

APOLOGIES TO THE GRANDCHILDREN

Civilization is, by its very nature, a long-running Ponzi scheme. It lives by robbing nature and borrowing from the future, exploiting its hinterland until there is nothing left to exploit, after which it implodes. While it still lives, it generates a temporary and fictitious surplus that it uses to enrich and empower the few and to dispossess and dominate the many. Industrial civilization is the apotheosis and quintessence of this fatal course. A fortunate minority gains luxuries and freedoms galore, but only by slaughtering, poisoning, and exhausting creation. So we bequeath you a ruined planet that dooms you to a hardscrabble existence, or perhaps none at all.

I

It is not as though we did not have ample warning that industrial civilization was becoming the author of its own demise. In 1954 Harrison Brown argued that a profligate “machine civilization” was burning through resources at such a rate that it would soon be bankrupt. Hence the industrial age was likely to be only a brief historical interlude between two long epochs of agrarian civilization. In the unlikely event that we escaped this fate, the outcome would be a nightmarishly regimented dystopia. He therefore urged humanity to make a timely transition to a high-level agrarian civilization, one that retained many technological advantages and offered the prospect of reasonably good life for centuries to

come. To wait until necessity forced our hand would guarantee a bleak future of exhausted mines, depleted soils, toxic environments, and limited possibilities.

Brown's larger point was that political, social, and economic systems are decisively shaped by the quantity and quality of the available resources, especially the energy resources that are the sine qua non for exploiting every other resource. This was spelled out in more detail by Fred Cottrell in 1955. Using an array of historical examples, he showed that the availability of energy effectively determined the nature and fate of societies. And as the resource base on which it depended deteriorated, industrial civilization would experience a decline in the "net amount of surplus energy."¹ This would compel a painful regression to the mean that existed before the age of fossil fuels—i.e., an agrarian civilization.

Along these same lines, William Ophuls argued in 1977 that the relatively open, egalitarian, individualistic, and libertarian societies prevailing in the modern world were the luxuriant fruit of an era of unparalleled ecological abundance occasioned first by Europe's appropriation of the New World's mostly untapped resources and then by the exploitation of first coal and then petroleum. The return of ecological scarcity presaged by the decline in net energy, the depletion of major resources, the rise in management costs, the growth in pollution, and the increase in population would cause the process to operate in reverse. The golden age of individualism, liberty, democracy, and

¹ Now known as EROI or EROEI (energy return on energy invested).

mass consumption would be over, and society would resume its former shape—namely, that of pre-industrial civilization, socially, economically, and politically.²

Industrialization and pollution have always gone hand-in-hand but without diminishing the belief in economic growth as an almost unmitigated good. That began to change in 1962 when Rachel Carson documented the harm caused by pesticides, especially DDT, and by extension the danger of other organically active compounds released into the environment with little regard for ecological or human costs. And in 1965 the terrible consequences of heavy-metal poisoning from industrial pollution became apparent when heart-rending photos of the victims of Minamata Disease were widely published. The growing contamination of rivers and lakes with a variety of chemicals as well as of air sheds with smog also became headline news at this time. The result was some effort by the early 1970s to control the most glaring forms of pollution, but the steady drip of contaminants into the environment has never ceased, because it is intrinsic to mass consumption and the industrial process.

In 1972 the Club of Rome's report on the limits to growth expressed a deeper systemic understanding of humanity's ecological predicament. Donella Meadows and her colleagues constructed a simple but elegant computer model that linked data on food, population, pollution, industrial output, and resources

² A recent work by Ian Morris explores in some detail how values, practices, and institutions are ruthlessly shaped by cultural selection for what works best given the quantity and quality of energy available to a population. (Thus the radical differences in the lives of foragers, farmers, and industrial peoples.) This evolutionary dynamic operates over time to push societies at the same energy level toward a common structure with similar mores and politics.

to show their interaction over time. The model revealed that, if current trends were allowed to run their course, industrial civilization would overshoot by far the carrying capacity of the Earth and experience a traumatic collapse. The authors suggested an array of reasonable policies to forestall this outcome. The report drew widespread attention, but also savage criticism (much of it uninformed), and its recommendations were not adopted. Other authors—Ophuls in 1977 and William Catton in 1980—used prose to describe the same predicament: overshoot followed inevitably by collapse unless major remedial actions were taken decisively and soon.

