . . . rolled back," revealing "white shores and beyond them a far green country under a swift sunrise"? I doubt it. Frodo was leaving the world in which he had struggled so long and to such good effect.[6] We will have no such choice.

We have to stay put, and it will not be Utopia. What we will find is that the damage already done to the earth's "biospheric services" (such as healthy ecosystems and a relatively stable atmosphere) and the damage to its people, plus the hidden costs of the ending of the present techno-economic system with both the bad and the good that it contains, will have conspired together to deprive us of the world of our dreams. Once the problem of bigness and globalization has faded or disappeared, other problems will take its place, just as the nineteenth-century scourge of child labor was followed by the twentieth-century scourge of idle teens haunting the street corners, drug-intoxicated and violent. Many of the troubles of the decentralized, low-tech world to come are not hard to predict, and this is the time, during the tumultuous transition, to think about them if we can. In an address delivered to the International Academy of Philosophy, meeting in Liechtenstein in 1993, Aleksandr Solzhenitsyn said: "We all see and sense that something very different is coming, something new and perhaps quite stern. No, tranquillity does not promise to descend upon our planet and will not be granted us so easily."[7] The new problems, I believe, will sort themselves out into two overlapping groups: techno-environmental problems, and human social and economic problems.

It is too early to assess the extent and permanence of the many kinds of damage done to the earth in our time, nor can we gauge the effects of this damage on our successors. For example, during the first centuries of European colonization in North America, there was rich, uncontaminated topsoil almost everywhere; abundant, easily accessible oil and iron; and apparently limitless old-growth forests containing massive trees beyond number. In the twenty-first century, these resources are sadly depleted. To fill the resource gap, we have turned to other, poorer and economically defenseless regions of the world, stripping them bare; the harm done to these places is greater than what we have inflicted on ourselves. How will we manage with what is left? A society of rich consumers is about to become a society of poor scroungers: ripping shingles, plumbing, and fixtures from abandoned suburban houses, searching the innumerable rubbish heaps left behind by a spendthrift culture for yesterday's trash—tomorrow's necessities.[8]

Some of the myriad concerns that the residents of Utopia will face are scarcity of clean drinking water, the droughts, storms, and floods brought on by grievously disrupted climates, toxic dumps everywhere, the widespread disappearance of useful, practical skills and knowledge, the spread of destructive exotic species, and poorly controlled infectious diseases. Ironically, all of this will happen in the absence of the powerful, globally coordinated science and technology that might have been counted on to give real assistance, or at least reassurance.

And what will become of the countless inventions and services created during the technological explosion once technology and its parent, science, have been starved by shortages of resources, money, and well-educated recruits? What will survive and what will disappear? Many of us will not miss supporting the army of technicians and technocrats working on an antiballistic missile defense shield that is almost certainly doomed to fail, or the production of expensive, high-tech weapons that don't win wars. The demise of NASA's hideously expensive interplanetary program and the space shuttle will not be mourned by all. These are technologies that eat up a nation's wealth while offering little that is commensurate in return, and their production requires a level of centralization, coordination, and control unique to history. In like spirit, we can gladly wave goodbye to recombinant bovine growth hormone, along with the totally unnecessary social, medical, and economic problems it has spawned.[9]

But there are technologies we may be more reluctant to lose. Computers, peripherals, and computer networks consume an inordinate amount of electric power to run and fresh, clean water and other resources to produce—far more than may be available if the majority of the world's people decide to go electronic. How much of this technology will we be willing to do without? The earth-observing satellites, both NASA and private (Landsat, EOS, Digital Globe, etc.), provide a host of vital information about climate change, sea level rise, human population shifts, and other variables that used to be very hard to measure. Similarly, we ought to wonder and worry about what it might mean to give up magnetic resonance imaging (MRI), a benign and useful but resource-consumptive technology that depends for its existence on a high order of economic centralization, exploitation, and reliable energy. The Global Positioning System (GPS—also dependent on satellites), which has revolutionized navigation, is a similar example. Many other technologies in this category seem equally vulnerable.

Perhaps under ideal circumstances we will be able to selectively save some of the softer, more beneficial technologies for use in our decentralized green Utopia. More probably, the entire technological system is so heavily interlinked and so thoroughly dependent on political and

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