Meanwhile, philosophical critics of industrial civilization saw its ecological sins as symptoms of a larger problem. In 1973 E. F. Schumacher argued that not only was modern technology unnecessarily harmful ecologically but also that it was mostly unnecessary, because we could make a reasonably good life for ourselves without depriving posterity if we were to use simpler, thriftier “intermediate technologies” more adapted to human needs. Then in a series of provocative works published from 1971 to 1974, Ivan Illich launched an attack on the values and practices of industrial civilization. He argued that the “shadow price” attached to industrial goods and services exceeded their true value, that industrial systems robbed individuals of agency and autonomy by exercising a radical monopoly over most spheres of life, and that as a consequence we had become inmates in a technological asylum. In effect, we were enslaved by our

energy slaves and needed to free ourselves by slowing down and radically simplifying our lives.

More than a decade later, in 1990, the Intergovernmental Panel on Climate Change, a world-wide coalition of experts under the aegis of the United Nations, published the first in a series of reports documenting how human activities were inducing a slow but sustained warming of the atmosphere that, if allowed to continue, would have serious impacts on the biosphere and human life. Each successive report (the latest in 2013) has shown the evidence for human-caused climate change to be stronger and the urgency of action greater.³ Because of inertia in the climate system, the impact of CO₂ on the atmosphere can take decades to manifest fully, making a proactive response essential. Although the international community has acted to curb emissions, the proposed measures appear to be too little and too late to prevent serious harm to the biosphere and human life.

An update to the Club of Rome's report appeared in 1992. It responded to valid criticisms of the original model and used newer data, but the outcome did not change. Except now that another 20 years had elapsed, the actions required to avoid the worst consequences of overshoot were both more stringent and more urgent. The report attracted none of the attention of the original.

³ A more recent report issued by the U.S. government freshens the data and reaches a similar conclusion: the problem is very real and time grows ever shorter. See **USGCRP**, 2017: *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp.

In that same year, 1,700 of the world's leading scientists published *World Scientists' Warning to Humanity*. It said that human beings and the natural world were on a collision course that portended serious risks to both parties and urged fundamental changes to forestall catastrophe. In effect, it threw the full weight of the scientific establishment behind the ecological case for radical changes in our way of life. The response to this warning was business as usual.

Undeterred by the tepid reception of the 20-year update, the authors published a 30-year update of *Limits to Growth* in 2004. Refinements to the model and newer data changed almost nothing. In fact, the original model had tracked real-world trajectories very closely. However, an additional ten years without decisive action to forestall overshoot and collapse had increased both the urgency and the magnitude of the required measures. Now only drastic actions would suffice. Again, the report attracted none of the attention of the original.

Then in 2017, 25 years after the original warning, 15,364 scientists from 184 countries signed *World Scientists' Warning to Humanity: A Second Notice*. Its message was blunt: industrial civilization was courting catastrophe and needed a total makeover. Virtually all of the adverse trends specified in the first warning have worsened, and time has grown far shorter. Urgent and radical action was therefore needed to forestall widespread ecological damage and human misery.

Since the 13 actions specified in this second warning would stop industrial civilization in its tracks, cause massive disruption to business as usual, and require almost everyone to make major sacrifices, the likelihood of their being implemented, in whole or even in part, is effectively zero. As Illich warned, industrial man has become a slave to his energy slaves, totally addicted to the industrial production of goods and services and unable to envision any other way of life.

Illich also correctly intuited that the bads created by industrial civilization had begun to outweigh the goods. This is due to the operation of a basic physical law, the Entropy Law, which states that greater order (i.e., a good) in one part of a system inevitably implies greater disorder (i.e., a bad) in another. Thus when coal is burned in a power plant, only about 35 or 40 percent of the original energy in the coal becomes electricity (the good) while the remainder becomes pollution in one form or another (the bad), and even the good is dissipated as low-grade heat once it has done its work. To speak of fossil fuel use more generally, besides being a depleting, non-renewable resource, it necessarily involves a host of “negative externalities,” “unintended consequences,” and “side effects”—mostly euphemisms for bads, both ecological and social. Above all, it involves the release into the atmosphere of the CO₂ that causes the warming that will in turn lead to a rise in sea levels, desertification, extreme weather, and other threats to our current way of life.

Even areas not directly tied to energy production follow the same law. Modern medicine, for example, can perform what would have been seen as miracles in olden times, but the costs are high—not just financially, but also in terms of iatrogenic disease and other “side effects,” such as the release of antibiotics and hormones into the environment where they have begun to negatively impact not only animal populations but also human health. The essential meaning of entropy for human life was well stated by Carl Jung: “Everything better is purchased at the price of something worse.”⁴

If every good implies an equal and opposite bad—in fact, as the example of coal above illustrates, the bad can outweigh the good—what allowed the Industrial Revolution to be such a success? The answer is sixfold. First, most obvious, it began with an abundance of high-grade resources. Second, the original bads, such as industrial waste, were relatively small compared to the atmosphere or the rivers into which they were discharged. The harm did not go unnoticed, but the damage seemed minor compared to the benefits. Third, the benefits and costs of industrialization were not distributed equally. The industrialists and their allies profited greatly, the natural world and the poor, disadvantaged, or colonized paid the price. Fourth, due to inertia in the system, a major portion of the costs of industrialization were shoved into the future. As with the climate regime, the effect of current industrial activity does not always become apparent until decades into the future. Hence grandchildren pay for the

⁴ C. G. Jung, *Memories, Dreams, Reflections*, ed. Aniela Jaffe, trans. Clara and Richard Winston (New York: Vintage, 1989), 236

ecological sins of grandparents. Fifth, even the slowest rate of growth is exponential. Thus the absolute amount of both goods and bads grows steadily over time, doubling and doubling again until the burden of bads becomes impossible to sustain. Finally, sixth, economic growth involves an inescapable increase in complexity whose management requires ever more time, energy, resources, and money—a burden that, again, grows larger over time, forcing the society to run harder and harder just to stay in the same place.

That industrial civilization is being strangled by a slowly tightening noose of ecological scarcity has been apparent to anyone who cares to examine the evidence without prejudice. Sadly, this patent reality continues to be mostly denied in societies made up largely of the passively uninformed and the passionately misinformed. But the fact is that humanity's current ecological footprint is roughly 60 percent more than the Earth can sustain over the long term, and it continues to grow.⁵ And the last several decades of less-than-robust economic growth have required a constantly increasing debt load along with widespread financial chicanery. This has kept the game going for a little longer, but only by further enriching the very apex of the wealth pyramid while condemning the middle to stagnation and the bottom to penury. So we have

⁵ See www.footprintnetwork.org

every indication that we are living on borrowed money and time. Unfortunately, rational behavior is not characteristic of addicts and ignoramuses, so the warning signs of overshoot are denied or rationalized away by a divided, distracted, and deluded populace, and this would not change even if 100 percent of the world's scientists were to issue a warning to humanity. So far from trying to solve our problems, we persist in the behavior that makes them worse.

This state of affairs cannot continue. System theorists warn that although overshoot develops gradually, collapse tends to happen rapidly and often suddenly. And the pace of ecological deterioration has indeed accelerated. Whether it is the impact of a warming climate on polar ice, the decimation of fish stocks and the acidification of oceans, the rapid decline of insect and bird populations (not to mention the increased rate of extinction in general), the growing loss of topsoil due to industrial agriculture,⁶ or the various ways in which chronic, low-grade pollution has begun to impact animal and human health, the evidence is mounting across the board that the ecosystems on which we depend are unraveling and that we may be approaching thresholds leading to irreversible changes. To be specific, we risk entering a regime of positive

⁶ At the current rate of depletion, the world's topsoil will be effectively gone in six decades. Chris Arsenault, "Only 60 Years of Farming Left If Soil Degradation Continues," *Scientific American/Reuters* accessed at <https://www.scientificamerican.com/article/only-60-years-of-farming-left-if-soil-degradation-continues/> See also, World Economic Forum, "What If the World's Soil Runs Out?," *Time*, 14 December 2012.

feedback producing runaway change, as when global warming threatens to unlock the CO₂ and methane now sequestered in permafrost.

Given the accelerating trend toward ecological scarcity, humanity can no longer postpone adaptation to the end of the fossil-fuel era. Barging ahead with business as usual will relatively soon trigger a collapse—perhaps gradual and shallow, but more likely rapid and deep. Even if we avoid oblivion, the result would be a dark age whose darkness would be roughly proportional to the extent of the overshoot. To avoid such a fate, humanity must either achieve a total technological mastery over nature via the perfection of artificial intelligence and robotics, an outcome that has been dubbed the Singularity, or make a relatively fast transition to a high-level agrarian civilization, precisely the options posited many years ago by Harrison Brown.

In reality, however, a state of total technological mastery is probably not achievable owing to basic physical and biological laws, such as the Entropy Law and the Law of the Minimum. Technology cannot sustain a “machine civilization” or even a “digital civilization” out of thin air.⁷ In addition, as noted by Brown, the Singularity would be a regimented, collectivized dystopia. (The digital panopticon of today is but the merest harbinger of such a future.) Humanity might survive, but it would no longer be recognizably human. Aiming for the Singularity would also be the kind of high-risk gamble that wise strategists

⁷ See Kris De Decker, “The Monster Footprint of Digital Technology,” *Low-Tech Magazine*, June 16, 2009. Accessed at <http://www.lowtechmagazine.com/2009/06/embodied-energy-of-digital-technology.html>. This footprint is growing rapidly. See <https://arstechnica.com/tech-policy/2017/12/bitcoins-insane-energy-consumption-explained/>

abhor. For if we should fail in the attempt to achieve it, we will have used up all our remaining resources in a lost cause, thus guaranteeing a deep collapse into the darkest of dark ages, if not oblivion.

So here is where we stand. We are hurtling toward a day of ecological reckoning. We should have acted many years ago to contain the damage and build a bridge to a different kind of civilization. Now we are faced with an increased population, worse pollution, dwindling resources, progressive biological destruction, much greater complexity, compounding debt, and enormous inertia in the system—a nexus of problems that have no separate solutions, only an aggregate solution requiring a total revolution in our way of life.

II

If we were wise, or had any concern for or posterity, we would now confront ecological reality and make a virtue out of necessity by transitioning as soon as possible to an agrarian society while we still have the wherewithal to create a relatively prosperous and egalitarian political economy, instead of one marked by scarcity and duress.⁸ Alas, we are not wise, or even very smart, but merely clever. So we will continue poisoning and impoverishing the Earth until we blunder into a terminal crisis.

⁸ In reality, nothing is more difficult than to reform a civilization. Making changes to a poorly understood complex adaptive system can precipitate the collapse you are trying to avoid. But when in extremis, as we are or soon will be, there is no choice but to make the attempt.

In an ideal world, government at every level would be making plans for the great simplification to come. As generals have learned, even the best war plans rarely survive first contact with the enemy, but having planned is essential, because it forces you to imagine different scenarios and to prepare for the worst. In other words, planning is an inoculation against stupefaction and panic, so when things do not go according to plan, you are less likely to lose your head and quicker to make the necessary adjustments.⁹ But this is not an ideal world. To the extent that governments are seriously looking ahead to a future beyond the electoral cycle, they are doing their level best to preserve industrial civilization in more or less its current form, not to replace it with something different. When that effort fails and industrial civilization begins to break down, stupefaction and panic are probably what we will get.

Our descent into chaos and turmoil will precipitate a struggle for survival for which we are totally unprepared, individually or collectively. As the manifestations of collapse multiply, the masses will be bewildered and angry, while the elites will be attempting to perform damage control with no real understanding of what to do, much less a vision of a desirable future that they want to create. It will be a severe test of character for both peoples and individuals. Many, if not most, will fail the test.

The outcome will be partly determined by how badly damaged and depleted the Earth is when the terminal crisis strikes, partly by the degree to

⁹ See Appendix for how officials at all levels might be prepared for the consequences of breakdown.

which the worst forms of madness can be avoided, and partly whether fate is kind to us. The outcome will also be different according to location. The most advanced economies are the most dependent on highly integrated systems of support that may not survive even a relatively shallow collapse. It is one thing when disaster strikes and outside aid is available to provide relief and to help rebuild; it is quite another thing if everyone is in the same dire circumstances with nothing left but their own bootstraps. And even if there is some possibility of mutual aid after the crisis, rebooting the energy-dependent, complex systems we rely on today would be a herculean task even if we had an abundance of resources. Ronald Wright's metaphor is apt: as we climbed the ladder of "progress," we kicked out the rungs below, leaving us stranded and helpless with no graceful or practical way to climb down once disaster strikes.

Paradoxically, therefore, those who are accustomed to a simple life without modern conveniences and who win their subsistence locally and directly from the Earth may be better positioned not only to survive the crisis but also to reconstruct their societies along the lines envisioned by Schumacher and Illich.

The upshot for individuals in "advanced" economies dependent on global systems rather than local resources for basic necessities is that they will be largely on their own. If they want to thrive, or even survive, our grandchildren will need to be like the tough, hard-working, cooperative, jacks and jills-of-all-trades that built industrial civilization in the first place. However, even more than technical skills and practical nous, the right mindset will be critical. Instead of

hankering after a restoration of a high mass-production and consumption society, they will need to look resolutely forward—aiming to create a civilization founded on radically different principles, one that is in harmony with biological and physical reality and that relies for its sustenance on the annual flow of solar energy instead of the stock of solar capital laid down in previous ages.

III

A first glance, it seems hardly possible to depict an attractive future. Those in the more developed economies accustomed to the luxury of flicking a switch or turning a key and having energy slaves instantly doing their bidding will undoubtedly recoil at the prospect of doing without modern conveniences, not to mention having to do much of the work that these slaves used to do. And the world's poor will hardly welcome an end to their own dreams of affluence. It is also evident that today's world population of 7.6 billion is far too large to be supported by the flow of solar energy, so a benign future depends upon a radical reduction in numbers.¹⁰ In addition, agrarian civilizations are no paradise. As James Scott points out, the earliest city states repeatedly collapsed when farmers—rebellious against disease, toil, and oppression—

¹⁰ It is not possible to state with certainty what a sustainable population level would be, but back-of-the-envelope calculations suggest 1-2 billion. To attain this level in the reasonably near future would not require a massive die off, although that may indeed occur, because a mere 2 percent surplus of deaths over births per annum would achieve this level by the end of the century.

deserted them to resume the more agreeable life of foraging.¹¹ It was only when the latter option was foreclosed by the relentless geographical advance of agriculture that agrarian civilization was able to put down roots and develop into the stable, complex societies that characterize antiquity.

However, we now know of alternatives that are both less backbreaking and potentially less oppressive than the extensive cultivation of cereal grains. (As Scott points out, this form of agriculture is inescapably marked not only by toil and disease but also by the predation of tax collectors and other vermin.) Paradoxically and sadly, many of the agricultural alternatives proposed by modern reformers, such as permaculture, were practiced by the pre-Columbian peoples of the Americas. Unfortunately, the conquest of the New World devastated its populations and virtually eradicated pre-existing ways of life. Hence these highly sophisticated agricultural practices were lost and are only now being rediscovered by anthropologists.¹² Putting this knowledge together with what we might be able to keep of modern technology means that we have material possibilities undreamt of by our ancestors. The question is, do we have the wit to employ them to make a timely and orderly transition to a technically and agriculturally sophisticated agrarian civilization?

¹¹ See Suzman for why foraging can be more attractive than farming and what we can learn for our own future from our hunter-gatherer ancestors.

¹² Charles. C. Mann, "1491." *Atlantic Monthly*, March 2002. Access at <https://www.theatlantic.com/magazine/archive/2002/03/1491/302445/>

More important is the question of political and social arrangements. And here we can offer the hope of a saner and more humane post-industrial order. Jean-Jacques Rousseau pinpointed the fundamental contradiction of a life devoted to consumption by saying, "For the impulse of appetite alone is slavery, and obedience to the law one has prescribed for oneself is freedom."¹³ In this light, moving away from our current state of addiction to appetite would be a positive development, however deeply resisted at first, because it would allow us to create a way of life that is both in harmony with nature and also in accord with the deepest political and spiritual wisdom.

Although the quantity and quality of available energy indeed determines the fundamental shape of a society, the details of agrarian social and political arrangements can vary enormously. For instance, traditional Bali and Tokugawa Japan both depended on rice cultivation but had very different aesthetic, social, economic, and political cultures. And 18th century England, which relied on mixed farming, was very different from both. But they all had a class structure—relatively relaxed in Bali, quite strict in Japan and England—with the bulk of the population attached to the soil at the bottom and much smaller strata of merchants, landlords, soldiers, officials, and rulers above. And they also had a moral structure—again, more relaxed or quite strict depending on the culture—

¹³ *Social Contract*, I, viii. See also Illich, *Energy and Equity*, 6: "The energy crisis focuses concern on the scarcity of fodder for these slaves. I prefer to ask if free men need them."

that imposed sanctions but that also supplied a framework of mores that united the society.¹⁴

So we have a wide latitude of choice within the limits set by the flow of solar energy. It is possible in principle to create an agricultural civilization founded on yeoman farmers instead of exploited peasants or slaves—that is, the kind of small-hold, egalitarian, salt-of-the-earth farming society that Thomas Jefferson envisioned for the United States. Ophuls has imagined such an agrarian civilization, which he calls “Bali with electronics.”¹⁵ In short, we can have benign and culturally rich societies without energy slavery. True, these societies may not offer the kinds of permissive freedoms that many enjoy today; individuals will have to find their freedom within the prevailing moral framework, not apart from it. But in return they will get back the autonomy, agency, and integrity that were lost in societies given over to distraction and consumption.

The famous lines of Wordsworth point to the deeper spiritual issue:

Getting and spending, we lay waste our powers;—

Little we see in Nature that is ours;

We have given our hearts away, a sordid boon!

What profit is it to wallow in pleasure and permissiveness if it costs us our hearts? Would a panel of the wise—Confucius, Gautama Buddha, Jesus of

¹⁴ See Azby Brown for a richly detailed portrait of life in Tokugawa Japan. Its political and social structure may not constitute a model we would want to emulate, but many of its values, practices, and techniques suggest the direction in which we will be compelled to move.

¹⁵ Ophuls, 2011, 179. See also the whole of Chap. 7, which advocates a political future based on ecological principles and the ideas of Rousseau, Jefferson, and Thoreau.

Nazareth, Lao Tzu, Rumi, and Socrates—conceivably approve of our current way of life? Obviously not. What the impending ecological crisis forces us to confront is that we have sacrificed meaning, morality, and almost all higher values for the “sordid boon” of material wealth and worldly power. To keep drinking from this poisoned chalice will bring only sickness and death.

IV

The ecological challenge facing humanity has been compared to the Neolithic Revolution that established agrarian civilization in the first place. In fact, that “revolution” was a long, drawn-out affair lasting well over a thousand years, whereas we will soon be resuming this condition rather abruptly after a mere two and a half centuries of industrial existence. Thus a better analogy is the Mauryan Emperor Ashoka’s conversion to Buddhism in the aftermath of a terrible war of conquest in which he was victorious but sickened by the cost of victory. What Ashoka experienced is called *metanoia*—a transformative change of heart, especially a spiritual conversion. And this is exactly what is required today: a profound transformation of consciousness that abjures self-destructiveness and selfishness, manifests a will to live in harmony with nature, and aspires to some higher values than worldly wealth and bodily comfort.

We live in a civilization that produces goods in abundance but not *the* Good. It is generally thought that the so-called death of God, after which everything is permitted, resulted in nihilism. While this is certainly true—who

would deny that we have largely abandoned traditional morality?—it is only a part of the truth, and the lesser part at that. For industrial civilization does in fact have a tacit religion: the worship of Mammon, a false god that incites us to lay waste our powers in getting and spending.

So we bequeath you the monumental task of reestablishing civilization on principles that are sane, humane and ecological. And it is indeed up to you; your elders are probably irredeemable. While we may have left you with little in the way of resources, your task is not hopeless. In the end civilization is not something material, it is spiritual. Be inspired by the beauty of the cosmos to invent a way of being devoted to feeding the soul instead of filling the belly. Rediscover the spiritual abundance that resides in material simplicity. Learn again that the only wealth worth having lies in the treasury of the human heart.

How simple and frugal a thing is happiness: a glass of wine, a roast chestnut, a wretched little brazier, the sound of the sea All that is required . . . is a simple, frugal heart.¹⁶

¹⁶ Nikos Kazantzakis, *Zorba the Greek*, trans. Carl Wildman, Simon & Schuster, 1996, 80.

APPENDIX

If the litany of warnings cited in the main text proves anything, it is that rational arguments or computer printouts are of quite limited use in persuading officials and executives at any level that they will soon confront a crisis. Nor are they effective preparation for the kinds of challenges they will face once the crisis arrives. In part this is due to the ideology of economic growth itself, which asserts that any ills caused by growth can and should be cured with more of the same, so contradictory information is simply discarded. But another reason is that the ability to comprehend the world systemically *in the abstract* seems to be quite limited in many human beings. This is not a function of intelligence in the usual sense but rather of an inability to perceive patterns, to synthesize disparate variables into a coherent picture. The reaction to the Club of Rome's original report is a case in point. Leaving aside instances when it was rejected out of hand ("the computer that cried wolf"), most saw only a series of discrete problems that could be solved in isolation, not a global problem that demanded a comprehensive solution. Thus the cogency and gravity of its findings was not always fully appreciated: an interesting report, to be sure, but not something to provoke an agonizing appraisal of one's world view. And the two later updates showing that the situation had grown more dire and the necessity for action more pressing were greeted with collective shrugs.

Whatever the reason for this apparent inability to grasp the world systemically—mental laziness, lack of training, or the trained incapacity of the specialist who knows more and more about less and less—the task is to account for it and to overcome it by communicating both the problem and a possible solution in a different way, one that imparts a bodily experience of the problem and that teaches the utter necessity of advance planning. Since the closest analog to what we are about to experience as a civilization is war, we should employ the military practice of war games, simulations of campaigns and battles that help to prepare leaders for conflict and that allow them to try out tactics and strategies in advance. In this way, they begin to understand in their bones, not just intellectually, what they must do. As noted in the main text, plans may need to be changed on the fly once battle commences, but the experience of simulation and advance planning would at least give those in charge at every level a better chance of navigating the chaos. Now the challenge is to persuade key personnel to participate in wargaming the end of industrial civilization.

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